

## **Introduction**

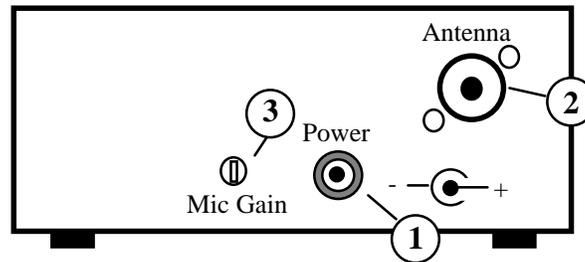
Congratulations on choosing the MFJ-9475 75-Meter transceiver. At home or on the road, your MFJ-9475 is built to deliver performance you never thought possible from a low-power radio. Before attempting to operate, please read this manual carefully! Let's begin with an introduction to some special features we think you'll like!

- **Easy to Operate:** A "back-to-basics" radio, the MFJ-9475 is simple to use. There are no complex microprocessor functions to master, and you'll be on the air in minutes!
- **Great Receiver Performance:** Your radio features a quiet DBM (doubly-balanced mixer) front-end and carefully-distributed gain. If the signal is there, you'll hear it. If the signal *isn't* there, you won't hear a lot of other things that shouldn't be there!
- **Analog S-Meter:** Responsive mechanical meter gives accurate meaningful reports.
- **Excellent Selectivity:** Sharp ladder filter cuts adjacent chatter and focuses transmitter power where you need it most.
- **Smooth, Stable VFO:** Effortless tuning with custom-manufactured 8:1 reduction-drive ball-bearing VFO tuning capacitor.
- **Powerful AF Output:** Big audio--even on the road--from a special Philips BTL audio chip and rugged 3" speaker.
- **Full-time RF Speech Processing:** Commanding speech cuts through QRM. Compare it with your 100-Watt rig--you'll be *amazed* by the signal reports.
- **Travel Light:** Packs a heavy punch without the heavy power supply! Designed to run on NiCad's or the ultra-light MFJ-4110 AC wall-adapter supply.
- **Rugged PA:** Bullet-proof final runs cool, tolerates accidental shorts and opens.
- **Made to Last:** Conservative design, premium plate-through pc board, quality components, handsome brushed-aluminum panel, and a tough vinyl-clad case ensure years of dependable service.

You'll enjoy countless hours operating the MFJ-9475. If anything goes wrong, it's fully backed by MFJ's exclusive "No Matter What" 1-year guarantee. If it breaks, we'll take care of it!

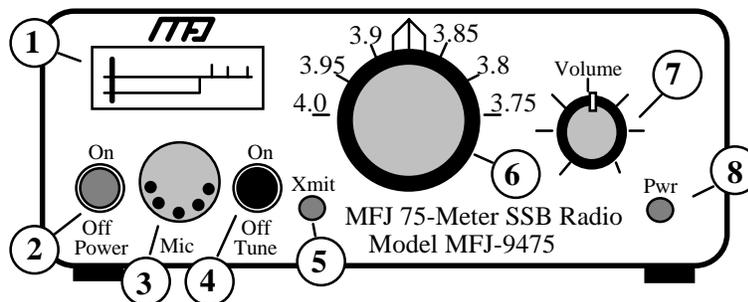
**Note:** Due to bandwidth considerations, no CW adapter is offered for the MFJ-9475.

## MFJ-9475 Control Locations and Functions



### Rear Panel

- 1. Power Jack:** 5.5 mm OD x 2.1 mm ID, (+) to center pin.
- 2. Antenna Jack:** SO-239 for standard coax plug.
- 3. Mic Gain:** Controls speech-amp gain--normal setting 12:00.



### Front Panel

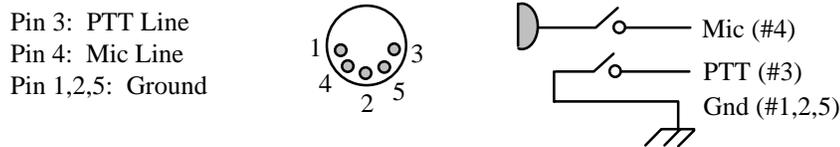
- 1. Meter:** Shows signal strength on RX, ALC Voltage on TX.
- 2. Power Switch:** Turns on power to the transceiver.
- 3. Mic Connector:** 5-pin DIN connector for 600 $\Omega$  dynamic microphone.
- 4. Tune Switch:** Injects carrier for antenna tuner or other adjustments.
- 5. "Xmit" LED:** Illuminates when unit is transmitting.
- 6. Tuning Dial:** VFO control for tuning in stations.
- 7. Volume Control:** Adjusts speaker volume to a comfortable listening level.
- 8. "Pwr" LED:** Illuminates when power is turned on.

**Assembling Your Station**

You'll need three items to put your MFJ-9475 on the air:

**Power Supply:** The MFJ-4114 AC/NiCad Portable Power Pack or MFJ-4110 AC. Wall-adaptor Supply are especially designed for the MFJ-9475. You may also use any other regulated 13.8-Volt supply or 10-cell NiCad pack that delivers 2 Amps on peaks (RF output slightly lower with 12-volt supplies). Use a 5.5 mm OD x 2.1 mm coaxial-type power plug (Radio Shack 274-1567) with (+) connected to the center pin.

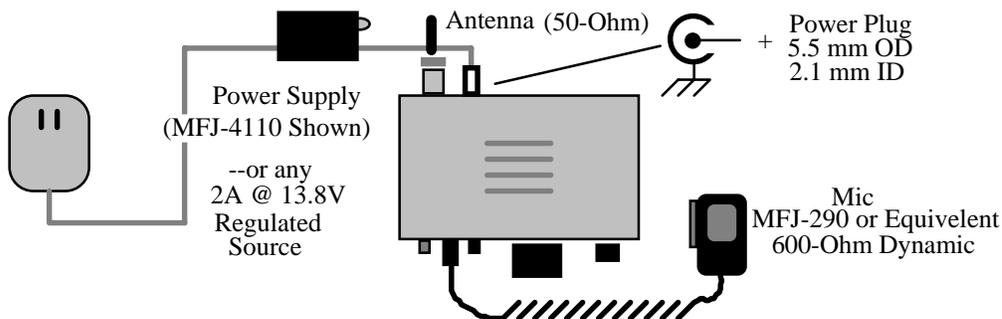
**Microphone:** The MFJ-9475 speech processor was designed around our companion MFJ-290 600Ω Dynamic Microphone. However, you may use any low-Z dynamic microphone with a switched cartridge and PTT line by installing a 5-pin DIN connector (Radio Shack 274-003 or equivalent), as shown below:



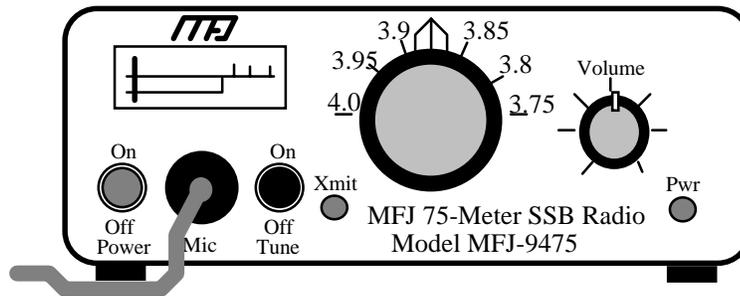
**Antenna:** The MFJ-9475 works with any 75-Meter 50Ω antenna exhibiting low VSWR (2:1 or less is considered acceptable for amateur radio service). *Avoid antennas with unknown or high VSWR.* See page 5 for more detailed 75-meter antenna suggestions.

**Setting up Your Station**

The MFJ-9475 is small in size, allowing you to set up an amateur radio station in nearly any location. The better the operating environment, the better your radio will perform. Find a space that is sheltered, dry, and dust free. Avoid surfaces that are exposed to direct sunlight, strong magnetic fields, rapid temperature changes, or high ambient noise levels. Connect your transceiver to a good earth ground, if available.



## Operating Your MFJ-9475



**Receiving:** The MFJ-9475 is extremely simple to operate. To get started, press the *POWER* switch on (the green *PWR* LED should illuminate). Adjust the *VOLUME* control for a comfortable listening level. Now, tune in your station with the *VFO TUNING* knob. That's all there is to it!

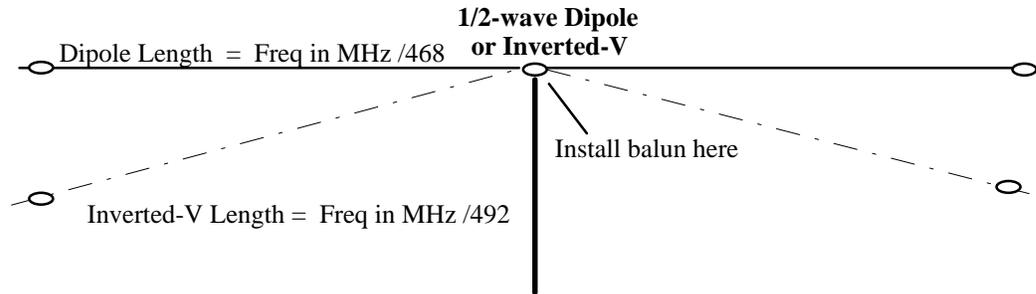
**Antenna Tuners:** If you are using a tuner, adjust controls for the strongest received signal first--before keying the transmitter. This will bring antenna VSWR into the "ballpark". For final adjustment, press the radio's *TUNE* switch to *ON*. This will generate a steady carrier (the red *XMIT* LED should light). Be sure to follow the tuner manufacturer's procedures when adjusting for minimum VSWR.

**Before You Transmit:** Your radio's VFO dial was calibrated at the factory. However, under FCC rules, you are solely responsible for the operating frequency of your transmitter (MFJ is not). If you have doubts concerning the dial's accuracy, check it out against a radio with a digital frequency readout before operating near the band edges. Also, know where the sub-band margins are for your particular class of license.

**Transmitting:** Press the PTT switch and speak normally while holding the microphone 1-2 inches away (the red *XMIT* LED should light). The radio's S-meter should deflect about 1/2 scale as you speak. Resist the temptation to yell or close-talk. The speech processor is designed to automatically re-adjust gain for each syllable. Over-driving the radio's speech amplifier circuitry will detract from its performance. As you speak, note that the S-meter is indicating ALC voltage--not RF output power. Speaking loudly to push the meter higher will have no benefit.

**Antenna VSWR:** Always check VSWR before using a new or questionable antenna. Highly reactive loads will affect ALC meter readings during transmit, making them appear abnormally high or low, depending upon the nature of the mismatch. In extreme cases, highly-reactive loads can cause the transmitter to emit spurious out-of-band signals in violation of FCC rules. If you notice that your ALC voltage is swinging excessively high or low, consider this a "wake-up call" to check the condition of your antenna!

## Antennas for your MFJ-9475



The key to success when operating low-power SSB is a properly-installed full-sized resonant antenna. Dipoles and inverted-Vs generally work best for regional coverage.

Typical length for a 75-meter phone-band dipole is around 121 feet. This length may vary somewhat, depending upon antenna height, ground conditions, etc.

For restricted-space installations, inductively-loaded dipoles deliver nearly equal on-air performance--but with a sacrifice in bandwidth. If you shorten your dipole with loading coils, use high-Q inductor stock ( $Q = 300$  or better for minimum loss) and install them at the center of each antenna leg.

Regardless of type, always mount your antenna as high and in-the-clear as possible. For flat dipoles, best VSWR typically occurs at 40-70 feet AGL. A single dipole will not cover the entire 75/80 band at low VSWR, but if you cut for resonance just below 3.9 MHz, VSWR should remain acceptable at both phone-band edges. Alternatively, cut for the center of your allotted sub-band or favorite rag-chewing frequency.

Feedline loss is usually not a critical consideration at 3.9 MHz, and any light-weight 50- $\Omega$  cable such as RG-8X or RG-58 will work fine. A simple choke-balun can reduce feedline interaction when coax does not drop perpendicular to the flat-top. Use a commercial balun, or simply coil 25 feet of feedline and tape in place just beneath the center block for an inexpensive solution. Make sure all connectors and joints are clean, properly soldered, and protected from moisture. Avoid water-proofing methods that can trap moisture or condensation inside connectors.

For alternative antenna designs, see *The ARRL Antenna Book* or *ARRL Antenna Compendium* for descriptions and construction details. If possible, avoid compromise or multiband designs.

**Typical Technical Specifications**

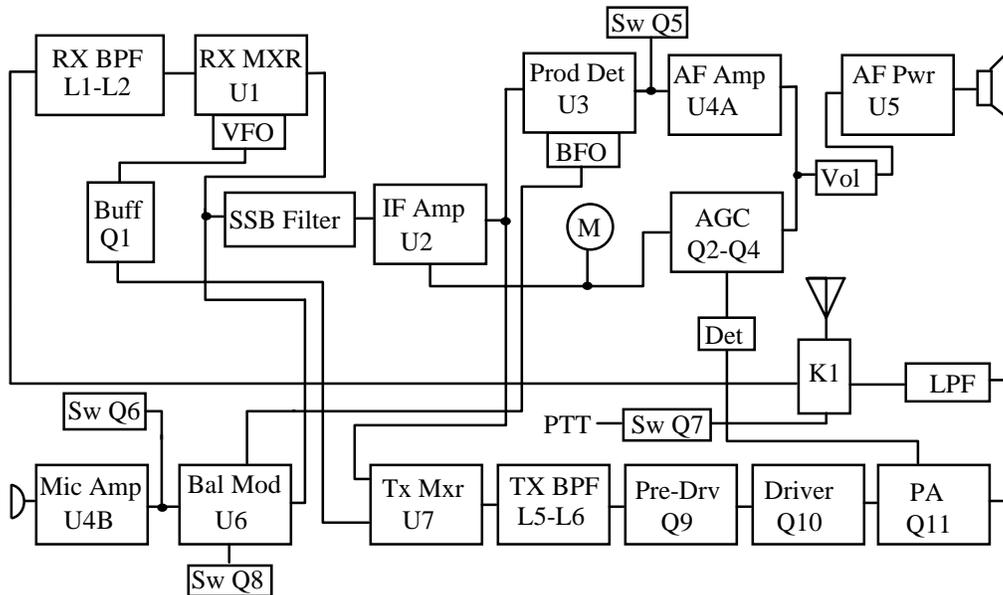
**Receiver Section:**

Frequency Coverage	3750 - 4000 kHz
Receiver Type	Single-conversion Superhet
VFO Frequency	6.0 - 6.250 MHz
IF Frequency	10 MHz
IF Selectivity	-6 dB @ 2.4 kHz
Blocking Dynamic Range	>100 dB
Sensitivity	0.3-uV MDS
Audio Output	0.75 Watts into 8Ω at 10% THD
Receive Current	100 mA

**Transmitter Section:**

RF Power Output	12-Watts PEP (10-Watts average speech)
Suppression	45 dB
VSWR Tolerance:	3:1 VSWR
Maximum Current	2.2 Amps at 13.8 VDC
Speech Enhancement	Syllabic RF-compression
Transmit Current	2.0 Amps @ 13.8 VDC

**Block Diagram**



## **Theory of Operation** (see Block Diagram)

**Receiver:** A four-pole bandpass filter at L1-L2 pre-selects incoming 4-MHz signals. Active mixer U1 amplifies and converts signals to 10-MHz using a self-generated 6.0-6.25 MHz VFO signal. Crystal ladder SSB filter Y1-Y6 sets message-channel bandwidth at approximately 2.4 kHz. Diode switching routes signals through the SSB filter and IF amplifier U2. U2 provides AGC-controlled IF gain in RX mode, and syllabic-rate RF-compression in TX mode. DC amplifier Q3/Q4 drives the AGC port of U2--plus the S-meter circuit. In RX mode, AGC is audio-derived from AF pre-amp U4A. Switch Q2 sets slow AGC rate for SSB reception. In TX mode, AGC control voltage is derived from PA level detector D9, and switch Q2 sets a fast AGC time constant for processing. In RX mode, U2 feeds receiver product detector U3 through switch D3,D4. U3 demodulates incoming SSB signals, using a self-generated 10-MHz LO signal. U3's audio port feeds AF preamp U4A, which boosts and actively-filters the recovered AF signal for HF noise. Input to U4A is killed in TX mode by switch Q5 to disable the AF AGC path to U2. U4A drives AGC detector D6,D7--and drives AF power amplifier U5 through the radio's volume control. U5 powers the speaker during RX mode, and is gated off via the logic-level kill pin in TX mode.

**Transmitter:** Microphone speech amp U4B drives balanced modulator U6 during TX mode. Switch Q6 kills U4 output in RX mode to prevent mic bleed-through into the IF. LO for U6 is derived from U3's on-board BFO oscillator. FET Switch Q8 is used to unbalance U6 for full carrier generation (for tune-up). DSB output from U6 is routed through ladder filter Y1-Y6 via switch D1,D2 to remove USB products and carrier artifact. After undergoing dynamic compression in U2, the processed LSB signal is routed to transmit mixer U7 via switch D3,D4. U7 mixes 10-MHz LSB with VFO energy to generate RF output (the VFO signal is buffered prior to mixing by source-follower Q1). Band-pass filter L5,L6 selects the desired mixer product (4 MHz), and suppresses other mixer products. FET pre-driver Q9, which functions as impedance-matching device and amplifier, provides a high-Z load to the BPF for higher filter Q. Lo-Z output is then fed to broad-band driver Q10. Q10 drives PA stage Q11, a single-ended un-tuned linear amplifier. Bias for class AB operation is generated by clamping diode D10. T5 matches PA output into a 50 $\Omega$  low-pass harmonic filter at L7,L8. Level detector D9 tracks RF amplitude of the speech envelope, and generates a DC feedback voltage to drive AGC amplifier Q3,Q4 for control of U2 gain (speech processing).

**Switching and Regulation:** Q7 activates relay K1, which--in turn--routes the antenna line and activates the +T and +R buses in the radio. The +T and +R buses are used to power some low-level stages, as well as key several switch nodes and bias Q11 on during TX mode. Adjustable regulator U8 sets Vcc for most low-level stages. Fixed regulator U9 hardens U1 operating voltage to ensure VFO stability. Crowbar diode D11 and a pc-track fuse protect the radio from reverse polarity.

## **Troubleshooting**

**Radio Does Not Power Up:** Check the power plug, supply wires, and power source. Also, check to see if the *REVERSE-POLARITY FUSE* is open inside the radio. This fuse is etched onto the pc board next to the radio's power jack. If open, replace with a 2.5-A pigtail type fuse or short length of #36 enamel wire.

**No Signals Received:** Check the antenna and feedline. Is the *TUNE* switch stuck on? Is the band dead??

**Does Not Transmit:** Check the microphone PTT switch, cable, and connector. Check your power source to see if enough current is available to transmit.

**Erratic Transmit:** Check to see if VSWR is above 3:1. Also, is the voltage of your power source low or "soft" under full load?

**Receiver Motorboats (low-frequency oscillation) on 12-V battery:** Regulator voltage set too high. Reset R64 for 10.0 Volts at TP1. Set AGC voltage (R6) for 4.3 Volts at TP2 and re-zero Meter Zero trimpot (R51).

**VFO Drifts in Frequency:** Is the radio sitting in direct sun-light, on a hot surface, or in a cold draft? Was it recently moved from a very cold to a warm area (condensation)?

**Poor Carrier Suppression:** Was the radio exposed to rough-handling or shock? To null, turn *MIC GAIN* down and adjust R36 and T3 for minimum carrier.

**Low Transmit Audio:** Is the microphone a 600 $\Omega$  dynamic type? Is the *MIC GAIN* set too low?

**Noise on Transmit Audio:** Is the *MIC GAIN* set too high in a noisy room? Is the microphone or radio positioned next to a motor or large power transformer?

## **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 FAX to 601-323-6551; or by email to [mfj@mfjenterprises.com](mailto:mfj@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.

## **Field Alignment Procedures for the MFJ-9475 Transceiver**

These internal adjustments require technical competence and access to accurate lab-type test equipment. If you don't feel qualified to perform these procedures, please let MFJ--or a qualified radio service technician--do the work. Mis-alignment could result in out-of-band spurious emission (in violation of FCC rules) and poor on-air performance.

### **Special Tools, Parts, Test Equipment:**

- AC Power Supply, 13.8 Volts @ 2 Amps
- Voltmeter
- Non-inductive Alignment tool Kit
- Frequency Counter
- Watt meter with 50Ω Dummy Load
- 4-MHz Signal Generator or Other Signal Source
- 75-Meter Receiver

### **Initial Test Set-up:**

- Remove transceiver cover.
- Connect 13.8-V power source to radio's Power Jack
- Connect Microphone.
- Turn on unit.

### **Voltage Checks and Adjustments:** (Use Voltmeter)

- Set Voltage Regulator for 10.2 Volts at TP1 via R64.
- Set Receiver AGC for 4.3 Volts at TP2 via R6.
- Set S-meter pointer to "0" via R51.

### **VFO Calibration:** (Use Counter, Dummy Load)

- Tune VFO dial to mid-band (3.9 MHz), and connect dummy load.
  - Place counter pickup lead near (but not touching) wire from pc board to antenna jack.
  - Press *TUNE* and adjust L3 for 3.900 MHz reading on counter.\*
- \*(or connect a counter to U7 pin 6 and adjust L3 for a 6.103 MHz readout)

### **BFO Frequency Check and Alignment:** (Signal Generator, AF Osc or Counter)

- Tune across 3.900 Mhz signal, identifying peaks in passband on S-meter.
  - Carefully set VFO dial to lowest-pitched response peak (listen to heterodyne note).
  - Adjust BFO trimcap (C61) until CW note is 600 Hz \*
  - Recheck to confirm that the *1st peak* is at 600 Hz and that receiver mode is LSB.
- \* (Use an audible 600-Hz reference tone, or connect AF-range counter to U4 pin 7).

### **Carrier Null:** (Use a second receiver to monitor residual carrier)

- Tune *MIC GAIN* full off (counter-clockwise).
- Key the microphone and monitor residual carrier with second receiver.
- Adjust R36 and T3 (alternately) for minimum carrier.

**Receiver Sensitivity:** (Use a calibrated RF-Signal Generator)

- [ ] Connect a weak 3.900 signal source to *ANTENNA* jack.
- [ ] Tune in source for maximum S-meter reading using VFO.
- [ ] Adjust Signal Generator amplitude for S5-S7 meter reading.
- [ ] Touch up L1, L2, T1, T2 for maximum S-meter reading.

**Transmitter Bandpass Filter Alignment:** (Use a Watt meter and Dummy Load)

- [ ] Connect low-power watt meter with dummy-load to the *ANTENNA* jack.
- [ ] Turn R61 fully clockwise to disable the transmitter's ALC detector.
- [ ] Press *TUNE*, carefully touch up L5, L6 for maximum power output on watt meter.

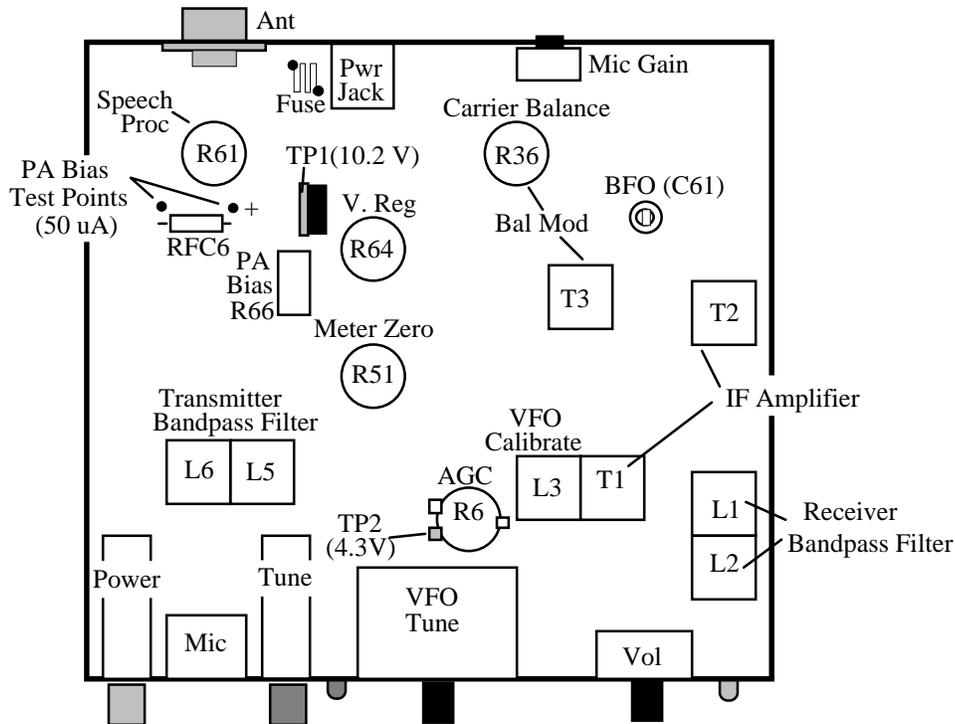
**PA Bias Adjust:** (Use the uA function on a Voltmeter)

- [ ] Turn *MIC GAIN* fully off (CCW).
- [ ] Connect uA meter across the *PA-BIAS* test points located at RFC6 (see below).
- [ ] Key Mic and adjust Bias Pot R66 for a 50-uA reading on the test meter.

**Speech Processor Adjustment:**

- [ ] Set the radio's *MIC GAIN* control to fully open (clockwise).
- [ ] Press PTT switch and speak into the microphone--2 inches away, normal voice.
- [ ] Adjust R61 for mid-scale meter readings on peaks (re-set *MIC GAIN* when done).

**Internal Adjustment Locations:**



## DC Voltage Chart

For advanced trouble-shooters, the following values are typical DC voltages found in the MFJ-9475 Transceiver:

Vcc = 13.8 Supply Voltage  
 TP1 = 10.2 (LM-317 Output)  
 TP2 = 4.3 VDC

## Integrated Circuits:

Pin #	U1	U2	U3	U4	U5	U6	U7
1	1.4	10.2	1.4	5.0	9.9	1.3	1.4
2	1.4	10.0	1.4	5.0	2.5	1.3	1.4
3	0	0	0	5.0	0	0	0
4	3.9	3.3	4.0	0	2.9	4.9	4.7
5	3.9	4.9	4.0	5.0	4.9	4.9	4.7
6	4.9	3.3	5.0	5.0	0	5.7	5.8
7	4.5	0	4.6	5.0	0	4.9	5.2
8	5.0	10.2	5.1	9.9	4.9	4.9	5.8

**BPT and FET Devices:**     **D/E = Drain/Emitter**  
                                       **S/B = Source/Base**  
                                       **G/C = Gate/Collector**

\* Test in Transmit Mode

\*\* Test with Tune switch depressed

\*\*\* Do Not Test gate of Q9 -- may cause parasitic instability.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7*	Q8**	Q9	Q10
<b>D/E</b>	9.8	0	9.0	9.7	0	0	3.5	0	13.0	0.25
<b>S/B</b>	2.3	0.7	3.9	8.9	0.7	0.7	2.8	0	0	1.0
<b>G/C</b>	0	0	0	4.3	13.0	0	0	9.0	***	13.7

**Q11:** To avoid meter damage from RF, check Q11's collector voltage in receive mode only--full supply voltage should be present. Check base bias voltage with PTT pressed (no audio, mic gain fully off)--it should read approximately 0.6 VDC. A measured current of 50 uA across the PA bias test points should correspond with 100-mA IDq on PA transistor Q11 (RFC6 acts as a meter shunt for this measurement).

**MFJ-9475 Schematic Diagram**

**MFJ-9475 Parts List**