Collins 51J2

The 51J and its military counterpart, the R-390, were by far the finest receivers ever built and their revolutionary architecture inspired new designs of high-end receivers well into the solid-state age.

In the late ‘940s Collins introduced two receivers, the ham-band 75A and soon later the general coverage 51J. Both diverted considerably from the known architecture used at the time, a single conversion superheterodyne with one or two tuned RF stages, to grant good image frequency rejection, and up to three or even four IF stages to grant the wanted selectivity. The 51J was a double/triple conversion superheterodyne, depending upon the band. It used crystal-controlled first and second oscillators, the last oscillator in the conversion chain being the variable one. The variable oscillator, the so-called PTO, Permeability Tuned Oscillator, was a masterpiece of ingenuity and craftsmanship granting linearity and accuracy, up to then even hard to imagine, over its entire frequency coverage. 51J had 1.000 divisions for each 1MHz band. For the first time the operator could set the dial pointer at the frequency of the emitter and listen.

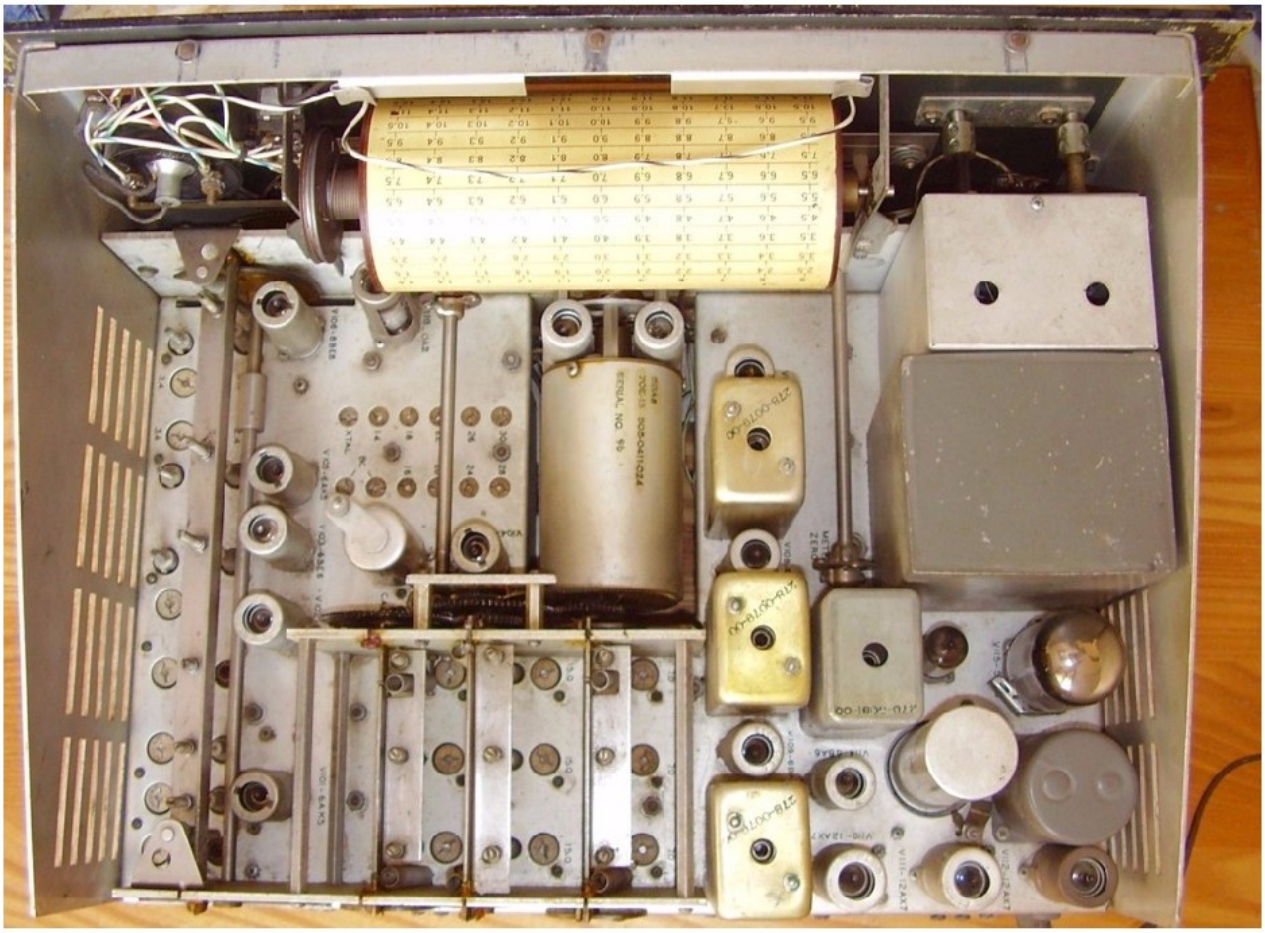
The 70E **PTO** was the heart of the 51J, covering from 2.0 to 3.0 MHz in exactly ten shaft revolutions. The resonating components were mounted inside a factory sealed enclosure, filled with dry atmosphere. The tuning shaft had a twin screw thread, to smoothly advance the iron-powder core inside the tuning coil through an anti-backlash nut. The coil wire was wound according to a logarithmic helix and the core advance was accurately controlled by a factory-adjusted linear cam, to get absolutely linear frequency variation through the full range. Nevertheless Collins had to solve a lot of problems to obtain a general coverage receiver and had to accept some compromises to contain the complexity and the cost of its otherwise revolutionary equipment. The receiver had 30 bands, all permeability tuned for the greatest stability, 1 MHz each, from 0,5 to 30,5 MHz. Each band was covered in exactly ten turns of the PTO tuning shaft. The same shaft had to move the tables with the tuning slugs of the RF and of the variable IF circuits. To save on costs, only ten crystals were used to cover 30 bands. The band switch had to select the proper crystal and the associated local oscillator circuits, tuned to the fundamental or to one of the harmonics, depending upon the band. The megacycle shaft switched the tuning capacitors for the IF stages and, through a mechanical differential, moved the table with the IF tuning coils slugs to their proper position, according to the selected band. The megacycle shaft also selected the upper linear tuning scale graduated with 100KHz divisions. The lower circular tuning scale, with its 1KHz divisions referred to the adjustable hairline cursor, was driven by the PTO shaft. A 100 KHz crystal calibrator was used to check the dial calibration of the kilocycle scale and adjust the tilt of the hairline cursor.

The conversion scheme varied with the selected band. In the first band, 0.5 to 1.5 MHz, triple conversion was used: the input signal was first mixed with the third harmonic of a 4 MHz xtal oscillator, then mixed with the second harmonic of the same oscillator to have the second variable IF between 3.5 and 2.5 MHz. A single conversion scheme was used in the second band, 1.5 to 2.5 MHz, and in the third one, 2.5 to 3.5 MHz. All other bands used a double conversion architecture. The fixed IF frequency was 500 KHz. Diagrams of the conversion scheme and of the complex tuning mechanism are given in the appendices below.

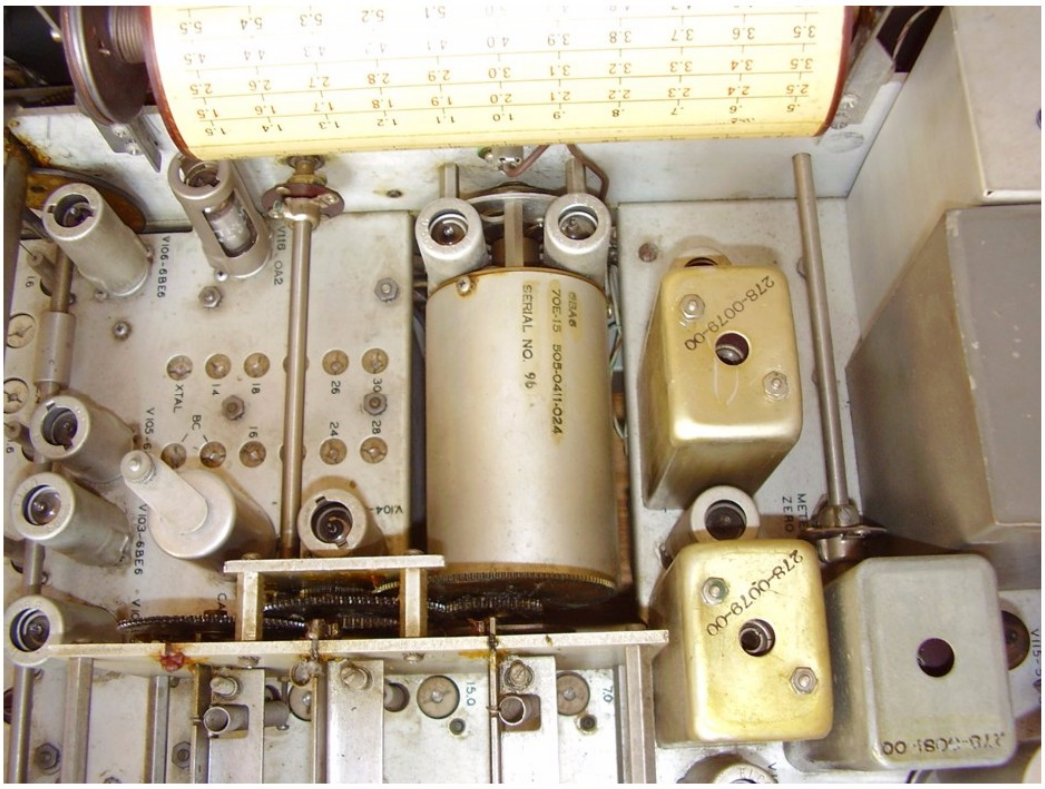
Overall frequency stability was granted within 2 KHz in the range from -20°C up to +60°C. Below also an ad of the 51J receiver family from Electronics, February 1953.

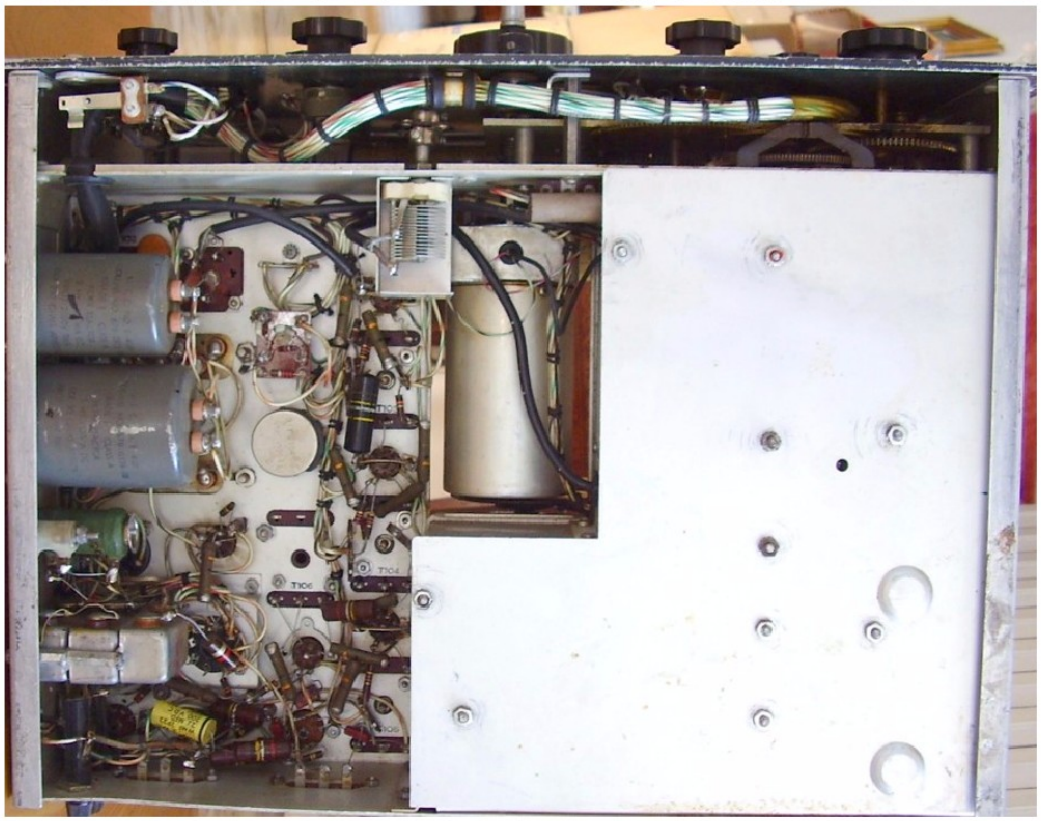
Collins 51J2





- Top, the photo of the front panel of the receiver. The band change knob selects the proper dial in the upper window. Bottom picture gives an internal view of the receiver. On the left there is the variable IF tuning table. In the middle, from the top, the band scale drum, the crystal oscillator including the crystal calibrator, the sealed PTO and the RF tuning table. On the right the IF stages, the BFO, the AF amplifier and the power supply. The aluminum box just over the power transformer contains the crystal filter and its phasing capacitor.





- Close-up view of the 70E-15 PTO and bottom view of the chassis. The large shielding plate covers the RF and the variable IF coils.

Appendices

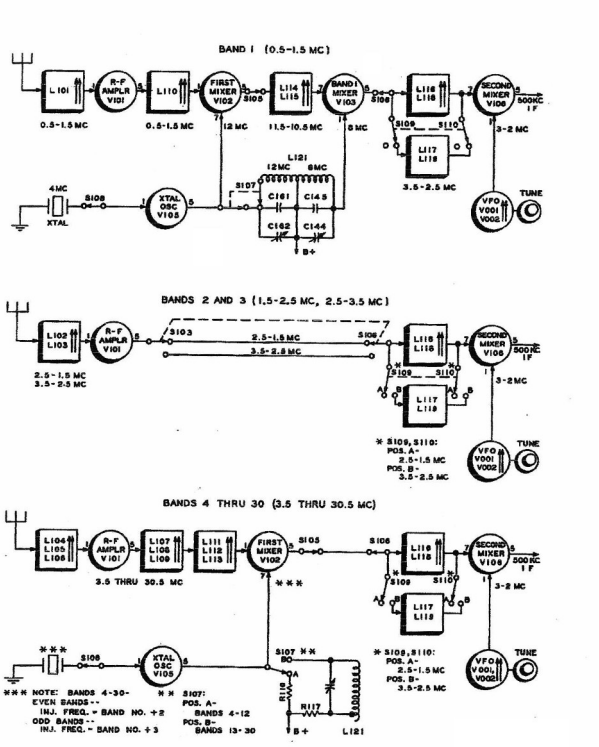


Figure 4-3 Frequency Conversion Circuits

- Frequency conversion diagrams.

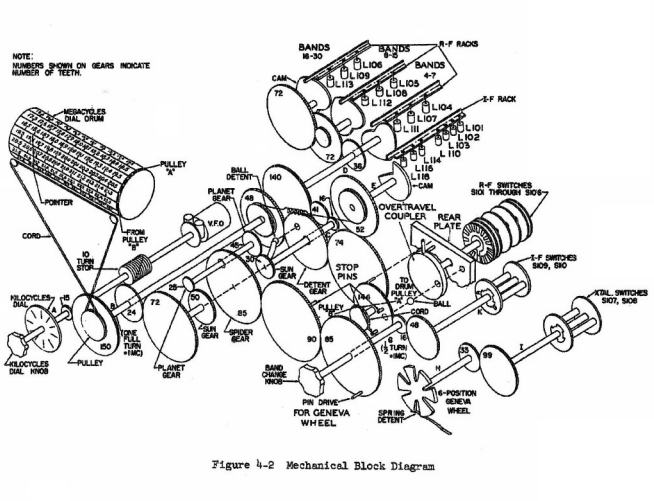


Figure 4-2 Mechanical Block Diagram

- Diagram of tuning mechanism

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CONDENSED SPECIFICATIONS

FREQUENCY RANGE:
.54 to 30.5 megacycles.

TYPE OF CIRCUIT:
Double Conversion Superheterodyne.

CALIBRATION:
Direct reading in megacycles and kilocycles. One turn of main tuning dial covers 100 kilocycles on all bands.

TUNING:
Linear, divided into 30—one mc bands.

FREQUENCY STABILITY:
Overall stability within 1 kc under normal operating conditions.

SELECTIVITY:
5.5 to 6.5 kilocycles wide at 6 db down. 17 to 20 kilocycles wide at 60 db down.

AUDIO OUTPUT:
4 and 600 ohms impedance. 1 1/2 watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.

RF INPUT:
High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.

POWER REQUIREMENTS:
85 watts 45/70 cps, 115 volts or 230 volts by reconnection on power transformer.

DIMENSIONS:
Panel — 10 1/2 inches high, 19 inches wide, notched for rack mounting. Optional metal cabinet — 21 1/8 inches wide, 12 1/4 inches high and 13 1/8 inches deep. Speaker available in metal cabinet 15 inches wide, 10 5/8 inches high and 9 1/8 inches deep.

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