

VERY IMPORTANT! PLEASE READ:

Your Receiver Kit carries MFJ's respected *No Matter What*[™] guarantee specifically to the extent that you may return the entire kit UNASSEMBLED for credit or refund. If you have never built an electronics kit before, PLEASE study the book carefully before unpacking the small parts. Once you begin soldering parts, neither MFJ or any dealer can accept the return of this kit for any reason whatsoever.

Note: We have designed this book and the receiver itself to assure that you can build it successfully and enjoy using it as soon as construction is completed. If, after building your receiver, double-checking all assembly steps and going over the preceding troubleshooting suggestions, you are still having a problem, please contact MFJ at 1-601-323-5869. Before calling, please be prepared to explain your exact difficulty as clearly as possible, and please be sure you have installed the right parts in the right places! If needed, your receiver can be repaired by MFJ provided that it has been completely assembled, using rosin-core solder only. Call for quote.

MFJ Enterprises, Inc.
921 Louisville Road
Starkville, MS 39759 USA

MFJ will verify repairs on any unit requiring more than the minimum service fee covers with the owner of the unit by phone.

MFJ-8400K FEATURES

- Covers entire 2-Meter Ham Band, from 144-148 MHz.
- Easy to tune -- smooth capacitor with 8:1 planetary drive
- Super-sensitive, pulls in weak stations with small antenna
- Easy on the ears with MFJ's exclusive *TAILFREE*TMsquelch
- Extra-large 3" built-in speaker for full-bodied sound
- Unsquelled-audio Packet Radio monitor jack
- Runs on internal 9V battery or optional AC adapter supply
- Uses state-of-the-art Motorola FM-receiver IC chip
- Easy to build and align -- a great "first kit"
- Perfect way to learn about Ham Radio and get a license

Please read this manual carefully before you start assembly. Also, please inventory all parts BEFORE you begin.

VERY IMPORTANT GUARANTEE INFORMATION, PLEASE READ:

- MFJ's KIT RETURN POLICY: MFJ's respected guarantee covers your MFJ-8400K specifically to the extent that you may return the entire UNASSEMBLED kit for credit or refund.

Once you begin soldering parts, you assume responsibility as the radio's manufacturer. Neither MFJ nor its dealers can be held accountable for the quality or outcome of your work. Because of this, MFJ and its dealers cannot accept the return of any kit-in-progress or completed kit for any reason whatsoever.

- MISSING OR DAMAGED PARTS: If you discover missing or damaged parts when you inventory your kit, call MFJ at (800) 647-8324 or (601) 323-5800 for assistance.

ABOUT THE MFJ-8400K INSTRUCTION MANUAL:

The MFJ-8400K FM 2-Meter Receiver and its instruction manual were developed by Rick Littlefield (amateur radio call K1BQT) exclusively for MFJ. This manual is Copyrighted (c) 1993 by MFJ, Inc. All Rights Reserved.

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INFORMATION FOR RADIO BEGINNERS -- BUILDING THE MFJ-8400K:

Building the MFJ-8400K gives you valuable construction experience plus a great opportunity to work with the latest state-of-the-art components. "State-of-the-art" doesn't mean difficult to build. Like many modern electronic products, The MFJ-8400K is electronically sophisticated yet physically simple. This is because most of the complex circuitry is self contained within a single IC (integrated circuit). You'll add a few peripheral parts to make the receiver IC work properly. You'll also add a sensitive preamplifier to pull weak stations and an audio amplifier IC to drive the radio's speaker. The Motorola FM-receiver IC will do the rest!

The fun isn't over when your kit is done. You'll quickly discover the MFJ-8400K is a "serious" receiver with superb SENSITIVITY (ability to pull in weak stations.) Tuning in stations is easy. This is because we use an expensive ball-bearing reduction-drive tuning capacitor rather than a cheap potentiometer for channel selection. MFJ's *TAILFREE*TM squelch circuit, especially designed for monitoring repeater stations, is another plus that makes the MFJ-8400K enjoyable to use. Finally you get a BIG 3" built-in speaker for robust natural-sounding speech -- something no other kit and only few expensive commercial radios provide.

WHAT YOU'LL HEAR ON 2-METER FM:

Two meters is especially popular because it provides an abundance of "on-air" meeting places for the hams in your area. Located in the VHF (Very High Frequency) portion of the radio spectrum, 2-meter FM is relatively free from atmospheric interference and noise -- and is especially well suited for MOBILE UNITS and small HAND-HELD RADIOS. You'll hear friends discussing an endless array of ideas and topics (an activity called "rag chewing"). You may also hear hams performing public service -- coordinating a road race, reporting a traffic accident, or tracking a dangerous weather situation. Many families use ham radio for personal communication, staying in touch with each other throughout the day. Some even access the phone system from their automobiles and make phone calls using a special device called an AUTOPATCH. Others communicate via personal computer using special PACKET RADIO signals. Listening in on 2-meters, or "reading the mail," is a great way to improve your technical knowledge, since hams are always sharing hobby-related information.

Most of the stations you'll hear on 2-meter FM will be transmitting through REPEATER STATIONS. Repeater stations make 2-meter FM more useful because they extend transmitting and receiving range.

FM REPEATER STATIONS, WHAT THEY DO:

VHF radio waves normally travel line-of-sight.* When mobile and handheld stations attempt to communicate directly with each other over longer distances, hills, buildings, and the curvature of the Earth eventually get in the way -- blocking or absorbing the signal. This limits reliable VHF radio contact to a few miles. Repeater stations provide a way to overcome this limitation.

A repeater consists of a receiver, transmitter, and antenna system located as high as possible above the surrounding terrain -- usually on a mountain top, high-rise building, or tall tower. Because the antenna is positioned well above local ground clutter, distant signals have a direct path to the repeater which is free from signal-robbing obstructions. From this ideal listening post, weak mobile and handheld signals that wouldn't be audible at ground level come in loud and clear.

Repeaters extend communicating range by retransmitting (or repeating) everything they pick up. The repeater rebroadcasts on a second channel -- one sufficiently removed in frequency so it won't interfere with the repeater's receiver. Since the transmitter is powerful and the antenna is high in the air, the repeated signal blankets a wide area. This "boost" can enable a tiny walkie-talkie with a normal point-to-point range of 1-2 miles to reach out 40-50 miles and beyond!

* VHF signals sometimes "bend" and travel beyond the usual line-of-sight path, following the contour of the Earth. Technically, this condition is called Tropospheric Bending or Atmospheric Ducting (depending on the exact cause). However, you'll usually hear it called "skip" or "lift" by hams. Warm air trapped aloft is the most frequency cause.

REPEATER INPUT AND OUTPUT CHANNELS:

Each amateur repeater station has two assigned operating frequencies. The repeater's INPUT FREQUENCY is the channel where it listens for incoming signals. The OUTPUT FREQUENCY is the channel where it retransmits what it hears.

Two-meter repeater input and output channels are normally spaced 600 KHz apart. This STANDARD SPLIT provides enough channel separation to prevent the repeater's transmitter from interfering with its receiver. It also provides a standard spacing between transmit and receive frequencies that manufacturers can program into their two-way radios.

When you tune around the 2-meter band, you'll be looking for repeater outputs to monitor, since these provide the strongest and steadiest signals.

REPEATER OWNERSHIP AND CONTROL:

Like most amateur stations, ham repeaters are privately owned and operated by individuals or radio clubs. Most repeaters are "open" -- anyone with a ham license can use them freely. However, repeater clubs may collect annual dues from members to raise money for new equipment or to pay for site rental. A few repeaters are "closed" and can only be accessed with a special encoded tone which is kept secret from non-members.

Virtually all repeater stations are unmanned and fully automated by a microprocessor unit called a REPEATER CONTROLLER. The controller unit, which tells the repeater's transmitter and receiver what to do, also periodically sends the transmitter's call letters in MORSE CODE or digitized voice to identify the station. In addition, the controller may provide a number of special functions like AUTOPATCH (permits making phone calls), TIMEOUT (cuts off people who talk too long), COURTESY BEEP (lets people know when the channel is clear), and much more. Some functions are automatic, which others are "called up" via the built-in touch-tone pad found on most modern 2-way FM radios.

With thousands of repeaters on the air from coast to coast, 2-meter FM operation is both fun and practical nearly everywhere in the U.S. Indeed, most of the conversations you monitor on 2-meters will be coming through repeater stations built and maintained by the hams in your local area.

HOW YOUR MFJ-8400 WORKS -- MADE SIMPLE:

A. Your radio's antenna picks up all kinds of VHF stations -- including fire, police, FM broadcast, and aircraft. The MFJ-8400K uses a BANDPASS FILTER to get rid of unwanted signals.

B. Desired two-meter signals pass through the filter without being affected. They are boosted by a LOW-NOISE AMPLIFIER (LNA). The LNA (or preamplifier) is especially designed to improve reception of weaker stations.

C. A VARIABLE FREQUENCY OSCILLATOR (VFO) is used to select the 2-meter channel or frequency you wish to monitor. VFO frequency is controlled by the radio's main tuning dial.

D. The FM Receiver IC transforms radio signals into usable voice signals. To accomplish this, incoming radio signals are CONVERTED, FILTERED, and AMPLIFIED at two successive INTERMEDIATE FREQUENCIES (10.7MHz and 455KHz). The receiver's DETECTOR then

extracts the audio (voice) component from the radio signal and sends it to the radio's AF amplifier for further amplification.

E. The detected AUDIO signal passes through a VOLUME CONTROL to the AF AMPLIFIER IC which powers the radio's speaker.

F. FM receivers generate random noise (an annoying rushing sound) when no radio signal is being picked up. A special circuit called a SQUELCH senses when this is happening.

G. The squelch shuts off the AF Amplifier IC, keeping the radio silent (and conserving battery power) until a signal appears.

HOW YOUR RADIO WORKS -- FOR EXPERIENCED HAMS AND ENGINEERS

Please refer to the schematic diagram shown on page 26.

A two-section bandpass filter at L1-L2 rejects out-of-band signals and matches the 50-ohm antenna line to Q1. Q1, a low-noise preamplifier biased for minimum noise figure, boosts incoming signals by approximately 20 dB. The untuned output of Q1 is fed to U1, a monolithic dual-conversion FM-receiver IC. The first mixer of U1 down-converts two-meter signals to the 10.7 MHz 1st-IF. LO is provided by a Colpitts tunable oscillator running in the 130MHz region. All LC tank components are selected for temperature and mechanical stability and U1 is voltage regulated by U3 to ensure electrical stability. FL1 establishes a 100 KHz bandpass window for the 10.7 MHz 1st-IF. Although some conversion gain is realized at 10.7 MHz, most of U1's overall gain is focused in the 455-KHz 2nd-IF to limit IMD potential. The 2nd-LO is crystal controlled by Y1, and 2nd-Mixer output is filtered for message-channel bandwidth by FL-2, a 20-KHz FM-data bandwidth ceramic filter. After amplification and limiting, the 455 KHz signal is fed to a quadrature detector for audio recovery. U1 then amplifies the audio signal to quasi-line level.

Unsquelled audio output from U1 is fed to packet-monitor jack J2 and also routed to AF Amplifier U2 via volume control R13. U2, a gated device, boosts audio output to speaker level and provides a squelch gate for voice-signal monitoring.

U1's RSSI output drives the squelch circuit. RSSI level is sampled across squelch sensitivity control R12 and fed to a comparator. Any time the sampled RSSI level drops below a fixed reference set by R5-R6, the comparator triggers U2 into its low-current stand-by mode, shutting off the speaker and reducing receiver power drain. When an incoming signal -- or a change in the squelch setting -- causes a rise in RSSI voltage, U2 is triggered on. This *TAILFREE*[™] squelch circuit responds instantaneously to the presence or absence of signals, eliminating squelch lag and annoying noise-bursts characteristic of hysteresis squelch.

The receiver may be powered by an internal 9-volt battery or an external power source. Vcc to U1 is regulated at 5.0 volts by U3, while Q1 and U2 operate at the input source voltage. The MFJ-8400K operates on any well-filtered DC source between 6.5 to 15 volts.

RECEIVER CONTROLS :

1. **POWER ON:** Applies power from the internal battery -- or from an external power source -- to receiver circuitry.

2. **TUNE:** The channel-selector knob for tuning in stations. Dial pointer indicates approximate frequency of reception.

3. **SQUELCH:** A control used to blank out background noise when no signal is present.

4. **VOLUME:** Adjusts voice signals for a comfortable listening level.

5. **POWER JACK:** Accepts external power sources such as an AC adapter or 12-volt automotive electrical system. Radio's 9-V battery is disconnected whenever a power plug is inserted.

6. **ANTENNA JACK:** Accepts the connector-mounted whip antenna or coaxial lead-in cable from an external 2-meter antenna.

7. **PACKET MONITOR:** Provides unsquelched audio for a TNC (Terminal Node Controller -- a radio MODEM device). Signal level at this jack is not affected by the volume control setting.

ANTENNAS FOR YOUR MFJ-8400K:

The MFJ-8400K is especially designed to work with the 19" rod antenna provided. However, to explore for distant signals, you may wish to try an outdoor antenna such as the one shown below:

To mount on the mast, wrap electrical tape around the feed line connector until it matches the inside diameter of the mast, then push the antenna into the top as shown. Mount your antenna 8-10 feet above the roof using a chimney or gable mount. Feed with foam-dielectric RG-8X cable and seal outside connections against moisture. If you prefer to buy a ready-made antenna, we suggest these MFJ products:

MFJ-1740 1/4-WAVE GROUNDPLANE: This is a "pro" version of the antenna described above, made from light-weight corrosion-protected aluminum and supplied complete with instructions and mounting hardware.

MFJ-1750 5/8-WAVE GROUNDPLANE: Like the 1740, only with a 5/8-wave top element and matching system to provide somewhat better weak-signal performance.

If you live in a condo or apartment where outdoor antennas are banned, try the MFJ-1730 **POCKET ROLLUP** portable antenna.

When it comes to selecting the right antenna, you can overdo a good thing. A high-gain 2-meter array or "powered" antenna could easily overload the MFJ-8400K's sensitive LNA and degrade rather than improve performance -- especially if you live in a high-signal urban area.

WHERE TO LISTEN FOR SIGNALS ON 2-METERS:

The 2-meter ham band is divided into segments according to a BAND PLAN. If you know the plan, you'll know the best spots to listen:

SIMPLIFIED 2-METER BAND PLAN

144.0 - 144.5	Non-FM Signals (CW, SSB).
144.6 - 144.9	Repeater Inputs
144.9 - 145.1	Packet Radio
145.5 - 146.0	Experimental, Space
146.0 - 146.4	Repeater Inputs
146.4 - 146.6	Simplex Channels
146.6 - 147.4	REPEATER OUTPUTS
147.4 - 147.6	Simplex Channels
147.6 - 148.0	Repeater Inputs

REPEATER OUTPUTS: The best spots for casual monitoring. Signals are steady and you'll hear both sides of the conversation.

SIMPLEX CHANNELS: Hams use "simplex" when they are in close proximity and don't need a repeater to maintain contact. You may or may not hear both simplex stations from your location.

REPEATER INPUTS: There will be signals here, but you'll hear the same conversation better by monitoring the repeater's output.

EXPERIMENTAL/SPACE: Offers exciting listening from time to time, including ham contacts with Space Shuttle astronauts!

PACKET RADIO: The metallic "BRAAAP" on these channels is the sound of Packet signals carrying bursts of digital information.

CW/SSB SEGMENT: This portion of the band is reserved for modes other than FM. Most signals won't be readable on your MFJ-8400K.

TIPS FOR TUNING IN FM SIGNALS:

When scanning for signals, try tuning with the Squelch control open so you can hear the receiver's background noise (turn the volume down to a comfortable level). Signals are easy to spot because background noise will quiet rapidly as you tune across them. Once you spot a signal, tune for maximum speech clarity.

SIGNAL STRENGTH:

You can estimate the relative strength of an incoming signal by the way it tunes. The diagram below illustrates how this works:

SIGNAL CLASSIFICATION

WEAK SIGNAL: Little noise reduction either side of center, audible background noise under the voice.

MODERATE AND STRONG SIGNALS: Deep noise reduction either side of center, audible background noise under the voice (such signals are often called "full quieting").

EXTREMELY STRONG SIGNAL: Wide band of noise reduction either side of center with no audible background noise under the voice (these signals may be more difficult to tune because you can't use background noise as a tuning aid). In some cases, an extremely powerful local signal may "wipe out" reception of weaker signals on adjacent channels.

GLOSSARY OF 2-METER FM TERMS :

AUTOPATCH: Connects a repeater to the phone system so users can place phone calls over the radio.

BAND PLAN: Rules and agreements that determine how an amateur band is shared among users.

BASE STATION: Two-way radio permanently installed in a building.

CONTROLLER: Automated switching unit that controls repeater operation.

COURTESY BEEP: Tone signaling repeater input channel is clear.

FM (FREQUENCY MODULATION): When the frequency of a radio signal is varied to convey voice or data.

FULL-QUIETING: Strong FM signal with little background noise.

GROUNDPLANE: Antenna with a single vertical element plus 3 or more horizontal elements arranged at the base to simulate ground.

HANDHELD: Hand-carried battery-operated VHF-FM transceiver. Also called a handi-talkie, HT, or walkie.

INPUT FREQUENCY: Channel you transmit on to access a repeater.

MACHINE: Another name for a repeater.

MOBILE UNIT: Two way radio mounted in a vehicle.

MORSE CODE: System of dots and dashes conveying letters and numbers. Many repeaters use code to self identify.

OUTPUT FREQUENCY: Channel used by a repeater to rebroadcast signals appearing on its input channel.

PACKET RADIO: Method of transmission used to communicate via personal computer over radio.

REPEATER: Automated transmitter/receiver unit especially designed to extend communicating range.

STANDARD SPLIT: 600 KHz spacing between repeater's input and output channels.

TIMEOUT: Repeater function that cuts off long-winded talkers.

TRANSCEIVER: Radio that transmits and receives signals.

VHF (VERY HIGH FREQUENCY): 30-300 MHz portion of radio spectrum.

ELECTRONIC TERMINOLOGY:

AF (AUDIO FREQUENCY): Occuring in the audio spectrum.

ALIGNMENT: One-time adjustment -- usually during initial testing.

AMPLIFIER: Device increasing the strength of electronic signals.

BANDPASS FILTER: Circuit passing signals in a specified frequency range, but rejecting signals above and below that range.

COLD SOLDER JOINT: A defective solder connection caused by incomplete heating or metal corrosion.

CONVERT: Change to a different frequency.

DC (DIRECT CURRENT): Constant energy source -- as from a battery.

DETECTOR: Recovers information imposed on a radio signal.

ELECTROLYTIC CAPACITOR: Capacitor with polarized leads (+/-).

GROUND: All points on the PC board common to the (-) power lead.

IC (INTEGRATED CIRCUIT): Miniature device providing several stages of electronic circuitry in one encapsulated package.

IF (INTERMEDIATE FREQUENCY): A standardized frequency used to filter and amplify radio signals in a radio (such as 10.7 MHz).

KHz (KILOHERTZ): 1,000 Hz.

MHz (MEGAHERTZ): 1,000,000 Hz or 1,000 kHz.

OHM: Unit of electrical resistance (used for resistors).

OSCILLATOR: Circuit that generates a radio-frequency signal.

pF (PICOFARAD) Unit of capacitance (used for smaller value capacitors).

RF (RADIO SPECTRUM): Occuring in the radio spectrum.

SLUG-TUNED COIL: Inductor or coil that is adjustable in value.

uH (MICROHENRY): Unit of inductance (used for coils and chokes).

uFD (MICROFARAD): Unit of capacitance (used for larger values).

VARIABLE CAPACITOR: Capacitor that is adjustable in value.

VOLTAGE REGULATOR: Device that supplies a constant output voltage -- even if the input voltage changes significantly.

BEFORE YOU START BUILDING:

Experience shows there are FIVE COMMON MISTAKES builders make. Avoid these, and your kit will probably work on the first try!

1. **INSTALLING THE WRONG PART:** It pays to double check. A 1K and 10K resistor look almost the same, but will act very differently in an electronic circuit!
2. **INSTALLING PARTS BACKWARDS:** Check polarity of electrolytic capacitors -- make sure the (+) lead goes in the (+) hole. Transistors have a flat side or emitter tab. IC's have a notch or dot at one end indicating correct polarity. **Always double-check!**
3. **FAULTY SOLDER CONNECTION:** Inspect for cold-solder joints and solder bridges. Cold solder joints happen when you don't fully heat the connection -- or when metallic corrosion and oxide contaminate a component lead. Solder bridges form when a trail of excess solder shorts pads together. See solder tips below.
4. **OMITTING AN PART:** Its easier to do than you might think!
Always double-check to make sure you completed each step.
5. **INSERT THE PARTS FULLY INTO THE HOLES:** Long leads can cause sensitivity problems and interaction with other components.

SOLDERING TIPS:

CLEANLINESS and GOOD HEAT DISTRIBUTION are the two secrets of professional soldering. Before you install and solder each part, inspect leads or oxidation. If dull, sand with fine emery paper until shiny. Allow your iron tip to contact both the lead and pad about 1 second before feeding solder surfaces must become hot enough to allow solder to flow. Feed solder to the **OPPOSITE** side of the lead from your iron tip. Solder should flow around the lead to the tip. Apply solder sparingly and do not touch solder direct to the iron to promote melting.

DESOLDERING TIPS:

If you make a mistake and need to remove a part, follow these instructions carefully. First, grasp the component with hemostats or your fingers. Heat the pad beneath the lead you intend to extract and pull apart gently. The lead you intend to extract it. To re-open the hole, heat the pad again and gently insert a common pin (solder should not stick to the pin's chromium plating). When the pad cools, remove the pin. You may now insert the correct component. For IC's or multi-pin components, use desoldering

STEP-BY-STEP CONSTRUCTION:

You'll assemble the MFJ-8400K in stages -- starting with the A.F. Amplifier. Please follow the published order for installing parts. Each instruction has two check boxes. Check the first box as you assemble the unit. You'll use the second box later on -- when you check your work.

Remember, **INSTALL** means:

1. Insert the correct part into the indicated board position.
2. Make sure the part is seated close to the PC board.
3. Solder all points.
4. Trim away excess leads on the bottom side of the board.

ASSEMBLY STAGE #1: A.F. AMPLIFIER

Install R9 (orange-orange-black) 33 ohms.

Install R10 (brown-black-yellow) 100K.

Install R11 (yellow-violet-red) 4.7K.

Install R14 (brown-black-orange) 10K.

Install U2, MC34119 8-pin IC. Make sure dot is toward the back of the board as shown in the parts placement diagram. Fold tabs slightly so IC can't fall out during soldering.

Install C23, 10 uF electrolytic. Check polarity.

Install C24, 10 uF electrolytic. Check polarity.

Install C25, 100 uF electrolytic. Check polarity.

Install C26, 220 uF electrolytic. Check polarity.

Install C27, .001 (102) disk ceramic.

Install C28, 1 uF electrolytic. Check polarity.

ASSEMBLY, STAGE 2: FRONT PORTION OF FM RECEIVER SECTION

Install R8 (brown-black-orange) 10K.

Install U1, the MC13135P FM Receiver IC. Make sure dot is toward left side of the board as shown in the placement diagram.

Install C11, .1uF (104) disk ceramic.

Install C12, .1uF (104) disk ceramic.

Install C13, .1uF (104) disk ceramic.

Install C14, 47pF monolithic.

Note: Do not force monolithic capacitors into their mounting holes -- this can cause them to break. Better to form the leads "bow-legged" before insertion as shown below:

Install C15, 120pF monolithic.

Install C16, .001uF (102) disk ceramic.

Install C17, 15pF monolithic.

Install C18, 15pF monolithic.

Install C19, 100pF (101) monolithic.

Install C20, 15pF monolithic.

Install C21, 68pF monolithic.

Install FL2, 455 KHz filter (black cube with 55D on top).

Install Y1, 10.245 MHz crystal (flat metal can, 2 leads).

Install L4, VFO coil (10-mm tall metal can, 2 pins).

ASSEMBLY, STAGE 3: REAR PORTION OF FM RECEIVER SECTION:

Install R3 (red-red-red) 2.2K.

Install R4 (orange-white-orange) 39K.

Install R5 (brown-black-yellow) 100K.

Install R6 (red-red-red) 2.2K.

Install R7 (orange-white-orange) 39K.

Install U3, 78L05 Voltage Regulator IC (black 3-lead case that looks like a transistor).
Make sure U3's flat side faces front as shown in placement diagram. Center lead is bent back slightly to fit pc-pad pattern.

Install C7, .1uF (104) disk ceramic.

Install C8, .1uF (104) disk ceramic.

Install C9, .1uF (104) disk ceramic.

Install C10, .1uF (104) disk ceramic.

Install C29, 1uF electrolytic. Observe polarity.

Install FL1, 10.7 MHz ceramic filter (square 3-lead case).

Install L3, Detector Coil (short 10-mm can with 5 pins).

ASSEMBLY STAGE 4: RF PREAMPLIFIER SECTION:

Install R1, (yellow-violet-brown) 470 ohm.

Install R2, (brown-black-yellow) 100 K.

Find Q1, (round black-plastic case with 4 tabs). Identify Q1's top side by finding the numbers 901 and the Motorola logo. Bend all four leads downward and insert in mounting holes with the longest lead facing the right side of the board (see placement).

Install C1, 4.7pF disk ceramic.

Install C2, 27pF monolithic or disk ceramic.

Install C3, 4.7pF disk ceramic.

Install C4, 100pF (101) disk ceramic.

Install C5, 470pF (471K) disk ceramic.

Install C6, 470pF (471K) disk ceramic.

Install C30, 27pF monolithic or disk ceramic.

Install C31, 2.2 (2.20) disk ceramic)

Install L1, 1/8" (0.125") diameter 4-turn coil (green wire) as shown below. Compress coil to about 3/16" in length (should be slight spacing between turns).

[] [] Install L2, (same as L1).

ASSEMBLY SECTION 5: LARGER COMPONENTS:

[] [] Install R12, a 100K potentiometer (squelch control). Note the two sets of holes on the PC board for R12 -- use the rear set. Locate the small metal tab protruding from the front of the control and nip it off with cutters.

[] [] Install R13, a 100K potentiometer (volume control). Follow the same procedure given for R12.

[] [] Locate C22, the main tuning capacitor, and find the four (4) brass mounting pins located on the bottom of the capacitor frame. Clean these thoroughly with emery paper.

[] [] Find C22's tinned solder terminals -- there are 2 mounted on each side -- pointing downward. Bend the left-rear terminal 180-degrees so that it points upward. This will be used for a connection later on. Carefully nip off the remaining three terminals with cutters.

[] [] Install C22 on the PC board by inserting its brass mounting pins through the board. Make sure C22 is squared with the front of the PC board and firmly seated before soldering (it will help to support the rear of the board -- as shown below). Secure in place by soldering all 4 pins.

[] [] Find a PC pad located next to the left rear terminal of C22. Solder a short length of bare wire from this pad to the capacitor's terminal lug (use a discarded component lead). Keep this lead straight and short as possible.

[] [] Install push-button on/off switch SW1 (solder terminals with holes should be on top). Solder all six pins.

[] [] Install Coaxial Power Jack J1 as shown. Twist pins slightly with cutters to lock in place before soldering.

[] [] Install Packet Audio Jack J2 (3.5-mm mini-jack) as shown.

[] [] Install 9-volt battery snap connector on the left-hand side of the board -- red lead at the (+) PC pad, black lead at the (-) pad.

Install the two 6" speaker leads (one black, one white). Pads for the speaker-wire connections are located on the right-hand side of the PC board on either side of C6. You'll connect these to the radio's speaker later on.

Cut and install a 1" insulated wire lead at the PC pad marked "ANT" on the rear of the board. You'll connect this to antenna jack J3 later -- when the PC board is installed in the cabinet.

Install each of the four 1/4" PC-board mounting spacers (one at each corner) using #4-40 nuts.

Locate parts and install the mounting stud for the radio's collapsible antenna as shown below:

This completes PC-board assembly of the MFJ-8400K.

INSPECTION:

BEFORE APPLYING POWER AND TESTING YOUR RADIO, PLEASE DOUBLE-CHECK EACH ASSEMBLY STEP, LOOKING FOR THE FOLLOWING:

- A. Omitted items
- B. Correct Value
- C. Polarity of electrolytic capacitors
- D. Proper positioning of ICs, transistors, etc.

Mark the second set of boxes as you inspect each item.

Carefully inspect the bottom of your PC board under a bright light, looking for the following conditions:

- A. Cold, incomplete, or missed solder joints.
- B. Solder bridges (especially around ICs).
- C. Protruding leads that were not trimmed off short.

Note: If you have an aerosol flux remover available, you may apply it to clean the board before inspecting (de-fluxing is optional).

INITIAL TESTING OF THE MFJ-8400K:

[] Thoroughly clean your work area of all wire-clippings, solder scraps, and debris before testing. Place PC board on a clean non-conductive non-skid surface (poster board, etc.).

[] Press the POWER SWITCH to its OFF position (shaft out). Turn VOLUME and SQUELCH controls (R12, R13) counter clockwise (CCW).

[] Connect a 9-volt alkaline battery to the battery clip -- or connect a suitable AC adapter to POWER JACK J1. (If you use an external power source without a battery installed, use tape to insulate the contacts on the 9-volt battery clip).

[] Temporarily connect both speaker leads to the radio's speaker (speaker need not be mounted in the cabinet lid for testing.)

[] Press in the POWER SWITCH to apply power.

[] Slowly turn VOLUME control R13 clockwise. You should hear a rushing sound in the speaker. If you do not, confirm SQUELCH control (R12) is fully CCW, That power is applied, and that both speaker connections are good.

IF YOU ARE UNABLE TO HEAR RECEIVER BACKGROUND NOISE AT THIS POINT, GO BACK AND RECHECK FOR CONSTRUCTION ERRORS.

[] Turn up VOLUME (R13) so the rushing sound in the speaker is fairly loud. Using a screwdriver-tip tuning tool, carefully adjust Detector Coil L3 for a peak in the background noise level in the speaker. Find the absolute peak (for a more precise indication, hook an AC voltmeter or scope to the speaker leads).

[] Confirm operation of the radio's squelch circuit by turning SQUELCH (R12) clockwise. At some point (about 1/3-1/2 up), the background noise should stop abruptly -- indicating the squelch has cut off the A.F. Amplifier. This indicates proper operation. If the squelch fails to operate, check for errors.

[] Find a hex type insulated tuning wand that fits the tuning slug in VFO Coil L4. Install a small flag made from a piece of tape on the shaft of the tuning wand. You'll use this "flag" to count the number of turns you make as you pre-adjust the coil.

[] Using the tuning wand, rotate L4's slug until its top surface is perfectly even with the top of the shield can.

[] Carefully rotate L4's slug 5 turns in a clockwise direction. This adjustment will place the receiver's tunable oscillator in the ballpark for 2-meter reception.

This completes initial testing of your radio.

FINAL ASSEMBLY, CABINET INSTALLATION:

- Install speaker SP1 in the cabinet lid with four black 1/4" - #6-32 screws provided. Secure with #6 lock-nuts.
- Install 4 adhesive-backed rubber feet on the cabinet bottom.
- Install the PC board into its cabinet. To do this, angle the board forward, allowing the tuning capacitor and potentiometer shafts to fit into their respective mounting holes. Drop the rear portion of the board down as the controls slip forward into position.
- Secure the board in place using four 1/4" x #4-40 screws.
- Attach the VOLUME and SQUELCH controls to the front panel using the hardware provided.
- Install the red button on POWER SWITCH SW1.
- Set TUNING CAPACITOR C22 fully CCW. Install the red dial pointer with plastic bushing toward the back (point to 144 MHz). If bushing fits too tight, do not force -- use emery paper or an exacto knife to deburr and relieve the hole. If too loose, tack in place with a dot of rubber cement on a toothpick. Do not allow adhesive to drip into the space between the inner and outer shafts; this will damage the reduction drive!
- Mount the 1-1/4" knob on C22 -- and 1/2" knobs on R12 and R13.
- Install ANTENNA JACK J3 on the inside surface of the back panel using two 1/4" x #4-40 screws. Secure with #4 locknuts.
- Connect the antenna lead wire to J3 and solder in place.
- If necessary, reconnect the speaker wires to speaker SP1.

FINAL VFO CALIBRATION:

Review the choices below and select an alignment procedure which best matches the resources you have available. DO NOT screw L4's slug to the bottom of the coil during calibration -- it can become wedged against the PC board and crack. If the slug binds, try lubricating with a drop of WD-40, then turn gently counter clockwise. The MFJ-8400K VFO should be calibrated at mid-dial, or 146.0 MHz.

METHOD #1 -- PRECISION SIGNAL GENERATOR:

- Set MFJ-8400K TUNING DIAL to 146.0 MHz (mid scale).
- Set VOLUME up, SQUELCH open (fully CCW), apply POWER.
- apply a 10uV 146-MHz signal to the antenna input.
- Slowly adjust L4 until the generator signal fully quiets the MFJ-8400K

METHOD #2 -- SCANNER OR EXTENDED-COVERAGE 2-METER HT:

The MFJ-8400K's VFO should oscillate at 135.3 MHz when tuned to 146.0 MHz. Use a scanner to tell when VFO is properly tuned.

- Set up MFJ-8400K as outlined above, but with VOLUME down.
- Tune SCANNER to 135.3 MHz with volume up and squelch open.
- Place SCANNER antenna 2-3 feet from the MFJ-8400K.
- Adjust L4 slowly until SCANNER receives 104K's signal.

METHOD #3 -- 2-METER HT

- Set up MFJ-8400K as outlined above, but with VOLUME down.
- Set 2-Meter HT to 146.0 MHz simplex, low power, and connect a dummy load or 47-ohm 1/2 watt resistor to antenna jack.
- Have friend hold HT several feet from MFJ-8400K and transmit.
- Adjust L4 slowly until transmitted signal is picked up.

METHOD #4 -- NOT TEST GEAR

- Set MFJ-8400K as above with VOLUME up and SQUELCH open.
- Connect an antenna (or extend the built-in antenna).
- Using L4 and the TUNING DIAL, search until you find 2-meter signals (confirm they are not 150 MHz commercial signals).
- Identify a signal with a known frequency (a local repeater with a published output frequency or a Packet Radio signal which should be very close to 145.0MHz).
- Set TUNING to the known reference frequency.
- Slowly adjust L4 until the desired signal is heard.

If you are unable to calibrate your radio in this manner, ask a local Ham or a friend with a scanner for assistance.

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Some improvement in receiver sensitivity may be possible by fine-tuning L1 and L2. Do this carefully, gently increasing or decreasing the distance between turns as outlined below. Do not distort or stretch the coils to where they lose shape. If you are using an external antenna or signal generator as a signal source, make sure the internal antenna is removed.

- Tune in a weak signal with audible noise in the background.
- Find an insulated chisel-tip wand or a flat wood toothpick.
- Stretch or compress the turns of each coil (L1, L2) for maximum quieting (repeat a couple of times until the best adjustment for both coils is found).

This concludes final tune up of your MFJ-8400K 2-meter receiver.

FINAL STEPS:

Install the lid and secure in place with the two screws provided.

Install the whip antenna through the hole in the cabinet lid and screw onto mounting stud on PC board.

THIS COMPLETES CONSTRUCTION AND TESTING OF THE MFJ-8400K.