

440 Repeater Building White Paper

A Step-by-Step Procedure

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Receiver Set Up

- 1) Test the receiver on its original frequency with the stock crystal in it (if there) to be sure the receiver works.
- 2) Check sensitivity... it should be at least 1 or 2 uv, or better (stock spec is .35 uv to open sq).
- 3) When ordering crystals be sure to order High-Side Injection if your receiver operating frequency is below 448.800 MHz. Order Low-Side Injection if your receiver operating frequency is above 448.800.
- 4) Install the new crystal in the existing ICOM. Be certain to keep it the same type of ICOM, ie. 5C/EC = 5C/EC; or 2C = 2C. Don't mix the crystal and ICOM accuracy values (2C crystal in a 5C ICOM). Stations should **ALWAYS BE 2C**, never 5C/EC, which were intended for mobile radios, not Stations.
- 5) Be sure to label RX frequency on the ICOM with 44xRxxx (eg. "448R900"). 'R' for receive, ILO (In Lieu Of) the decimal point.
- 6) And also label the LO (Local Oscillator) Frequency on the ICOM. 'LO 4xx.xxx' (eg. "LO 437.700").

Tune up the Local Oscillator

- 7) If your crystal is a High-Side Injection crystal then C306 and C307 on the Mixer should be turned all the way up (counter-clockwise) before tuning C406, C411 & C416.
- 8) With your DC voltmeter (or GE Test Set) at Pin 3 of the 9-Pin Metering Jack, peak C406.
- 9) With DC voltmeter at Pin 4, peak C411 & C416; then peak C406, C411 & C416 again.
- 10) Check the RX frequency for accuracy on a Service Monitor. Set the Service Monitor to receive the Local Oscillator frequency (operating frequency -11.2 MHz for normal Low-Side Injection; or +11.2 MHz if High-Side Injection) on the ANT input to Service Monitor. The LO frequency should be labeled on the ICOM. With the Service Monitor receive input on ANT, zero (or the net) the crystal to the LO frequency. This zero's your RX operating frequency.
- 11) With DC voltmeter at Pin 4 adjust C306 for some kind of change, either positive or negative.

Tune up the Mixer

- 12) With DC Voltmeter at Pin 7, peak C306; then peak C307; then peak both again.
- 13) Then dip C308.
- 14) Then peak C306. The Mixer is now peaked. **No more tuning** of the Mixer is required.

Tune up Helical Resonators

- 15) With DC voltmeter at Pin 1, inject an on-frequency signal into the hole adjacent to or C304 with a Service Monitor. There are two schools of thought on tuning up helical resonators: 1) Adjust signal level output from the Service Monitor for a slightly noisy signal; and 2) keep the signal level between 2/10 and 3/10 volts (.200 to .300 on a digital voltmeter), and adjust C305, C304, & A303-C2 for maximum. The choice is yours.
- 16) Inject an on-frequency signal into the hole adjacent to or C303. Peak C304 & C303.
- 17) Inject an on-frequency signal into the hole adjacent to or C302. Peak C302 & C303.
- 18) Inject an on-frequency signal into the receiver's antenna jack. Peak C301, C302, C303, C304, C305 & A303-C2. Continue to tune these controls for best possible meter reading, with at least .100 volts. Maximum possible reading is about .500 volts, so don't try and tune it up at that level. I usually keep the signal level at between .200 to .300 volts during helical tune up (the sweet spot).

Adjust Discriminator Audio Level

- 19) Connect an oscilloscope to the Discriminator (VOL/SQ HI). Inject a full-quieting on-frequency signal into receiver, and with a 1000 Hz tone, set the deviation to FSD (Full System Deviation) which is 5 kHz for the WIN System. Note the sine wave and be certain it is clean and not distorted. If it is distorted, remove the cover over the IF section (six screws) and adjust L503, L504, L507, & C504 to clean up the sine wave. Be sure you are at FSD for this test (5 kHz deviation with a 1000 Hz tone).
- 20) Pop open the Detector cover on the Audio/Squelch Board, and peak the inductor can with a small blade screw driver for maximum deflection on the Scope.
- 21) Set Discriminator audio level to WIN System standard with the on-edge pot inside the aluminum discriminator box to 2 Volts Peak-to-Peak with 1000 Hz tone at FSD (5 kHz deviation).
- 22) Sometimes, when we add a De-Emphasis Network in a Phase-Modulated (PM) MASTR II Exciter, we must run the audio levels on all receivers in the rack at a little higher level, to achieve a 1 to 1 audio through-put on the repeater and link transmitters. In that case, we need to set the discriminator audio at a higher value than 2 volts p-p. You need to experiment with this setting a little, but usually 2.5 kHz at FSD will produce enough audio level to drive the PM exciters to a 1 to 1 audio through-put, utilizing our De-Emph Network ahead of the mic input (Pin 6) on the Exciter.

Exciter Set Up

- 1) Test exciter with on its original frequency with the stock crystal in it (if there) to be sure the exciter works.
- 2) The output power should be as spec'd for the Power Amplifier: 40-watts; 75-watts; or 100-watts.
- 3) Install the new crystal in the ICOM. Be certain to keep it the same type of ICOM, ie. 5C/EC = 5C/EC; or 2C = 2C. Don't mix the crystal and ICOM accuracy values (2C crystal in a 5C ICOM).
- 4) Be sure to label the TX frequency on the ICOM 44xTxxx (eg. 443T900). 'T' for Transmit, ILO the decimal point.

Tune Up Exciter

- 4) With DC voltmeter at Pin 1 of the 9-Pin Metering Jack, peak T101, dip T102, & peak T103.
- 5) With DC voltmeter at Pin 3, peak T104, & dip T105.
- 6) With DC voltmeter at Pin 4, peak T106, & dip T107.
- 7) With DC voltmeter at Pin 7, peak T108, & dip C155.
- 8) With DC voltmeter at Pin 6, peak C157, & dip C167.
- 9) With DC voltmeter at Pin 4 of the **PA**, peak C171 & C175.

Final Tuning....

- 10) With DC voltmeter at Pin 1, peak T101.
- 11) With DC voltmeter at Pin 3, peak T102, peak T103, & peak T104.
- 12) With DC voltmeter at Pin 4, peak T105, & peak T106.
- 13) With DC voltmeter at Pin 7, peak T107, & peak T108.
- 14) With DC voltmeter at Pin 4 of the **PA** (or watching output power), peak C155 & peak C157.
- 15) With DC voltmeter at Pin 4 of the **PA** (or watching output power), peak C167, peak C171 & peak C175.
- 16) Adjust the power output at PA to specified level. Be sure NOT to exceed 22 amps DC current draw on 100-watt Continuous-Duty PA's.