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DEPRTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT
MAINTENANCE MANUAL

RADIO RECEIVER R-390/URR

This copy is a reprint which includes
current pages from Changes 1 and 2.

HEADQUARTERS DEPARTMENT OF THE ARMY
9 MARCH 1962

Technical Manual

HEADQUARTERS,
DEPARTMENT OF THE ARMY
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No. 11-5820-357-35

RADIO RECEIVER R-390/URR

*This manual, together with TM 11-5820-357-10, 29 December 1960 and TM 11-5820-357-20, 23 March 1961 supersedes TM 11-856, 11 January 1955 including C1, 23 June 1955; C2, 29 September 1955; C3, 19 January 1956; C4, 22 December 1958; and C5. 31 December 1959.

CHAPTER 1

THEORY

Section I. GENERAL

1. Scope

a. This manual covers field and depot maintenance for Radio Receiver R-390/URR. It includes instructions appropriate to third, fourth and fifth echelons for troubleshooting, testing, aligning, and repairing the equipment, and replacing maintenance parts. It also lists tools, materials, and test equipment for third, fourth, and fifth echelon maintenance. Detailed functions of the equipment are covered in the theory sections.

b. The complete technical manual for this equipment includes seven other publications (appx I).

c. Refer to DA Pamphlet 310-4 to determine what changes to or revisions of the publication are current.

d. Forward comments concerning this manual to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N. J.

Note: For applicable forms and records see paragraph 2, TM 11-5820-257-10.

2. Internal Differences in Models

During production, modifications were made to the receiver. When these modifications were performed, the subchassis affected were stamped with a modification (MOD) number.

a. *Changes to Rf Gear Train.* In unmodified radio frequency (rf) gear trains, the green coded offset gear has the green face to ward the rear of the receiver and is not meshed with the clutch gear. In gear trains stamped MOD 1, the green face is mounted toward the front of the receiver and is meshed with the clutch gear.

b. *Changes to Variable Frequency Oscillator Subchassis.* Refer to figure 5 for differences between unmodified variable frequency oscillator subchassis and those bearing MOD number 1.

c. *Changes to Rf Tuning Coils and Transformers.* Beginning with rf subchassis MOD 2, the cores of antenna coils T201 through T206 are made of different material to improve tracking. The cores on tuning circuits Z206, Z212, and Z218 are smaller in size to increase the tuning range of the high-frequency band. Coils or transformers that have identical functions are interchangeable for all models, providing that the change is made complete with tuning cores. When a tuning core alone is replaced, the correct one of the two types available must be selected for proper operation of the coil.

d. *Other Differences.* Other changes to the receiver during production are listed in the chart below.

Item	Subchassis	No MOD	MOD 1	MOD 2	MOD 3	MOD 4
R609, between junction of R604 and R608	Af.	18 ohms	18 ohms	Not used	Not used	Not used
R558	If.	1 megohm	1.2 megohms	1.2 megohms	1.2 megohms	1.2 megohms
C246	Crystal oscillator	130 uuf	120 uuf	120 uuf	120 uuf	120 uuf
C439	Crystal oscillator	Not used	Not used	5, 000 uuf	5, 000 uuf	5, 000 uuf
C440	Crystal oscillator	Not used	Not used	5, 000 uuf	5, 000 uuf	5, 000 uuf
C905	Crystal oscillator	150 uuf	200 uuf	200 uuf	200 uuf	200 uuf
C914	Crystal oscillator	Not used	0.01 uf	0.01 uf	0.01 uf	0.01 uf

Item	Subchassis	No MOD	MOD 1	MOD 2	MOD 3	MOD 4
L903	Calibration oscillator	Not used	0.5 mh	0.5 mh	0.5 mh	0.5 mh
R221	Rf	27 ohms	68 ohms	68 ohms	68 ohms	68 ohms
C307	Rf	1 uuf	1 uuf	0.75 uuf	0.75 uuf	0.75 uuf
C310	Rf	1 uuf	1 uuf	0.75 uuf	0.75 uuf	0.75 uuf
C207	Rf	22 uuf	22 uuf	150 uuf	150 uuf	150 uuf
C248	Rf	24 uuf	24 uuf	75 uuf	75 uuf	75 uuf
C271	Rf	24 uuf	24 uuf	27 uuf	27 uuf	27 uuf
C302	Rf	24 uuf	24 uuf	27 uuf	27 uuf	27 uuf
C249	Rf	56 uuf	56 uuf	51 uuf	51 uuf	51 uuf
C279	Rf	56 uuf	56 uuf	180 uuf	180 uuf	180 uuf
C303	Rf	56 uuf	56 uuf	51 uuf	51 uuf	51 uuf
C274	Rf	510 uuf	510 uuf	330 uf	330 uuf	330 uuf
C289	Rf	68uuf	68uuf	39 uuf	39 uuf	39 uuf
R203	Rf	100 ohms	100 ohms	220 ohms	220 ohms	220 ohms
C221B connected between	Rf	Terminals 3 and 5 of T206	Terminals 3 and 5 of T206	Terminals 3 and 5 of T206	Terminals 3 and 5 of T206	Terminals 3 and 5 of T206
C242	Rf	Not used	Not used	24 uuf	24 uuf	24 uuf
C343	Rf	Not used	Not used	Not used	2,000 uuf	2,000 uuf
C344	Rf	Not used	Not used	Not used	Not used	5,000 uuf
R635	Af	Not used	27 ohms	27 ohms	27 ohms	27 ohms
C612	Af	Not used	Not used	8 uf	8 uf	8 uf

Section II. THEORY OF RADIO RECEIVER R-390/URR

3. Block Diagram

(fig. 56)

Radio Receiver R-390/URR provides for the reception of voice, continuous wave (cw), single-sideband (ssb), and frequency-shift signals over a frequency range of 0.5 to 32 megacycles (mc). The receiver is a super-heterodyne of the multiple-conversion type. Triple conversion is used for the lower frequencies (0.5 to 8 mc), and double conversion is used for the higher frequencies (8 to 32 me). The block diagram shows each stage from antenna input to audio frequency (af) and intermediate frequency (if.) output. A schematic diagram (fig. 74) shows details of the circuits in the same order.

a. Antenna Circuits. Radio frequency signals are fed to the receiver from either a balanced or unbalanced antenna. If the balanced antenna input is used, the rf signals pass through one of several antenna transformers (selection of which is determined by the operating frequency of the receiver) and are fed to first rf amplifier V201. If the unbalanced antenna input is used, the signals are capacitor-coupled to the secondary of the antenna transformers and are applied to first rf amplifier V201. Antenna relay K101 grounds the antenna input for break-in operation, during calibration and standby operation.

b. Calibration Oscillator V901A, Multivibrator V902, and Buffer Amplifier V901B. This circuit supplies a signal at every 100-kilocycle (kc) point within the frequency range of the receiver. The signal for synchronizing multi vibrator stage V902 at 100 kc is provided by 1,000-kc calibration-oscillator stage V901A. Buffer-amplifier stage V901B isolates the multivibrator from the loading effects of the rf circuit and increases the strength of the 100-kc harmonics. B+ voltage is fed to the calibration-oscillator circuits only when the FUNCTION switch is in the CAL position.

c. Rf Amplifiers. The output of first rf amplifier V201 is coupled to second rf amplifier V202. The gain of the first and second rf amplifiers is controlled manually by the RF GAIN control and automatically by the automatic gain control (age) voltage. The output of the second rf amplifier (0.5 to 32 mc) is fed to either the first or second mixer (V203 and V204), depending on the MEGACYCLE CHANGE control setting.

d. Mixers.

(1) First mixer V203 receives heterodyning signals from the second rf amplifier and, in the range of 0.5 to 8 me, from first crystal oscillator V401. A variable if. signal is produced which has a range of 9 to 18 me.

(2) (2)Second mixer V204 heterodynes the first variable if. signals ((1) above) and those in the range from 8 to 32 me from second crystal oscillator V402. The range of the second if. is from 3 to 2 me. This frequency decreases as the input signal frequency increases.

(3) Third mixer V205 heterodynes the second variable if. signals ((2) above) and those in the range from 3.455 to 2.455 from variable frequency oscillator (vfo) V701. The resulting fixed if. output is always 455 kc.

e. If Amplifiers. The 455-kc output signal from the third mixer is applied to first if amplifier V501 either directly or through crystal filter Z501, depending on the bandwidth desired. For the 0.1- and 1-kc narrow bandpass positions, the crystal filter is used. Four additional degrees of selectivity that do not use the crystal filter are accomplished in the if. stages by the BANDWIDTH switch which varies the coupling between the primary and secondary circuits of the if. transformers. The if. amplifier consists of six stages, V501 through V506, which, with associated transformers, provide the required bandpass. The 455-kc output of V505 is applied to sixth if. amplifier V506, age amplifier V509, and cathode follower V511B. The output signal from the sixth if. amplifier is demodulated in detector circuit V507A. Provision is made on the rear panel for connecting an external diode load.

f. Age Circuit. With the FUNCTION switch set to AGC, the gain of rf amplifiers V201 and V202 and if. amplifiers V501 and V505 is automatically controlled by age rectifier V510A, which receives its signal from agc amplifier V509. The response rate of the age circuits can be controlled by a three-position front-panel control which changes the time constant through tube V511B. For manual gain control (mgc) operation, the age bus is grounded by the FUNCTION switch.

g. Cathode Follower. Stage V511B provides a low-impedance connection (50 ohms) from the output of the fifth if. stage for use when the receiver is used for operation of frequency-shift teletypewriter or single-sideband converters.

h. Beat-Frequency Oscillator. For reception of radiotelegraph (cw) signals and calibration signals, beat-frequency oscillator (bfo) V508 provides a signal in the frequency range of 452 to 458 kc. The 455-kc if. output signal from the sixth if. amplifier is mixed with the bfo signal to produce an audible beet note in the detector output. The pitch of the beat note can be varied by a front-panel control. For receiving ssb signals, the bfo is used to replace the carrier that was suppressed at the transmitter.

i. Detector. The detector demodulates the 455-kc signal for the reception of voice and tone-modulated signals. For receiving cw signals, it heterodynes the 455-kc carrier signal and the output of the bfo to produce audible tones.

j. Negative- an Positive-Peak Limiters. The limiter circuits reduce noise in the receiver output. A front-panel control disables the limiter or provides different degrees of limiting. The negative-peak limiter is V507B; the positive-peak limiter is V510B.

k. Af Amplifiers. The output of the limiters is coupled to af amplifier V601, which amplifies the audio input and supplies audio signals to the local and line af amplifiers. The local af amplifier stages, V602A and V603, supply audio power to drive the headset and the loudspeaker. The line af amplifier stages, V602B and V604, supply audio power to a balanced line for remote listening. The inputs to these audio amplifiers are shorted to ground by squelch relay K601 (*l* below) and break-in relay K602 (m below) when these relays are actuated.

l. Squelch Circuit. With the FUNCTION switch set to SQUELCH, a signal is fed to squelch tube V601B from detector V507A. The output of the squelch tube varies in proportion to the average signal level. When the signal drops below a level predetermined by the RF GAIN control setting, squelch relay