

MFJ-1780 *Box Fan*™ Portable loop Antenna

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MFJ-1780 *Box Fan*™ Portable loop Antenna continuous coverage 14.0MHz -- 30.0MHz

CAUTION! Do Not Attempt Operation Of This Unit Before Reading All Instructions, especially the warning section below. Improper use of this antenna can be hazardous!!!!!!

The MFJ *Box Fan* Loop is the best performing portable small space antenna available to amateurs today. This antenna has the same size and shape as a 2x2 foot *box fan*. It has a carrying handle and features an indoor tuning unit. All tuning and control voltages are coupled to the antenna through the coaxial feedline for simple, neat, one wire installation.

The *Box Fan* loop antenna element is constructed from wide, thick wall Aluminum sheeting. Every current carrying joint is welded to eliminate high resistance pressure contacts that reduce efficiency. The *Box Fan* loop is tuned with a superb all welded, low-resistance, high current, butterfly tuning capacitor.

WARNINGS

- **Keep this antenna out of reach of adults, children, and animals. Any contact with this antenna while transmitting will cause severe RF burns, and voltages that kill.**
- **Never place this antenna close to electric power lines or utility wires.**
- **Do not stay near the antenna if you are transmitting RF over 10 watts of power, especially above 14 MHz.**
- **Keep the antenna away from you to prevent exposure to high levels of electromagnetic field radiation.**
- **Keep this antenna away from water and moist areas, water and moisture increase conductivity which in turn increases the risk of RF burn and possibly death!!!**
- **MFJ-1780 is not weather proofed! Antenna will be damaged if exposed to water and moisture.**
- **Never operate this antenna near RF sensitive medical devices such as pacemakers.**
- **Do not touch the antenna metallic surface while transmitting even on very low power, the metallic surface of the antenna is the radiating element itself. Be aware, you can be killed!!**
- **Keep the feedline of this antenna away from utility lines.**

THEORY OF OPERATION

When resistive losses in a small loop antenna are kept low, a small loop antenna will transmit nearly as well as a full size dipole. MFJ was able to make this small loop antenna radiate nearly as well as a full size dipole by paying special attention to the electrical and mechanical construction of this antenna.

MFJ uses heli-arc welds on all joints to eliminate resistive pressure connections in the antenna. A specially constructed butterfly capacitor using arc-welded construction has much lower loss resistance than conventional, less expensive, pressure contact, air variable capacitors.

The care and expense used in selecting the best materials, not the most convenient materials, has resulted in an extremely efficient small size antenna. Extensive "on the air" tests have confirmed that most stations can detect little difference between the signal from the MFJ *Box Fan* Loop and the signal from a larger size none-portable loop at the same height.

PATTERNS, POLARIZATION AND LOCATION

WARNING

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- **Never place this antenna close to electric power lines or utility wires.**
- **Do not stay near the antenna if you are transmitting RF over 10 watts of power, especially above 14 MHz.**
- **Keep the antenna away from you to prevent exposure to high level of electromagnetic field radiation.**

The *Box Fan* loop antenna can be used to provide either vertical or horizontal polarization. To obtain vertical polarization the loop should be placed standing up on its edge. To obtain horizontal polarization the loop should be laid flat on its side over a *non conductive surface*. See Figure 1.

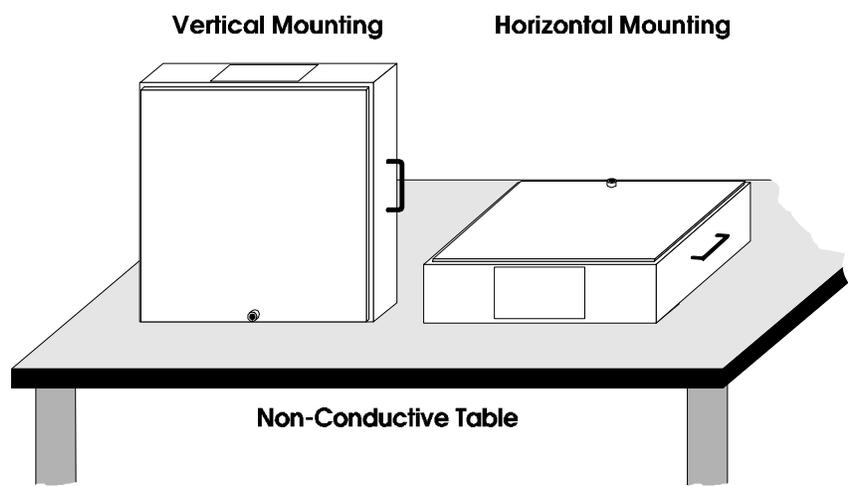


Figure 1

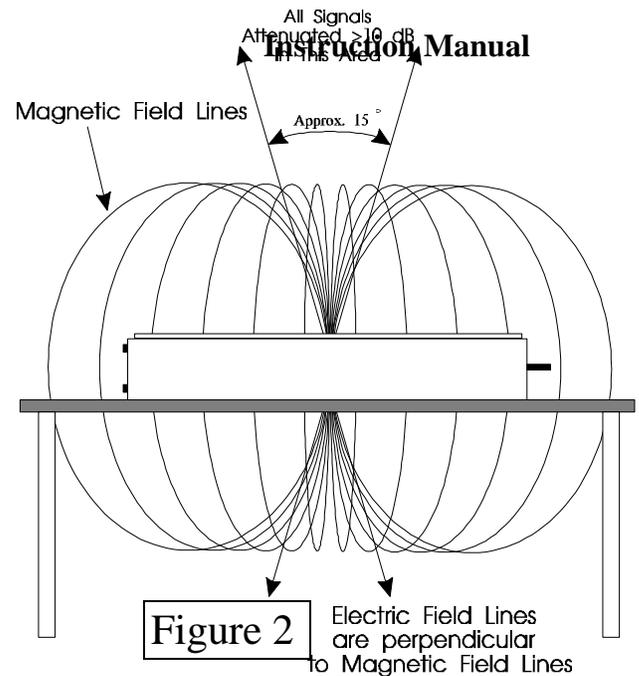
small loop antenna is essentially omni-directional with narrow nulls in the axis of the loop. If you visualize the

The radiation pattern of a the exception of two very

MFJ-1780 *Box Fan*™ Loop Antenna

loop as a wheel, the nulls are in the same directions that the wheel's axle would run. Signals will be attenuated more than 10 dB if they arrive within 15 degrees of the axis of the loop. See Figure 2.

- In general this antenna, like most others, should be placed as far away from and as high above other objects as possible. The null (or broadside axis) of the loop should be placed in line with the direction that you do not want to transmit or receive. **If the loop can not be placed more than 15 feet above ground level the best placement arrangement will be with the loop placed vertically (sitting on its edge). Otherwise, (higher than 15 feet) it is possible to mount the antenna horizontally.**



NULLING UNWANTED SIGNALS:

In the vertical position, the *Box Fan* loop nulls can be used to reduce interference (if receiving) from undesired directions if the unwanted signal is coming from a fixed direction and wave angle, or to minimize interference (if transmitting) caused by the antenna itself to other household electronics equipment.

Other examples of using the null can be understood if we consider a loop antenna placed horizontally on a second or higher floor of a building. By placing the antenna horizontally on the middle of the attic the null can be positioned directly below and the antenna (through the building). This placing arrangement helps receiving by reducing the noise pick-up from devices in the building and helps transmitting because energy is not coupled into the building's lossy structure. RFI in the building will also be reduced because the signal transmitted into the building is weaker. See Figure 3.

VERTICAL POLARIZATION:

When the loop is placed to provide vertical polarization the pattern is vertically polarized in line with the loop element. There will still be a large amount of horizontally polarized radiation broadside to the loop, especially if the ground under the loop is less than perfect or if the loop is placed some distance above ground.

The broadside horizontal radiation that occurs in a small vertical loop is mostly above 10 degree wave angles and extends straight above the loop and to the opposite 10 degree elevation point. **True vertical polarization occurs only in line with the loop.** As you move around the loop towards the sides, the pattern skews and eventually becomes completely horizontal broadside to the loop. See Figure 4. Unlike linear verticals, vertically polarized small loops also radiate straight up and down from the antenna. This high angle of radiation can be used to cover short distances by sky wave. The high angle horizontal radiation in a vertically polarized loop antenna occurs because the ground below the loop is

MFJ-1780 Box Fan™ Loop Antenna

either too far away or is not a good enough RF reflector to cancel the horizontal radiation component of the vertical loop.

HORIZONTAL POLARIZATION:

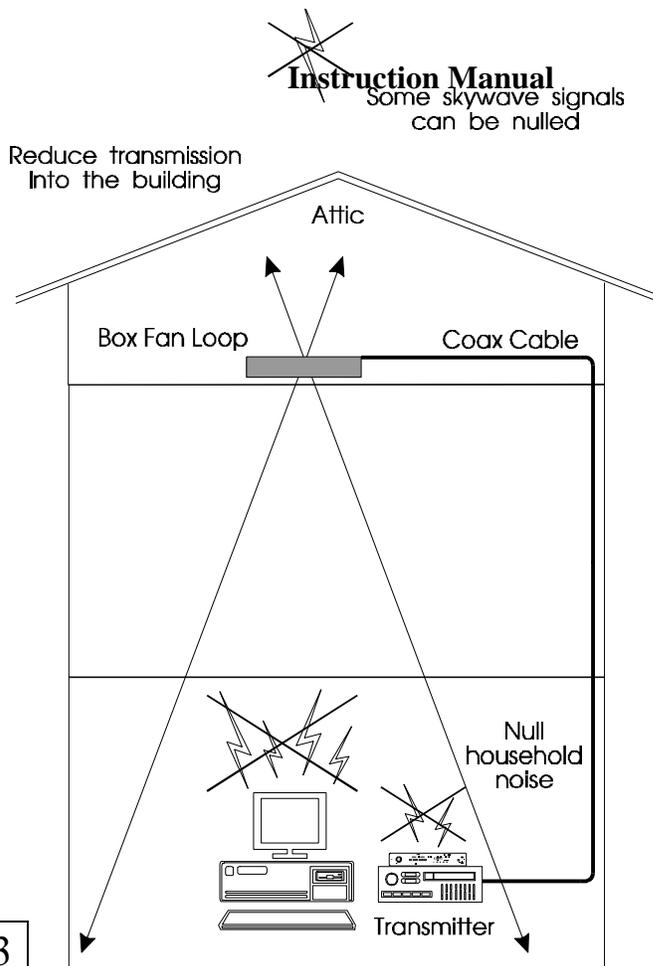
Horizontal mounting of the loop antenna results in an omni-direction, horizontally polarized pattern that has a null straight up in the air and straight below the center of the antenna. This means that any ground reflection will tend to cancel the radiation along the horizon, and also at low wave angles unless the loop is mounted some distance above ground.

Note: Do not expect the best results if you mount this loop antenna horizontally less than 15 feet above ground.

Since ground wave signals only propagate well along the earth when they are vertically polarized, a horizontally polarized loop may not respond to some local noise

sources. Like all other antennas, a small loop is generally a quieter receiving antenna when horizontally polarized. This also means that a horizontally polarized loop is not a good choice for local ground wave communications. It is an excellent choice for medium to long distance sky wave communications, however.

Figure 3



Instruction Manual
Some skywave signals can be nulled

OUTDOOR USE

Note : The MFJ Box Fan Loop *can be used outdoor only in good weather conditions* (not in windy or stormy weather).

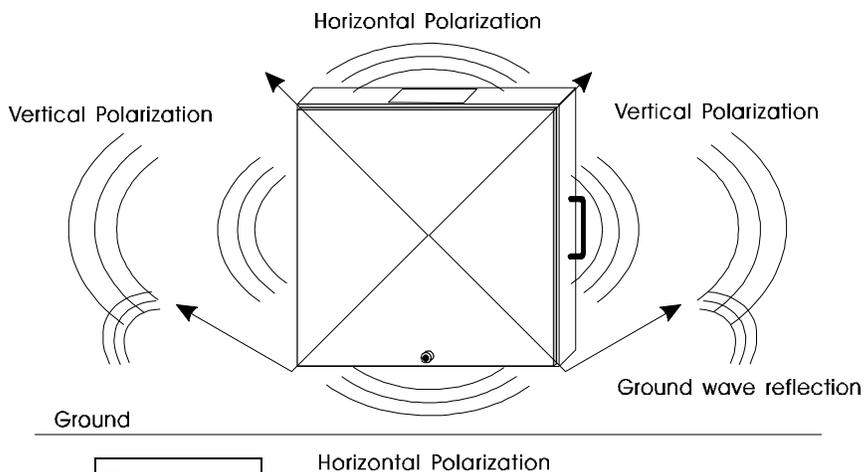


Figure 4

WARNING

When operating outdoors it is IMPORTANT to:

- Place the antenna away from reach of adults, children, and animals.
Severe RF burn or death can result if antenna was touched
- Never mount this, or any other antenna near power lines or utility wires!!
- Any materials: ladders, ropes, or feedlines, that contact power lines can conduct voltages that kill. Never trust insulation to protect you.
- Stay away from all power lines.
- Keep the antenna sitting stable on a flat surface, and make sure that it will not fall and cause damage or injuries.
- Do not use The *Box Fan* loop outdoor in wet or rainy condition. Antenna and / or your equipment will be damaged if it gets wet.

The best outdoor location for the *Box Fan* loop or any other antenna is high above ground and away from metallic objects, and trees. However, if a clear location is not available the antenna can be placed anywhere within distance from other objects.

As examples of possible locations around the house; the fan loop antenna can be placed on a balcony or porch, on top of a small non conductive table. Also it can be placed in the attic or on the roof if a flat surface is available.

The MFJ-1780 is a portable antenna with an easy carrying handle , you can take it with you anywhere, hotel, camp sites, traveling etc.. You can place the antenna on a picnic table, wooden table or any other non-metallic convenient place; and you are ready to start operating

The MFJ-1780 requires no tuner, it is self tuned all across the band with an SWR less than 1.5/1.0

INDOOR USE

WARNING: Never operate this antenna where people are subject to high levels of RF exposure, especially above 10 watts or above 14 MHz.

WARNING: Never use this antenna near RF sensitive medical devices such as pacemakers.

Note : *If you are operating the antenna in the vertical polarization mode, make sure to place your station in the null position of the antenna. Always face yourself to the opposite side of the antenna (antenna behind your back). Human eyes are very sensitive to RF at high frequency, do not look at the antenna directly when operating at high power.*

This antenna can be used inside a wooden or non-metallic building. *Caution must be used when this antenna is used indoor*, because the antenna generates strong electromagnetic fields. These fields can induce considerable RF currents into wiring and other metallic items. A secondary concern is that the effects of RF fields on humans is not yet fully understood.

In order to be on the safe side and minimize exposure to RF radiation, for example; place the antenna in a different room than the one you are operating from. To keep it out of reach of children or other adults it is advisable to have the antenna located in a locked room.

CONTROLLER BOX INSTALLATION

Warning: Do not install any devices between the controller box and the loop antenna!! If anything causes a low DC resistance or short between the center conductor of the coax and ground the control box or power supply will be damaged.

The controller box of the MFJ *Box Fan* Loop can be installed at any position that allows easy access to the controls of the unit and the transceiver. The coax lines should be good quality 50 ohm lines and be kept reasonably short to reduce losses. If you use quality low-loss cable the exact lengths used are not important and will not effect the operation or SWR of the system.

If you are using a lossy cable between your antenna and controller and have problem tuning, the easiest way to correct the problem is to get better quality cable.

You must only use the MFJ-1312B supply or batteries to operate this unit. If you chose to use an other power supply to power this unit, the power supply must not have a common ground with anything else in your radio system.

CAUTION!: THE POWER SUPPLY OF THIS UNIT MUST NOT BE GROUNDED! IF EITHER THE POSITIVE OR NEGATIVE LEADS ARE GROUNDED THE CONTROL UNIT WILL BE DAMAGED! USE ONLY THE MFJ-1312B power SUPPLY WITH THIS UNIT!

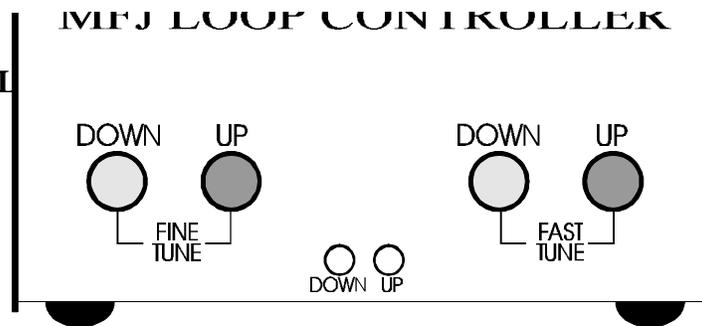
CONTROLLER BOX OPERATION

Warning: Do not install any devices between the controller box and the loop antenna!! If anything causes a low DC resistance or short between the center conductor of the coax and ground the control box or power supply will be damaged.

NOTE

In order to operate this antenna and be able to tune it, a wattmeter (capable of reading forward and reflected power), or an SWR meter is required. This extra meter should be placed in between the transmitter and the controller box of the system. (see figure 7)

The controller box supplies control voltages to the loop antenna through the coaxial feedline. These voltages are low voltage and low current so that the length of the coaxial line does not affect the operation of the motor. It is important that the feedline remain water-free and that there are no short circuits between the center conductor and the shield of the feedline.



FRONT

The controller box has four buttons and two LED in the front panel (see figure 5). Buttons and LED's are grouped in groups with up and down labels where the up and down represent up and down in frequency respectively. The button groups are as follows: the **FAST TUNE** and the **FINE TUNE**.

The **FAST TUNE** group is used to move the capacitor rotor fast to the tuning position.

The **FINE TUNE** group is used to move the capacitor rotor slow to the tuning position in order to optimize the SWR.

The MFJ-1782 controller box requires a 9-15 VDC, **ungrounded power supply**. The power jack accepts a 2.1 mm coaxial plug with the center conductor positive. The MFJ-1312B power supply will supply the correct power to the controller box.. There is also an internal battery connection that uses two 9 volt batteries for portable operation.

The controller box draws approximately 20 mA while tuning (because of the tuning motor in the loop and the LED's).

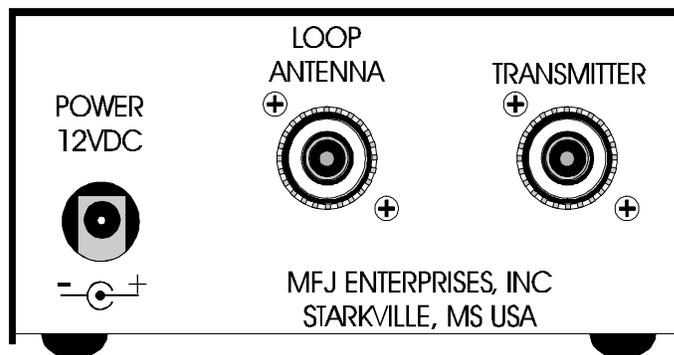


Figure 6

BACK

CAUTION! TO PREVENT DAMAGE TO CONTROLLER BOX:

- *Never connect a grounded power supply to the input jack.*
- *Never connect the power supply that is being used with this unit to ANY other device or controller box.*
- *Never exceed 15 VDC of well filtered dc input to the controller box power jack.*
- *Never connect any tuner, meter, switch, or other device between the controller box and the loop antenna.*
- *Always disconnect the antenna from this controller box during lightning storms and unplug the power supply.*

- Always ground the controller box to the station ground buss.
- Never transmit with more than 150 watts through the controller box.
- Always ground the shield of the feed line to a good earth ground for lightning and RF protection.

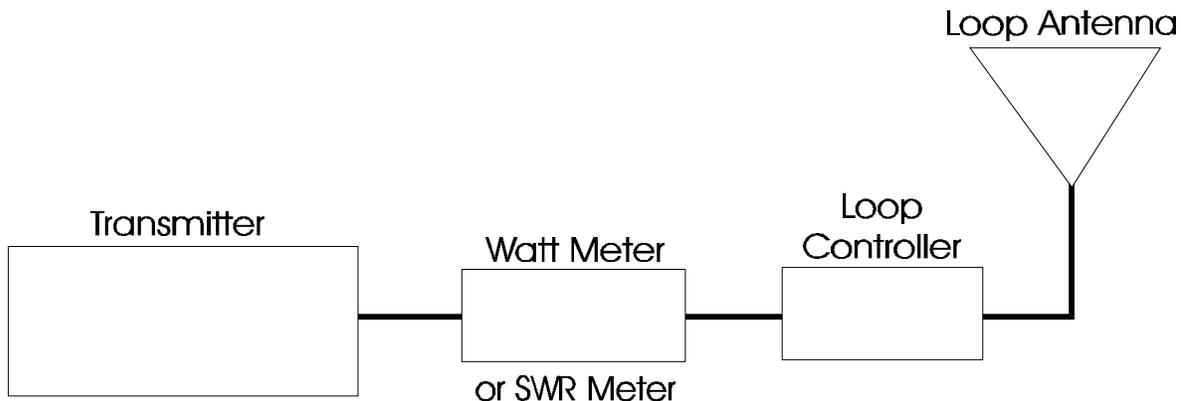


Figure 7

TESTING AND OPERATION

Warning! Connecting a power supply that has outputs grounded to chassis or earth ground will result in damage to the controller box.

To test your new installation and familiarize yourself with tuning the loop antenna, follow this procedure:

YOU MUST CAREFULLY READ THE WARNING SECTION LOCATED ON PAGE 1 BEFORE GOING ANY FURTHER!!!! MAKE SURE YOU UNDERSTAND ALL WARNINGS BEFORE YOU ATTEMPT TO TEST OR OPERATE THIS ANTENNA!!!!

- 1 - With power disconnected, set the group **FAST TUNE** switches in the OFF position (out).
- 2 - Connect the loop coax feedline to the proper connector on the rear panel of the controller box.
Failure To Connect The Coaxial Leads To The Correct Connectors On The Controller Box Can Damage The Controller Box Or Other Equipment! See figure 6. Be sure the cable to the transceiver and the power supply (if used) are connected.
- 3 - Plug the power supply into a 110 Vac outlet.
- 4 - Cycle the loop to the bottom of it's tuning range by pushing in the **Fast Tune** "DOWN" button. The frequency "DOWN" LED should light until the loop reaches the end of the tuning capacitors rotation (20-45 seconds) and then extinguish. release the "DOWN" button.

- 5** - Cycle the loop to the top of it's tuning range by pressing the **Fast Tune** "UP" button. The **FREQ** "UP" LED should light until the loop reaches the highest frequency and extinguish (approx. 20-45 seconds). release the "UP" button.
- 6** - Repeat the two previous steps using the **Fine Tune** "DOWN" and "UP" buttons. The "DOWN" or "UP" LED should flash off and on while the loop is tuning then extinguish when the upper or lower tuning range is reached.

IF ALL OF THE TESTS WORK YOU ARE READY TO APPLY **RF** TO YOUR NEW ANTENNA. CONTINUE WITH THE FOLLOWING:

- 7** - Adjust your transmitter to any desired frequency between 14.0 and 30 MHz and apply a small amount of **unmodulated carrier** to the loop between 1 and 15 watts.
- 8** - Press the **Fast Tune** "DOWN" Button while carefully monitoring the reflected power if a power meter is being used, or the SWR if an SWR meter is being used. The frequency "DOWN" LED should light and the capacitor should turn. While carefully monitoring the meter used, watch for a sharp dip on the meter. When a dip is located, release the **Fast Tune** "DOWN" button quickly.
- 9** - If you pass the dip simply use the **Fine Tune** buttons in the reverse direction to bring the capacitor back to the tuning position with the lowest SWR.

Note: The tuning of this antenna is very sharp due its high Q and narrow bandwidth (few KHz). Watch you meter carefully while tuning

Now you have successfully tested and operated your MFJ Box Fan Loop installation. You should now be familiar enough with the controller box and its controls buttons.

Please remember the followings while tuning your antenna

MAKE SURE THERE IS NO ONE close to or touching the antenna. Make sure the antenna is away from power lines and metallic objects. Use only low power during the tuning process.

THE TUNING OF THIS ANTENNA IS VERY SHARP due to the extremely high "Q" of the loop. The same thing that makes the loop work so well is what makes the tuning so sharp. If you move more than a few KHz in frequency you will probably want to adjust the SWR. After you use the antenna experience will help you decide when to use the **Fast Tune** or **Fine Tune** buttons.

TO PROPERLY TUNE THE LOOP ANTENNA on **Fast Tune**, the controller box must have between 100 mW and one hundred watts of RF power at the desired operating frequency applied to it, with one to 15 watts being the best power range. Although very little power can be radiated until the loop is tuned, please use the least power necessary during tuning. *Always check frequency before tuning, to avoid causing interference.*

GENERAL OPERATION AND TROUBLESHOOTING

After you have tested the loop as described in the TESTING AND OPERATION section you are ready to learn the *short-cuts* necessary for easy, day to day, use of this antenna. The following section will help you learn these *short-cuts*, as well as locate any problems that may occur with your new antenna system.

There are two basic methods that you can use to tune the antenna during daily operation. One method requires you to know whether the new frequency is higher or lower than the last frequency used, the other method must be used when you can't recall the last frequency where the loop was used.

TUNING WHEN YOU DO NOT KNOW THE LAST OPERATING FREQUENCY

ALWAYS REFER TO THE WARNING SECTION ON PAGE 1 BEFORE OPERATING YOUR ANTENNA!!!!

If you ever loose track of the last frequency the loop was used on you should follow this procedure:

- 1 - Press the **Fast Tune** "UP" button. The frequency "UP" LED should light as the loop moves to the highest frequency range. After the LED goes out, release the **Fast Tune** "UP" button.
 - 2 - Select the proper wattmeter range for the power you intend to use in tuning the loop, then switch to reflected power. Transmit a steady, low power, **unmodulated carrier** on the desired operating frequency.
 - 3 - Press the **Fast Tune** "DOWN" button while carefully watching the SWR or the reflected power meter for a dip, be ready to release the button at that point.
 - 5 - Press or tap on the required **Fine Tune** button while carefully watching the SWR or the reflected power meter. This adjustment is very sharp and you may pass the lowest SWR point slightly.
 - 6 - Tap the other **Fine Tune** button until the reflected power is as low as possible.
- You are now done tuning the loop. Any small changes in frequency can be handled by using the **Fine Tune** buttons.

TUNING WITH A KNOWN DIRECTION OF FREQUENCY MOVEMENT

ALWAYS REFER TO WARNING SECTION ON PAGE 1 BEFORE OPERATING YOUR ANTENNA

This method of tuning should be used when you know what direction the antenna needs to move. If the change is small then only the **Fine Tune** buttons need to be used (go to step 4).

- 1 - Adjust the transmitter to the new frequency and transmit a steady, **unmodulated carrier** (1-15w is ideal).
- 2 - Press the appropriate **Fast Tune** button in and observe the SWR or the reflected power meter. The LED should light while searching for the new tuning position at this frequency.
- 3 - After the reflected power goes through a dip release the **Fast Tune** button.
- 4 - Press or tap the appropriate **Fine Tune** button while carefully watching the SWR or the wattmeter's reflected power for the lowest reading. BE ALERT. This dip is very sharp.

After the lowest SWR point is reached you are ready to begin operating.

TROUBLE SHOOTING

The following suggests the most likely causes of abnormalities in operation:

If the LED's dim suddenly any time during operation.

Check that the coax is connected properly.

Check for a short from the antenna coax center conductor to ground.

Check for a short from the DC power supply to chassis ground.

If you push a Tune button and the Tune LED stays on for more than 40 seconds.

Check for moisture in the feedline or antenna.

If you press a Tune button and an LED does not light.

Check to see if you are at the end of the tuning range (press the other tune button, LED will light).

Make sure one of the Fast tune buttons are not latched.

Check for an open in the coax between the controller and the antenna.

If you tune throughout the entire range of the antenna and get no SWR dip.

Check the mounting of the antenna (too close to a building, or other improper mounting, etc.).

Check that you are transmitting within the range of this antenna (14.0MHz - 30MHz).

If the meter did not dip while tuning

Check to make sure that your tuning signal is an *unmodulated carrier*

If the meter dips, but the slow buttons will not tune the antenna.

The slow speed buttons may be pulsing too slow to overcome the backlash spring tension. Remove the cover of the controller box and find R1 While holding one of the slow tune buttons adjust R1 for a faster pulse (LED blinks Brighter). Test for tuning across the bands. Replace the cover.

If the slow tune buttons are too fast to tune properly.

As in above, adjustment of R1 is necessary. Adjust R1 for a slower pulse (LED blinks dimmer). Note that improper adjustment of R1 will cause the problem above. Check for tuning on all bands before reinstalling the cover.

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 charges 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 charges will be shipped COD to the owner.
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.