High-Efficiency Magnetic Loop Tuner
MFJ-933C

INSTRUCTION MANUAL

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DISCLAIMER

The information in this manual is designed for user purposes only and is not intended to supersede information contained in customer regulations, technical manuals or documents, positional handbooks, or other official publications. The copy of this manual provided to the customer will not be updated to reflect current data. Customers using this manual should report errors or omissions, recommendations for improvements, or other comments to MFJ Enterprises, 300 Industrial Park Road, Starkville, MS 39759.

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1 RADIO FREQUENCY HAZARDS

1.1 BACKGROUND INFORMATION

The following warning is printed on the back of the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™.

WARNING
DO NOT touch or come into contact with Loop Connectors or Loop Antenna while transmitting
YOU CAN BE SERIOUSLY INJURED

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ can, and in fact does, produce **LETHAL VOLTAGES** and **HIGH CURRENTS** during normal operation. The high-Q circuit produced by resonating the wire loop connected to the tuner, and matching it to the 50Ω coax supplying power creates this unique operating environment.

NOTICE
It is imperative that the operator specifically follows the operating instructions and complies with all CAUTIONS, WARNINGS, and FCC Guidelines for Human Exposure to Radio frequency (RF) Electromagnetic Fields.

1.2 RADIO FREQUENCY RADIATION

Radio frequency (RF) energy is one type of electromagnetic energy. Electromagnetic waves and associated phenomena can be discussed in terms of energy, radiation, or fields. Electromagnetic radiation is defined as waves of electric and magnetic energy moving together, or radiating, through space. The movement of electrical charges generates these waves. For example, the movement of charge in a radio station antenna (the alternating current) creates electromagnetic waves that are radiated away from the antenna and intercepted by receiving antennas. The term electromagnetic field refers to the electric and magnetic environment existing at some location due to a radiating source such as an antenna.

An electromagnetic wave (Figure 1) is characterized by its wavelength (λ) and frequency (f). The wavelength is the distance covered by one complete wave cycle. The frequency is the number of waves passing a given point in space over a second. For example, a typical radio wave transmitted by a 2-meter VHF station has a wavelength of about 2 meters and a frequency of about 145 million cycles per second (145 million Hertz): one cycle/second = one Hertz, which is abbreviated Hz.

Electromagnetic waves travel through space at the speed of light. Wavelength and frequency are inversely related by a simple equation: frequency × wavelength = the speed of light, or $f\lambda = c$. Since the speed of light is a fundamental constant, High Frequency (HF) electromagnetic waves

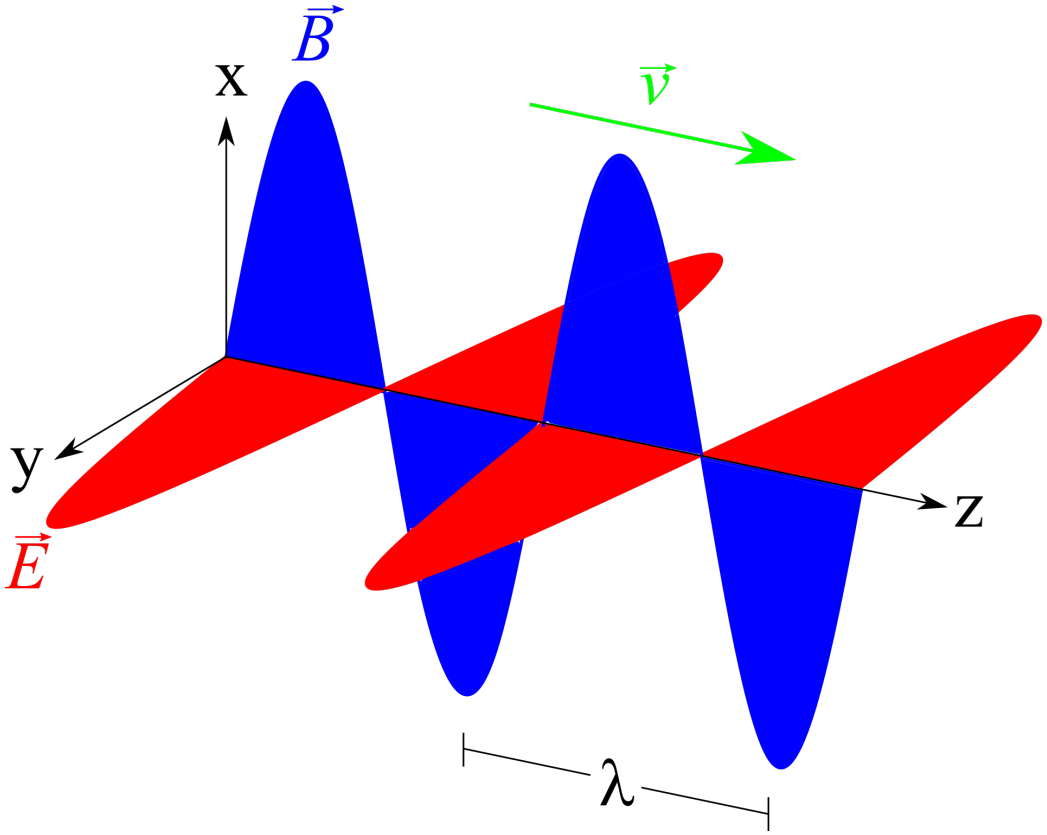

Figure 1: An Electromagnetic Plane Wave

have short wavelengths, and Low-Frequency (LF) waves have long wavelengths. The frequency bands used for amateur radio transmissions are usually characterized by their approximate corresponding wavelengths, such as 12, 15, 17, 20 meters, *et cetera.*

The electromagnetic spectrum (Figure 2) includes all of the various energies of electromagnetic radiation ranging from extremely low frequency (ELF) ranges (with very long wavelengths) to all the way up to x rays and γ rays, which have very high frequencies and correspondingly short wavelengths. In between these extremes lie radio waves, microwaves, infrared radiation, visible light and ultraviolet radiation. The RF part of the electromagnetic spectrum can generally be defined as that part of the spectrum where electromagnetic waves have frequencies that range from about 3 kilohertz (kHz) to 300 gigahertz (GHz).

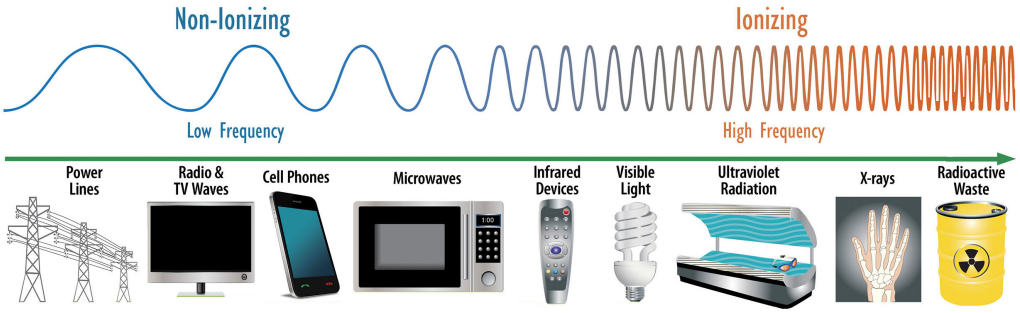

Figure 2: The Electromagnetic Spectrum

1.3 RF PRECAUTIONS

The FCC Office of Engineering Technology (OET) Bulletin 65, Supplement B, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields* directly impacts the use and operation of the MFJ-933C *Deluxe High-Efficiency Magnetic Loop Tuner*™. It establishes safe operating distances from the loop antenna and associated power levels in order to permit the operator and persons that may be impacted by operation to exist in a safe RF environment. Guidelines for Maximum Permissible Exposure (MPE) are defined in Supplement B of the bulletin.

IMPORTANT NOTICE

Use Supplement B in connection with FCC OET Bulletin 65, Version 97-01. The information in the supplement provides additional detailed information used for evaluating compliance of amateur radio stations with FCC guidelines for exposure to radio frequency electromagnetic fields. However, Supplement B users should also consult Bulletin 65 for complete information on FCC policies, guidelines and compliance-related issues. Definitions of terms used in this supplement appear in Bulletin 65. Bulletin 65 can be viewed and downloaded from the FCC's Office of Engineering and Technology's website at https://www.fcc.gov/general/radio-frequency-safety-0.

1.4 OPERATING ENVIRONMENTS

Under some circumstances, such as an antenna located unusually close to humans, an indoor antenna in a living space, or a balcony-mounted antenna a foot or so away from a neighbor's balcony, the FCC could require a station evaluation or take other action. Computer models of small HF loops, for example, yield RF fields very near the antenna that are much higher than the standard amateur radio station outdoor antenna installation fields. Therefore, when you use the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ in your shack, at a portable location, or in a hotel room, care must be taken ***not*** to exceed established MPE to yourself and others who may encounter the RF field associated with your operation.

1.5 RF RADIATION EXPOSURE CONCERNS

Controlled population exposure limits apply to amateur licensees and members of their immediate household but not their neighbors. A controlled environment is defined as one for which access is controlled or restricted. In the case of a fixed or portable amateur station, the licensee or grantee is the person responsible for controlling access and providing the necessary information and training as described in FCC OET Bulletin 65, Supplement B.

General population or *uncontrolled exposure* limits apply to situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment, such as hotel employees or overnight residents, may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public always fall under this category when exposure is not employment-related, as in the case of residents in an area near a broadcast tower. Neighbors of amateurs and other non-household members would normally be subject to the general population/uncontrolled exposure limits.

1.6 OPERATING ENVIRONMENTS & GUIDELINES

Tables 1 and 2 list various MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ operating environments, average power level, and safe distances that should provide compliance with the FCC's MPE recommendations and standards for controlled and uncontrolled populations. Distance data listed is a result of computer-modeling a circular loop, which is the most efficient radiator configuration. Parameters used include those listed below:

- *Loop perimeter:* or *circumference:* 20% of a full wavelength for each band
- *Diameter of loop conductor:* #10 gauge wire
- *Height of lowest section of loop above ground:* 1 meter and 3 meters feedpoint heights
- *Operating frequencies:* 7.175, 10.1, 14.2, 18.1, 21.2, 24.95, & 28.5 MHz
- *Output power:* 100 Watts average for Table 1 and 150 Watts average for Table 2

Table 1: 100W Indoor and Outdoor Operating Environment

Frequency (MHz)	Controlled Population Exposure (ft|m)		Uncontrolled Population Exposure (ft|m)		Height (m)
7.0	1.18	0.36	1.68	0.51	1
	1.25	0.38	2.48	0.75	3
10.0	1.88	0.57	2.48	0.75	1
	2.28	0.69	3.04	0.92	3
14.0	2.38	0.72	3.17	0.96	1
	2.54	0.77	3.17	0.96	3
18.0	2.81	0.85	3.50	1.06	1
	2.87	0.87	3.56	1.08	3
21.0	3.03	0.93	4.06	1.23	1
	3.07	0.93	4.95	1.50	3
24.0	3.23	0.98	5.48	1.66	1
	3.37	1.02	5.51	1.67	3
28.0	3.47	1.05	6.04	1.83	1
	3.47	1.05	6.04	1.83	3

Table 2: 150W Indoor and Outdoor Operating Environment

Frequency (MHz)	Controlled Population Exposure (ft|m)		Uncontrolled Population Exposure (ft|m)		Height (m)
7.0	1.45	0.44	2.05	0.62	1
	1.52	0.46	3.00	0.91	3
10.0	2.28	0.69	3.00	0.91	1
	2.77	0.84	3.66	1.11	3
14.0	2.87	0.87	3.83	1.16	1
	3.07	0.93	4.62	1.40	3
18.0	3.40	1.03	5.15	1.56	1
	3.47	1.05	5.25	1.59	3
21.0	3.70	1.12	5.94	1.80	1
	3.73	1.13	6.01	1.82	3
24.0	3.93	1.19	6.63	2.01	1
	4.09	1.24	6.67	2.02	3
28.0	4.19	1.27	7.33	2.22	1
	4.19	1.27	7.33	2.22	3

2 THE MFJ-933C

2.1 INTRODUCTION

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ (Figure 3) is a small, versatile, high-efficiency device that turns any wire or coax loop into a high-efficiency multi-band transmitting loop antenna system designed for a 50Ω input impedance and 150W RF power on all modes. It consists of two primary components:

- MFJ-933C *High-Efficiency Magnetic Loop Tuner*™
- Wire or Coax Loop (not included)

The MFJ-933C *Deluxe High-Efficiency Magnetic Loop Tuner*™ has two functions. First, it uses various lengths of wire to create a very-high-Q tuned circuit that is used as a transmitting loop antenna. An MFJ-19 low-loss Butterfly capacitor with no rotating contacts (available separately for your own homebrew projects) is the heart of this circuit. The second function is as a matching network that matches the high-Q transmitting loop circuit to your 50Ω coaxial cable.

Figure 3: The MFJ-933C

RF grounds, radials, or a counterpoise system are not required, though a safety ground is recommended. While the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ can tune any shape loop (circle, square, rectangle or any odd shape), a wire or length of coaxial cable approaching a quarter wavelength shaped as a circle is the most efficient configuration.

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ uses fixed-length wires or coaxial cables which will create a Standing Wave Ratio (SWR) around 1.5:1. Exact frequency coverage depends on each individual installation's choice of wire or coax length and diameter, shape of the loop, height above ground level, and operating environment.

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ has a mount for either an MFJ-57B or MFJ-58B PVC Cross assembly or your own homebrewed assembly. The assembly is inserted into the three-quarter-inch PVC receptacle mounted on the top of the unit's cover. Assembly takes less than five minues from opening the packaged kit to operating! Care should be taken, to secure the loop if wind becomes a factor in the operating environment.

2.2 FEATURES

- **Powerless:** No power supply required.
- **Maximum Input Power:** 150 Watts (all modes)
- **Easy-Carry Handle:** Permits easy handling to/from portable location(s)
- **Frequency Coverage:** 60–10 meters (5.33–29.7 MHz)
- **Small Physical Profile:** 5.75" wide, 8.75" deep, by 4.25" tall
- **Low Radiation Angle:** Rivals full size dipoles.
- **Quiet Reception:** Extremely quiet receiving antenna. High-Q design rejects out-of-band interference and harmonics *and* reduces overloading.
- **Indoor Use:** Perfect for apartments, hotel rooms, antenna restricted and portable locations.

2.3 CONTROLS & CONNECTIONS

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ front panel controls and indicators (Figure 4) function to permit resonating the wire loop at the output, and matching the coaxial line impedance at the input of the tuner.

Figure 4: Front-panel Controls: 1.) Tuning Control, 2.) Matching Control, 3.) PVC Mount, 4.) Coax Output

1. *TUNING:* This permits adjustment of the Butterfly capacitor.
2. *MATCHING:* This matches the tuned loop to a 50Ω coaxial cable.
3. *PVC MOUNT:* This is the mount point for the PCV cross assembly.
4. *COAX OUTPUT:* This is one of two *output* ports for using a coax loop instead of wire.

The MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ front panel controls and indicators function to permit matching the wire or coax loop to the coaxial line at the input of the tuner. Refer to Figure 4 and the numbered component locations.

1. *LOOP CONNECTORS:* Connect wire loops here.
2. *COAX INPUT:* Connection to transceiver.

A wire loop antenna connects to the Loop Connectors with the two wing nuts provided on the Loop Connector standoff rods. RF from the transceiver is input at the rear coax port. Care must be taken not to disturb the wires leading from the lugs on the Loop Connector stand-off rods and entering through the back of the tuner. The connection points must be kept clean at all times. This unit is **not** intended for outdoor installation except during portable operation and must be protected from the elements.

Figure 5: Rear-panel Connections: 1.) Wire loop connectors, 2.) Coax input

3 LOOP THEORY

A magnetic loop antenna is one that is characterized by low-noise reception, working well even when mounted at ground level, and a circumference of less than 1/3 wavelength. The ideal small transmitting antenna would have performance equal to a large antenna, and the MFJ-933C

approaches that performance. Bandwidth is quite narrow due to the extreme high-Q of the tuned-circuit configuration when paired with a capacitor.

The components in a resonant transmitting loop are subjected to high currents and voltages because of the large circulating currents in the high-Q tuned circuit formed by the antenna. It is very important that the capacitors used in this antenna have a high RF current rating. Even a 100W transmitter develops currents in the tens of amperes, and voltages across the tuning capacitor can be greater than 10kV. This consideration also applies to any conductors used to connect the loop to the capacitor. Therefore care must be taken when choosing materials in the loop. The best electrical connections possible are those using soldered or welded joints.

The heart of the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ is the "Butterfly" loop-tuning capacitor, which has no rotating contacts. When coupled to a low-resistance loop conductor, such as a copper strap or #10 stranded copper wire, it creates a high-efficiency transmitting loop.

The efficiency of the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ increases with its height above ground. When traveling, a room above the ground floor makes for a better portable operation experience with the MFJ-933C. At very low heights, close coupling to the ground causes detuning and losses due to the twin factors of current induced into a mirror image of the loop below the surface and the resistance of the image loop proportional to soil resistance. Another loss component is due to current flowing in the soil via capacitance between the loop and soil surface. These are all reduced by increasing the height of the MFJ-933C above the ground as measured from the tuner box. An operational height equal to 1/2 the diameter of the loop antenna is recommended to prevent detuning and excess ground losses when using the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ loop antenna system.

In practice, ground losses are rather low above 14 MHz, so it is acceptable to operate close to the ground on these bands. However below 14 MHz ground losses become significant and will noticeably degrade the performance of the MFJ-933C when placed close to the ground. If elevating the MFJ-933C is not an option, the loop should be mounted vertically.

It is possible to improve the efficiency of the loop antenna through the use of freeware antenna modeling software. Use the software to create a model of the antenna (including wire length, shape, height above ground, and orientation), and then vary the parameters until you optimize your particular operational configuration. One source of free programs can be found at http://zerobeat.net/G4FGQ/.

4 SYSTEM SETUP

4.1 CONFIGURATION

Setting up the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ (Figure 6) is simple and consists of the following components:

- RF Generator (Transmitter/Transceiver; 5 Watts minimum)
- SWR/Wattmeter
- MFJ-933C *High-Efficiency Magnetic Loop Tuner*™
- Coaxial cable(s)
- #10 gauge (or larger) stranded wire cut to approximately 20% of the full wavelength at the

chosen frequency

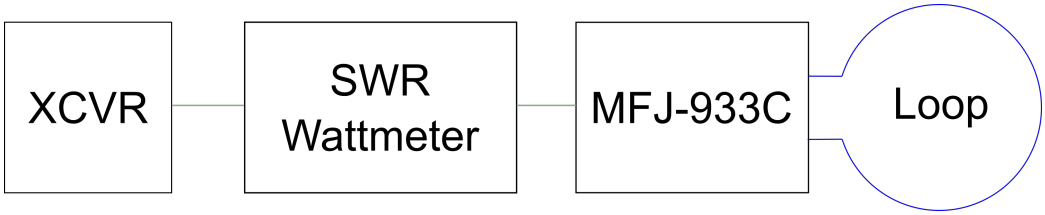

Figure 6: Typical MFJ-933C Configuration

4.2 LOOP CONSTRUCTION

Constructing the loop for the MFJ-933C *High-Efficiency Loop Tuner*™ is reasonably simple. Table 3a lists the maximum tunable lengths for the most efficient operation at the upper frequency limit of each band, and Table 3b list the loop lengths for the move convenient band coverage. Each length can be tuned lower in frequency. Exact frequency coverage depends on each individual installation configuration involving choice of wire, loop length, loop shape, height above ground, and operating environment.

The loop can be constructed from wire, tubing, sheet metal, or coaxial cable. An especially good material is one-inch-wide PCB board. However, finding a piece of PCB board long enough to form into a circular loop for 7.175 MHz may prove to be difficult! This leads us to the unique opportunity to *experiment* while using the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ to match the loop antenna you design.

The applications and parameters can be adjusted easily with the help of the freeware programs previously mentioned, and you may choose to design a totally new and unique loop antenna for on-air experimentation. Designing an outdoor loop for a band such as 7 MHz could be a challenge yet result in a very good radiator and especially good receiving antenna for DX-ing and rag-chewing. We at MFJ think the experimental aspects of the MFJ-933C are exciting, and can provide hours of quality operating, even at QRP levels.

Table 3: Efficient Loop Length Estimates

(a) Single Band

Band (m)	**Length (ft)**
80	63.0
40	28.0
30	20.0
20	13.0
17	9.0
15	7.0
12	5.5
10	4.0

(b) Multi Band

Bands (m)	**Length (ft)**
40 – 30	20.0
30 – 20	13.0
30 – 17	9.0
20 – 15	7.0
17 – 10	4.0

5 SYSTEM OPERATION

The most important aspect of using the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ is that it creates opportunities for Hams to once again experiment while enjoying operating at the same time. Imagine how exciting it can be to establish contact with a distant station using an antenna that you designed for the first time! Even more so, what if you are just using a few watts, and the antenna is just a few feet away from your operating position *inside your home?*

5.1 DETAILED OPERATION INSTRUCTIONS

Operation is simple but must follow specific steps in a specific order. Moreover, you must have first consulted Section 1 of this manual to ensure compliance with established standards for MPE to certain levels of RF radiation.

WARNING
DO NOT touch or come into contact with Loop Connectors or Loop Antenna while transmitting
YOU CAN BE SERIOUSLY INJURED

NOTICE
It is imperative that the operator specifically follows the operating instructions and complies with all CAUTIONS, WARNINGS, and FCC Guidelines for Human Exposure to Radio frequency (RF) Electromagnetic Fields.

Step 1 Place the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ at the chosen place of operation, and connect either the wire loop to the wing nut terminals on the rear panel or the coax loop to the SO-239 connectors on the side.

Step 2 Using non-conductive fasteners (plastic or wooden clothespins for example) form a loop to enclose as much area as possible (*i.e.* clothespin a wire loop to a curtain around a window frame). A circle encloses the maximum area. Otherwise, drape it across bookcases or similar non-conductive objects to fashion a loop of sorts to use. If the loop antenna is rigid, then place it in a position to accommodate its particular shape and size. The MFJ-57B or MFJ-58B make this simple by providing a precut PVC frame and wire lengths.

Step 3 Set up the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ as illustrated in Figure 6.

Step 4 Set the controls to the following positions:

- TUNING control to Position 0.
- MATCHING control to Position 10.

Step 5 Tune the transceiver to the desired frequency then adjust the controls for maximum noise and S-Meter reading. The tuner will produce a peak in both when the proper positions for the controls are achieved. The recommended process consists of the following steps:

- Slowly rotate the TUNING control clockwise while listening for a peak until you reach Position 5.
- If no peak is found, re-position the TUNING control to Position 0.
- Rotate the MATCHING control counter-clockwise one step to Position 9.
- Slowly rotate the TUNING control clockwise while listening for a peak until you reach Position 5.
- If no peak is found, re-position the TUNING control to Position 0.
- Rotate the MATCHING control counter-clockwise one more step to Position 8.
- Slowly rotate the TUNING control clockwise while listening for a peak until you reach Position 5.
- Repeat this sequence until the MATCHING control reaches Position 0.
- If no peak is found, the loop length is incorrect for the frequency of interest. At this point refer to Tables 3a and 3b for the most efficient loop lengths.
- Once a peak is found, alternately adjust the TUNING and MATCHING controls until the peak is maximized.

Step 6 Apply 10 to 20 Watts of power to the MFJ–933C and adjust the TUNING and MATCHING controls for minimum SWR on your external SWR/Wattmeter. Readjust the controls until you see no further improvement in minimum SWR.

Step 7 Once you are satisfied that the adjustments and settings are correct, you can increase the power to 150 Watts if desired. Be sure that MPE distance standards as defined in Supplement B of the FCC OET Bulletin 65, version 97-01 are met. Should any arcing be detected, stop transmitting and check connections and proximity to objects that may be suspect. If arcing seems to be inside of the MFJ–933C, lower the output power and re-check for arcing.

As a courtesy to our fellow hams, for safety, and to stay within FCC regulations you should use the minimum power needed for communications. Power levels of 20 to 50 Watts often provide very reliable communications. The difference between 50 and 100 Watts is less than 1/2 S-Unit and is generally not noticeable on the receiving end.

Step 8 You can now enjoy operating in your favorite mode. However, if you change frequency more than about 5 kHz, you may find you will need to re-adjust the TUNING controls for minimum SWR. Rotate the TUNING control clockwise for higher frequencies and counter clockwise for lower frequencies. Larger frequency changes can cause the MATCHING control to also require adjustment. This concludes the MFJ–933C *High-Efficiency Magnetic Loop Tuner*™ operating instructions.

5.2 QUICK-START INSTRUCTIONS

Although careful and complete reading of the technical manual is certainly important when receiving new equipment, successful operation of MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ can be achieved with minimum time and effort as long as certain and specific instructions are followed. Strict adherence to any WARNINGS and CAUTIONS associated with personal safety, coupled with following specific procedural steps can lead to a unique operating experience in a very short time.

WARNING
DO NOT touch or come into contact with Loop Connectors or Loop Antenna while transmitting
YOU CAN BE SERIOUSLY INJURED

NOTICE
It is imperative that the operator specifically follows the operating instructions and complies with all CAUTIONS, WARNINGS, and FCC Guidelines for Human Exposure to Radio frequency (RF) Electromagnetic Fields.

Step 1 Place the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ at the chosen place of operation, and connect either the wire loop to the wing nut terminals on the rear panel or the coax loop to the SO-239 connectors on the side.

Step 2 Setup the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ as illustrated in Figure 6.

Step 3 Set the MFJ–933C controls to the following positions for the 14.2 MHz operation (settings are approximate, but should be reasonable):

- TUNING control to Position 4.5.
- MATCHING control to Position 9.0.

Step 4 Tune the transceiver or receiver to the 20 meter band and frequency of interest and adjust the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™ controls for maximum noise and S-Meter reading. The tuner will produce a peak when the exact position for the controls and switches is found.

Step 5 Apply 10 to 20 Watts of power to the MFJ–933C and adjust the TUNING and MATCHING controls for minimum SWR on your external SWR/Wattmeter. Readjust the controls until you see no further improvement in minimum SWR.

Step 6 Once you are satisfied that the adjustments and settings are correct for minimum SWR and maximum antenna current, you can advance the power to 150 Watts if desired. Be sure that MPE distance standard is met. Should any arcing be detected, stop transmitting and check connections and proximity to objects that may be suspect. If arcing seems to be inside of the MFJ-933C lower the output power and re-check for arcing.

As a courtesy to our fellow hams, for safety and to keep within FCC regulations you should use the minimum power needed for communications. 20 to 50 watts often provides very reliable communications. The difference between 50 and 100 watts is less than 1/2 S-unit and is not noticeable on the receiving end.

Step 7 You can now enjoy operating in your favorite mode. However, if you change frequency more than about 5 kHz, you may find you will need to re-adjust the TUNING controls for minimum SWR. Rotate the TUNING control clockwise for higher frequencies and counter clockwise for lower frequencies. Even greater frequency excursions can cause the MATCHING control to also require adjustment. This concludes the MFJ–933C *High-Efficiency Magnetic Loop Tuner*™ operating instructions.

5.3 MFJ-933C ACCESSORIES

Two kits are available for use with the MFJ-933C *High-Efficiency Magnetic Loop Tuner*™, and each gives the operator expanded operational capabilities and use of pre-made/fabricated wires and equipment. These kits are:

- the MFJ-57B, which contains a PVC Cross device for mounting a precut and lugged wire loop to the top cover of the tuner. This flexible 10-gauge wire loop covers 20 and 30 meters, and the ends have low-resistance lugs.
- the MFJ-58B, which contains all of the MFJ-57 items, plus 40-meter, 15-20 meter, and 10-17 meter wire loops, with clips to hang loops as needed.

6 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 reading the manual does not solve your problem, you may call MFJ Technical Service at (662) 323-0549 or the MFJ Factory at (662) 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., 300 Industrial Park Road, Starkville, MS 39759; by Facsimile (FAX) to 662-323-6551; or by email to techinfo@mfjenterprises.com. Send a thorough description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station.

USER NOTES

MFJ-933 Schematic