

# **MFJ**

## *12-Meter SSB Transciever*

*Model MFJ-9412*

### **INSTRUCTION MANUAL**

CAUTION: Read All Instructions Before Operating Equipment

## **MFJ ENTERPRISES, INC.**

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## **INTRODUCTION**

Congratulations on your choice of the MFJ-9412 Twelve-Meter SSB Transceiver. Please read the whole manual carefully before attempting to operate your new radio. Let's begin with an introduction to some special features we think you'll like!

**Easy to Operate:** No microprocessors, no booting up -- just turn it on and tune in!

**Potent Signal:** Exclusive *Constant Current*<sup>™</sup> syllabic speech processing adds 4 to 6 dB of intelligibility to your signal to cut through noise, fading, and QRM.

**Low Drain:** Operate from a 3-Amp AC supply or 12-Volt battery. All-analog circuitry means high energy efficiency!

**Hot Receiver:** Low-noise preamp and active-DBM front end dig deep into the noise floor to capture the weak ones. If the signal's there, you'll copy it.

**Excellent Selectivity:** Sharp 2.4 KHz wide 10-MHz SSB ladder filter reduces passband noise, fights QRM, and improves transmitter intelligibility.

**Great Suppression:** Multiple tuned circuits and a 7-element lowpass filter keep your signal clean and free from unwanted interference.

**Real S-Meter:** Steer your beam with pin-point accuracy and give meaningful signal reports with a full-size analog meter. Also, monitor speech processing level.

**Agile Tuning:** No abrupt tuning-rate changes or stair-stepping. Reduction-drive analog VFO lets you scan the band quickly, yet zero in on SSB signals smoothly. Great for hunt-and-pounce contest operation!

**Impressive Audio:** A special BTL audio amplifier IC paired with a rugged 3-1/2" top-mount speaker deliver robust audio with unusual clarity.

**Phone Jack:** 1/4" jack accepts stereo or monoral headphones and cuts off the speaker automatically. Attenuated output protects your ears and makes gain adjustment easy.

**Amplifier Jack:** Solid-state FET switch with a RCA jack to key an external amplifier.

**Built to Last:** You get conservative design paired with quality components and a premium-grade SMT pc board -- all protected by a tough aluminum case and capped with a handsome stainless steel front panel. Built tough for years of dependable service.

At home or traveling the world, you'll enjoy superb 12-meter performance with your MFJ-9412. Best of all, it's fully backed by MFJ's exclusive *NO MATTER WHAT*<sup>™</sup> one-year guarantee. If it breaks, we'll take care of it.

## **GENERAL DESCRIPTION**

The MFJ-9412 monoband transceiver is designed especially for fixed or portable radio communication via the twelve-meter amateur band. Energy-efficient analog circuitry and syllabic speech processing deliver superior on-air performance while conserving valuable energy. The MFJ-9412 uses a single-conversion mixing format and a low-noise heterodyne VFO for enhanced weak-signal performance. The transmitter stages provide tuned inter-stage coupling and a built-in 7-element lowpass filter to suppress interference at TV and FM-broadcast entertainment frequencies. Other features include a sharp communication-grade crystal IF filter, built-in heavy-duty speaker, fully-analog mechanical S-meter, optional semi-break-in CW module, and intuitive controls.

### Typical Specifications

#### Receiver Section:

Frequency Coverage: .....	24.890-24.990 MHz
Mode: .....	USB
Receiver Type: .....	Single-conversion Superhet
Frequency Control: .....	6-MHz VFO mixed to 34.9 MHz
IF Frequency: .....	10 MHz
IF Selectivity: .....	-6 dB @ 2.4 KHz
AGC: .....	Audio-derived, 70-dB dynamic range
Sensitivity: .....	15 uV for 12-dB S/N
Audio: .....	500 mW into 8 Ohms at 10% THD
Average Receive Current Drain: .....	60-mA with S-meter lamp disabled

#### Transmitter Section:

Typical RF Power Output: .....	12 Watts PEP
Mode .....	USB
VSWR Tolerance: .....	3:1 VSWR maximum
Peak TX Current: .....	3.0 Amps
Speech Enhancement: .....	RF-compression, syllabic rate
Spurious Attenuation: .....	-60 dBc typical
Mic Input: .....	600-Ohm dynamic

\*CW operation possible within the 24.89 to 24.930 range with an optional CW adapter board.

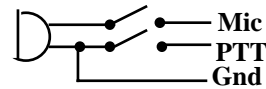
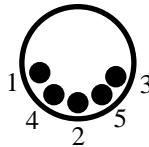
## **QUICK-START OPERATING INSTRUCTIONS**

- **Power Supply:** Use any regulated 13.8-Volt 3-Amp supply or comparably-rated 12-Volt battery. Connect power via a 5.5 OD x 2.1 mm coaxial power plug (Radio Shack 274-1569): **[+] lead must be attached to the connector center pin.**



- **Microphone:** The MFJ-290 dynamic microphone compliments your radio's speech processor, but other 600-ohm PTT microphones may be used with a 5-pin DIN connector installed as shown below (use Radio Shack 274-003). Amplified microphones *should not* be used with the MFJ-9412.

Pin 3 = PTT Line  
Pin 4 = Mic Line  
Pin 1,2,5 = Ground



- **Antenna Selection:** Use any vertical or horizontal 12-meter antenna exhibiting a VSWR of 2:1 or less. A simple dipole or groundplane is adequate for casual operation, but a 3-element yagi or 2-element quad yields better DX performance.

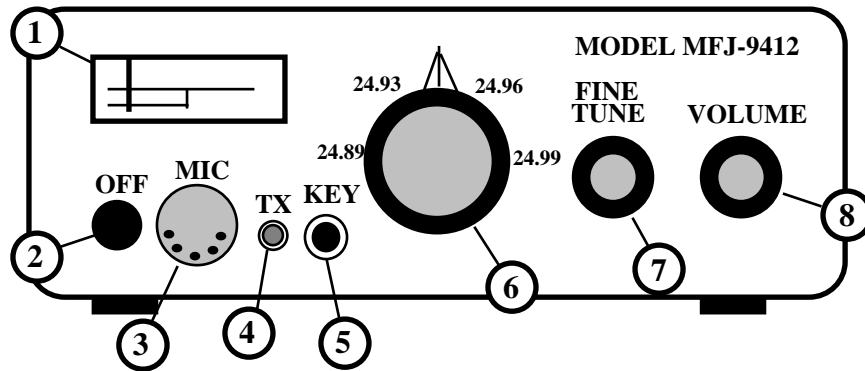
**Important Note:** Avoid using antennas with unknown or high VSWR. The MFJ-9412 does not provide automatic high-VSWR shutdown circuitry. Operation into extremely reactive loads may result in out-of-band spurious emissions in violation of FCC rules!

- **Speech Processing:** The MFJ-9412 processor rapidly readjusts transmitter IF gain for each spoken syllable. For best results, hold the Mic about 1-2" from your lips and speak normally. The S-meter should deflect 1/2 scale as you speak.

**Important Note:** Transmit meter deflection will be affected by high-VSWR loads. If the meter deflects beyond S9 or holds below S4 with normal speech, check your antenna. A VSWR of 2:1 or less is normally considered acceptable for amateur service.

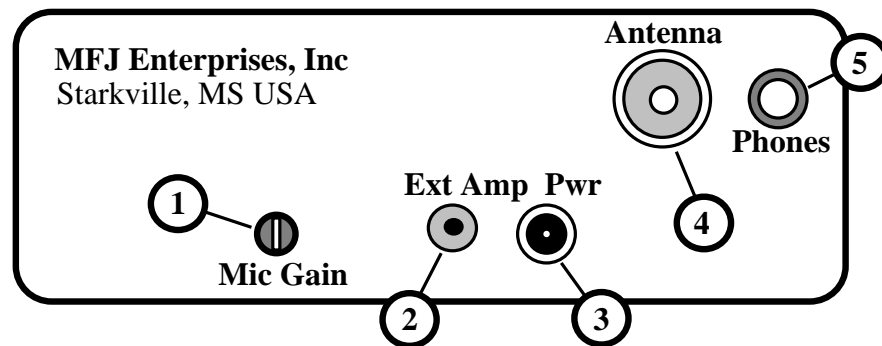
- **Connecting a Power Amplifier:** The MFJ-9412 provides a built-in FET switch to key an external amplifier. Be sure to follow all manufacturer's instructions carefully when installing an amplifier at your station. The *Ext Amp* jack provides closure to ground during transmit.
- **Choosing an Operating Location:** Set your station up in a sheltered and dry location. Avoid operating in direct sunlight--the radio's black case may absorb excessive heat that can impair normal operation or damage internal components.

**MFJ-9412 CONTROL LOCATIONS AND FUNCTION**



**Front Panel**

- 1. S-METER:** Measures signal strength on receive, ALC on transmit
- 2. POWER SW:** Applies DC power to the radio.
- 3. MIC JACK:** Accepts 5-pin DIN connector for PTT microphone.
- 4. TX LED:** Illuminates when transmitter is keyed.
- 5. KEY JACK:** Accepts telegraph key--only used with CW adapter module.
- 6. VFO TUNE:** Tunes in stations, indicates operating frequency.
- 7. VFT:** Fine tune control for precise SSB tuning.
- 8. VOLUME:** Adjusts listening level.



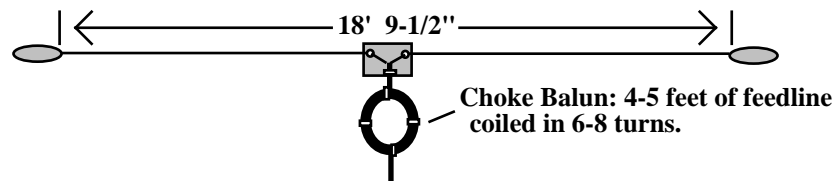
**Rear Panel**

- 1. MIC GAIN:** Adjusts speech-amp gain (normal setting 12:00).
- 2. EXT AMP:** Accepts RCA plug--keys external linear amplifier.
- 3. POWER JACK:** Accepts 5.5mm OD x 2.1mm ID plug, [+] to center pin (+13.8V/3A).
- 4. ANTENNA:** Accepts PL-259 for 50-Ohm coaxial line.
- 5. PHONES:** Accepts 1/4" stereo headphone jack.

## **TWELVE-METER ANTENNA SYSTEMS**

The better your antenna system works, the more you'll enjoy using the MFJ-9412. Here are some general tips for getting top performance:

- **Antenna Selection:** Dipoles, ground-planes, and converted CB antennas all provide good performance for casual operation. However, for serious DX hunting, a compact 3-element yagi or 2-element quad will yield significantly better results. Many compact directional antennas are small and light enough to roof-mount on a standard TV rotor using readily-available TV hardware. If possible, avoid using low-efficiency "compromise" antennas. Never operate into an antenna with unknown or high VSWR.
- **Making a Dipole:** A simple 12-meter dipole cut for 24.93 MHz will be approximately 18' 9-1/2" long. To prevent feedline radiation and reduce unwanted noise pickup, make a simple choke balun at the center by coiling up a short length of the coax and securing it with electrical tape or tie-wraps.



- **Antenna Location:** Mount your antenna as high and in-the-clear as possible, but remember to factor in feedline loss. A chimney-mounted antenna at 40' with a short low-loss feedline may actually out-perform one mounted 20' higher with a long lossy feed. Be sure to isolate your antenna from other larger antennas or RF-reflective metallic surfaces that may distort its normal radiation pattern.
- **Coax Cable:** For runs to 60', RG8X (or mini-8) works well at 24.9-MHz. For longer runs, or when running a high-power amplifier, use larger-diameter low-loss cable such as RG8 foam or RG213. Seal all exterior connectors against moisture with silicon grease, rubber tape, or premium-quality electrical tape.
- **Rotor:** Many TV-type rotors will handle a short-boom 12-meter Moxon, beam, or quad antenna. However, long-boom or stacked arrays will require a heavier rotor designed especially for amateur radio use.
- **Safety Tips:** When installing antennas, make sure someone is available to assist you in an emergency. Also, avoid any location where your antenna could fall and contact power wires. For catastrophic lightning protection, permanently ground the mast and coax shield *outside* the building with a good ground rod system. Also, remember to disconnect the feedline from your radio at the first sign of severe weather. Even nearby strikes may damage sensitive receiver components with the antenna connected.

## **THEORY OF OPERATION**

**General:** The MFJ-9412 is a 12-Watt PEP USB transceiver that tunes from 24.89-24.99 MHz. The radio's single-conversion format uses a high-frequency heterodyne VFO for superior stability, low phase noise, and circuit simplicity. The MFJ-9412 is designed for fixed or portable operation from light-weight power sources and uses all-analog circuitry throughout for reduced power consumption.

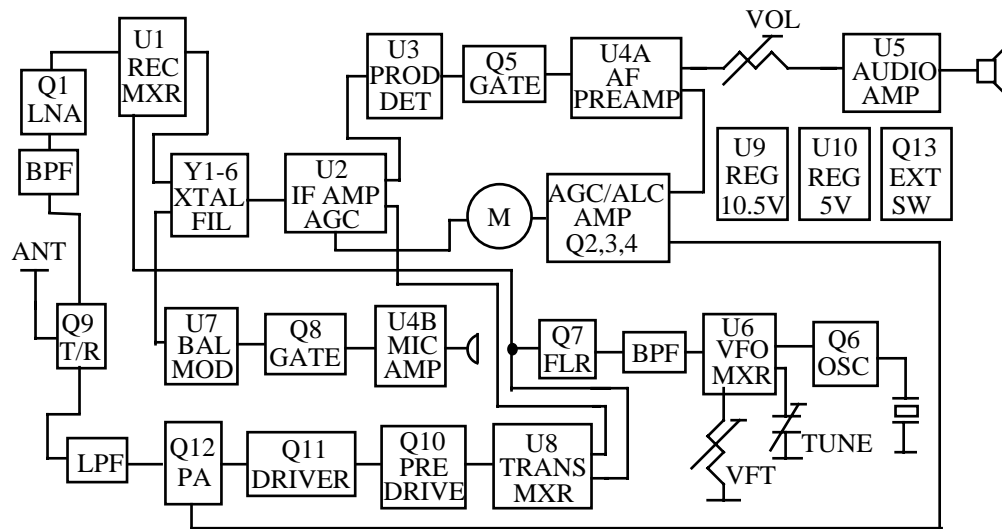
**Receiver:** A four-pole bandpass filter (L1/L2) pre-selects incoming 24.9 MHz signals and Q1 provides LNA gain ahead of the mixer. Operating frequency is controlled by a 34.9-MHz heterodyne VFO driving active mixer U1. The mixer then down-converts 24.9 MHz signals to the radio's 10-MHz IF. A six-crystal SSB ladder filter (Y1-Y6) establishes the radio's 2.4 KHz message-channel bandwidth. Gain of IF amplifier U2 is controlled by audio-derived AGC. Product detector U3 demodulates incoming SSB using a 10-MHz BFO signal generated by the mixer chip's oscillator section. Recovered audio is fed to preamp U4a, which simultaneously drives AGC amp Q3/Q4 and AF-power amp U5. Switch Q2 sets the AGC time constant for TX and RX modes.

**Transmitter:** Mic-amp U4b drives balanced modulator U7. Modulator LO is derived from the BFO section of U3. DSB generated by U7 is routed to the IF filter (Y1-Y6) where the lower sideband is removed. IF-amplifier U2 compresses the USB signal at a syllabic rate and routes it to transmit mixer U8. At U8, the 10-MHz IF signal mixes with 34.9-MHz VFO energy for conversion to 24.9 MHz. The signal is then amplified by driver stages Q10 and Q11. Interstage matching and 24.9-MHz passband filtering are provided by tuned-transformers T4-T6. PA-stage Q12 is a self-ballasted emitter-tab device operating in single-ended class AB. Input and output ports are matched by L-networks, and a seven-element low-pass filter reduces harmonic and spur content of the amplified signal. A RF-envelope detector samples signal amplitude and provides feedback to IF-amplifier U2 for speech processing. PTT switch Q9 drives T/R relay K1.

**Heterodyne VFO:** VFO mixer U6 combines 6 MHz tunable-oscillator energy with a 28.9-MHz crystal-controlled signal generated by Q6. Bandpass filter L6-L7 admits the 34.9 MHz mixer product to FET-follower Q7, where it is transformed to a low impedance and distributed to mixers U1 and U8.

**Regulation and Protection:** Adjustable monolithic voltage regulator U9 provides 10.5 Volts for most low-level stages in the transceiver. Regulator U10 supplies 5 Volts to the mixing VFO. A diode/fuse crowbar circuit protects the radio against accidental reverse-polarity damage.

**Amplifier Keying:** FET switch Q13 provides a ground-path closure for the purpose of keying an external linear amplifier.

**MFJ-9412 BLOCK DIAGRAM****MFJ-9412 INTERNAL ADJUSTMENTS** (see pictorial on next page)

- [1] **Voltage Regulator:** Adjust V-REG trimpot R78 for 10.5V on tab of U9 [18].
- [2] **RSSI Threshold:** Adjust AGC trimpot R11 for 4.3 V at RSSI test point [16].
- [3] **Meter Zero:** Adjust M-ZERO trimpot R17 for zero meter reading--no signal.
- [4] **IF Transformers:** Peak IF cans T1,T2 for maximum receiver sensitivity.
- [5] **RF Transformers:** Peak RF coils L1, L2 for maximum receiver sensitivity.
- [6] **BFO:** Set BFO trimcap C30 so close-in filter peak corresponds to 600 Hz beat note.\*
- [7] **VFO Cal:** Tune signal generator and VFO to 24.93 MHz, set L3 for zero beat.
- [8] **Mixing VFO:** Tune OSC coil L5 and filter coils L6,L7 for maximum RX sensitivity.
- [9] **Carrier Balance:** Carefully adjust BAL trimpot R57 for minimum carrier.\*\*
- [10] **Mic Gain:** Set for preference--12:00 position is factory default.
- [11] **PA Bias:** Attach 200-uA meter at [15], Set bias pot for 20-25 uA reading.

**Note:** To adjust [12 & 13], install a shorting plug at [14] to insert carrier. Also, turn ALC trimpot (R73) clockwise to disable ALC line (should be no meter deflection on TX).

- [12] **Exciter tune:** Key Mic and carefully peak C89, C96, C99 for maximum RF output.
- [13] **PA:** Key mic and peak C103, C110, C111 for maximum output--then remove plug.
- [14] **Carrier Insert:** Shorting plug location to insert carrier for tuning transmitter.
- [15] **IC Test Points:** Connect 200-uA meter here to set PA idle current (see above).
- [16] **RSSI Test Point:** Used when setting RSSI trimpot [2].
- [17] **ALC Level:** Key Mic and speak, adjust ALC trimpot for 1/2-scale meter deflection.
- [18] **V-REG Test Point:** Set V-REG trimpot [1] for 10.5-V DC reading on regulator tab.

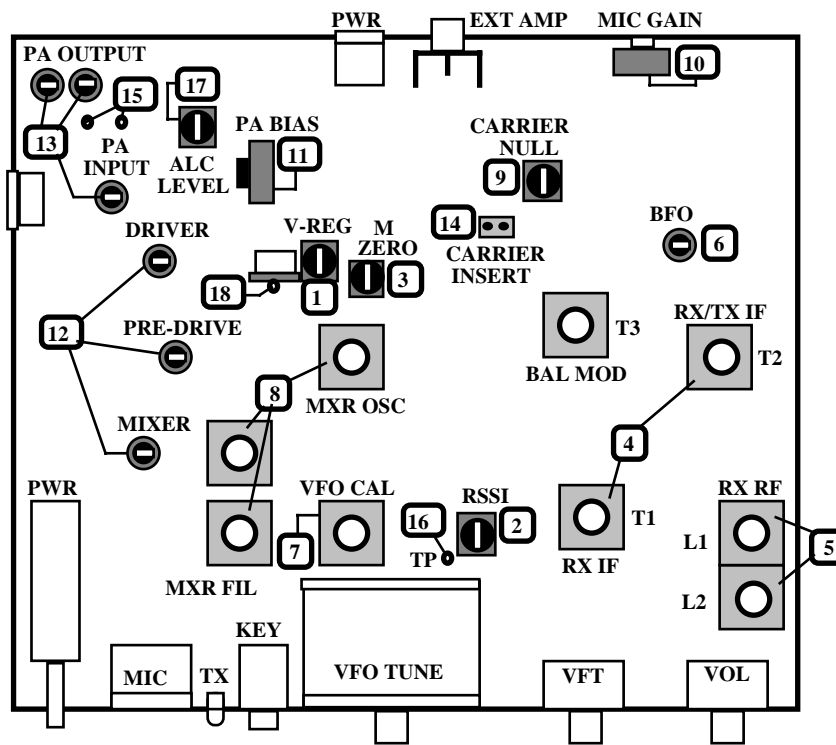
\*Caution--may unbalance carrier, step requires special skill and knowledge to perform.

\*\*If R57 alone does not produce deep null, interactively adjust R57 and T3 for best null.

**INTERNAL ADJUSTMENT LOCATIONS**



**WARNING:** The tune-up information provided in this manual does not constitute a step-by-step guide for aligning the MFJ-9412. IF YOU LACK THE TEST EQUIPMENT, KNOWLEDGE, AND SKILLS TO ALIGN HF SSB TRANSCEIVERS, DO NOT ATTEMPT TO MAKE THESE ADJUSTMENTS ON YOUR OWN!! Far better to contact the MFJ factory for assistance. Misalignment may cause permanent damage to your unit, and may result in interference to other radio services in violation of FCC rules. MFJ cannot be held responsible for the performance of radios that have been improperly tampered with or mis-adjusted by owners and users.



**Note:** For trimpots, trimcaps, and IF cans (T1-T3), use a non-conductive tuning wand with a metallic tip. For TOKO brand inductors, use a non-conductive wand with a narrow plastic tip. For Coilcraft brand inductors, use a small hex-head non-metallic tuning tool.

**IN CASE OF DIFFICULTY**

☐ **Radio does not power up:** Check power plug and power supply. Also, reverse-polarity protection fuse may be open (etched on PC board in front of power jack J3). If open, install a 3.0-A pig-tail replacement fuse or short length of #32 wire.

- No signals received:** Check antenna and feedline for breaks or shorts. If okay, you should hear increased background noise when the antenna is connected.
- Spurious signals received:** Look for interference from nearby computers, modems, TVs, cordless phones, or other devices that may emit 24.9-MHz signals.
- Distorted Receiver Audio:** Check for foreign debris in the speaker basket.
- Erratic transmit:** Check antenna VSWR. Also, check battery or power supply voltage. If supply drops below 12-V under load, the radio's regulator will drop out and operation will become erratic. If you operate exclusively from 12-V batteries, reduce V-REG output to 10.0V (measured on tab of U9) for added regulator headroom.
- High meter deflection on transmit, low RF output:** ALC pot R11 may be set too high (or VSWR may be high). Adjust R11 for mid-scale deflection into a 50-Ohm load.
- Splatter, low meter deflection:** ALC pot R11 may be set too low (or there may be a feedline short). Adjust for mid-scale deflection when transmitting into a 50-Ohm load.
- S-meter does not return to zero:** Confirm that V-REG (R78) is set for 10.5V on tab of U9. Confirm that AGC threshold (R11) is set for 4.3V at RSSI test point (no signal). When both readings are set, adjust R17 for zero meter deflection.
- Poor carrier suppression:** Turn Mic gain off (fully CCW) and key the radio while monitoring signal on an external receiver. Adjust R57 for minimum carrier.
- Low or distorted transmit audio:** Check to see if mic gain is set too low. Also, make sure you are using a 600-Ohm low-Z dynamic microphone.
- Excessive background noise on signal, hum:** Mic gain set too high for the ambient noise conditions. Also, is Mic or radio next to a power transformer or electric motor?

## **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., 300 Industrial Park Road, Starkville, MS 39759; by Facsimile (FAX) to 601-323-6551; or by email to [techinfo@mfjenterprises.com](mailto:techinfo@mfjenterprises.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.

## **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 of machine reproduction or 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 under warrantee 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 unrepai red.
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., 300 Industrial Park 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.



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