COLLINS

51J-3 COMMUNICATIONS RECEIVER

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The Collins 51J-3 communications receiver provides outstanding general performance combined with a long sought-for feature — accurate linear calibration with overall stability approaching that of a crystal. The tuning range, .540 to 30.5 megacycles, is divided into 30 one-megacycle bands selected by a "megacycle" knob and indicated by a slide rule dial having graduations at one-tenth-megacycle intervals. The main tuning control covers each of these megacycle ranges with a dial calibrated at *one-kilocycle* intervals. The frequency stability of the receiver is consistent with this finely divided calibration even at the highest frequencies.

The accuracy and stability of the 51J-3 receiver make it suitable for many communication applications where it is desired to receive known frequencies without searching or frequent readjustment. Thus it is possible to use the 51J-3 receiver to replace or to supplement fixed tuned crystal controlled receivers or to afford the advantages of crystal control in services where it is impractical

to employ separate crystals for a large number of frequencies. The high stability is of great advantage in FSK service.

A second important field of usefulness for this receiver is in laboratory work where it may be employed as a sensitive and accurate measuring instrument and as a spectrum analyser.

The unusual tuning and stability features of the 51J-3 receiver are obtained without resort to complicated gadgetry and without increasing the number of circuit components over that required in more conventional designs. Double conversion is employed, with the first i-f permeability tuned over a one-megacycle range. A total of ten crystals provide stable first injection frequencies for each of the 30 one-megacycle bands. A highly stable, sealed, permeability tuned oscillator operating in the range 2 - 3 megacycles provides the second injection frequency. Only six sets of linearly permeability tuned circuits are required to cover the entire signal frequency range .540 to 30.5 megacycles and a simple mechanical drive system is arranged to subdivide this range into 30 one-megacycle bands.

It has been possible in the design of the 51J-3 to achieve performance as regards sensitivity, noise figure, selectivity, suppression of spurious responses

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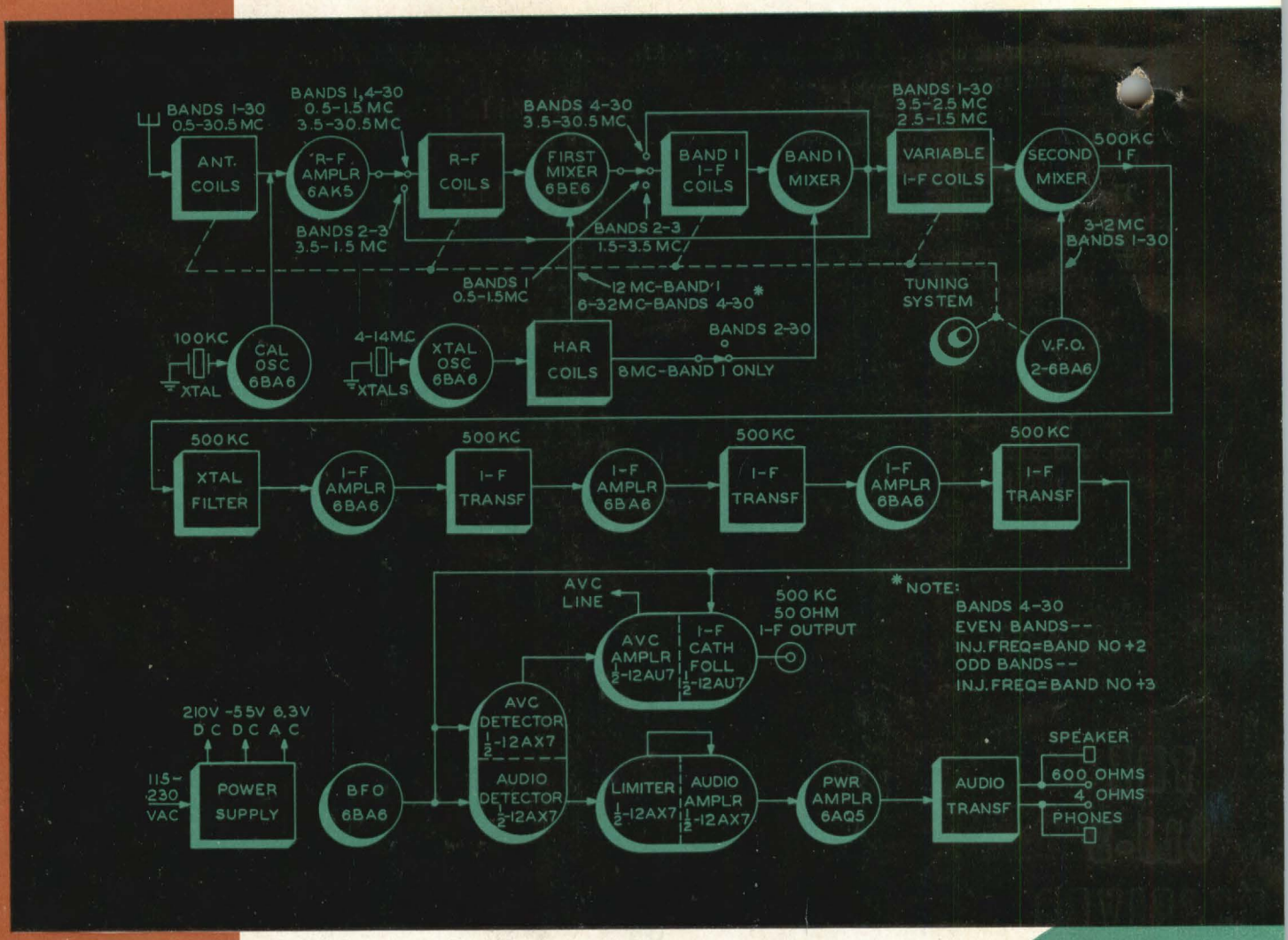


This block diagram shows th frequency system of the 51J- receiver. A total of 10 crysta are used to provide stabilizatio of the first conversion oscillato

and cross modulation equal to that obtained in the best more conventional designs not having the 51J-3's special tuning and stability features. Full advantage is taken of the inherent superiority of double conversion.

The first injection oscillator, which has the greatest effect in controlling the frequency of the 51J-3 receiver, employs crystals having an accuracy of approximately .002 per cent. The tuned oscillator, second i-f amplifier, and bfo, which are of secondary importance in determining the frequency by reason of their lower frequencies, are designed for high stability under varying conditions

Typical selectivity, noise and sensitivity data for the 51J-3 receiver.

of temperature, humidity and vibration. The combined effects of all parts of the circuit result in a total setting error and drift of less than one kilocycle under normal conditions of operation and a maximum error of less than two kilocycles under extremes of test conditions. These figures apply to the entire tuning range of the receiver.

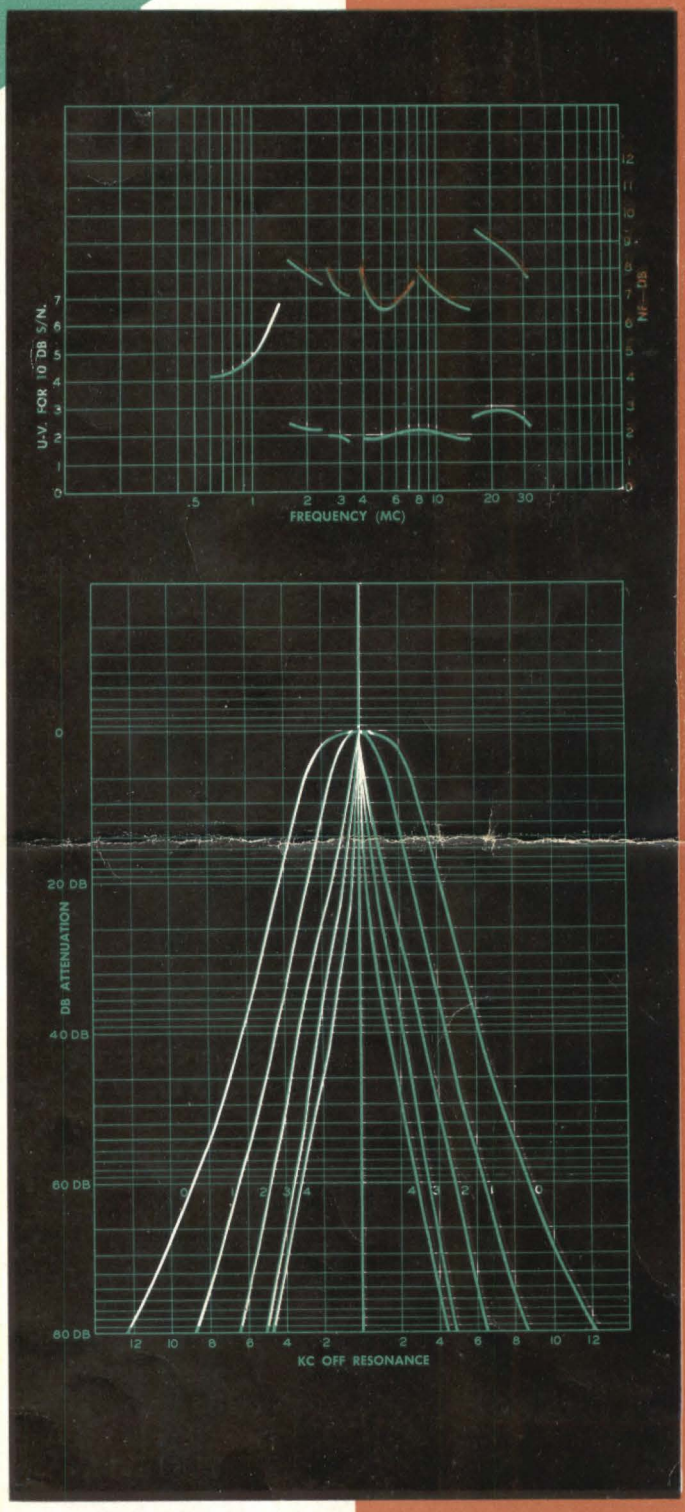
The inherent stability of the receiver is supplemented by a built-in 100 kc crystal calibration oscillator which may be adjusted for zero beat against standard frequency transmission from WWV. Thus, precision crystal check points are available at each one-tenth-megacycle interval throughout the tuning range of the receiver and a correcting knob is provided to permit the dial fiducial mark to be set to agree with the nearest check point. Interpolation accuracy between check points is of the order of 200 cycles.

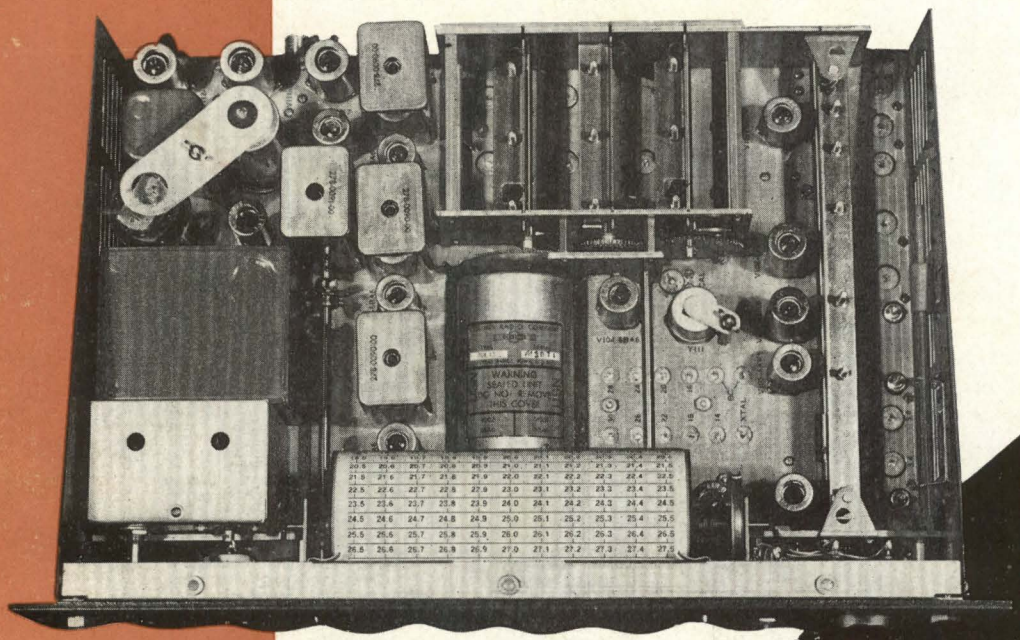
In addition to the innovations in the tuning and frequency control portions of the design, the 51J-3 receiver incorporates advanced circuitry in other respects important in a communications receiver.

An effective AVC is incorporated in the 51J-3. By use of d-c amplification of the AVC the audio output is held constant within 5 db over signal input ranges of 5 mv to 100,000 mv. The use of amplified AVC also allows the use of a low impedance AVC line which makes possible extremely quick recovery from strong signal or static overloads. The AVC also has an extremely short time constant and as a result of these features it is possible to use breakin operation with a nearby transmitter. An effective series diode noise limiter is incorporated. This limiter clips noise at a level equivalent to 30% modulation. A switch is provided on the front panel to remove the noise limiter from the circuit if desired.

The following controls are located on the front panel:

R-f gain	Crystal selectivity
Audio gain	Crystal phasing
BFO on-off	Power off-on-standby
Calibrator on-off	Megacycle tuning
BFO pitch	(bandswitch)
AVC on-off	Main tuning
Noise limiter on-off	Fiducial corrector
Meter switch	Ant. trim





A top chassis view of the 51J-3 with the dust shield removed. The sealed tunable oscillator is visible at the center of the chassis.

Screwdriver adjustments for calibrator crystal frequency, S meter sensitivity and S meter zeroing are located on the chassis.

Permeability tuning is used throughout the r-f stages of the receiver allowing a fairly constant L/C ratio over the entire range. This, in conjunction with a 6AK5 r-f amplifier tube, gives excellent sensitivity and signal-to-noise ratio. Since only 13 coils are needed to cover the tuning range of the receiver, tracking is extremely simple. Only 26 adjustments are necessary to completely align and track the r-f circuits, fewer than are required for most conventional receivers of equivalent coverage. The use of a high frequency first i-f together with three tuned circuits in the r-f portion of the receiver gives excellent image response performance. Images are down more than 50 db throughout the entire tuning range. Care has also been taken to apportion gain throughout, resulting in extremely good cross modulation and strong signal performance.

The last i-f, operating at 500 kc, uses three double tuned transformers result-

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ing in excellent skirt selectivity. An effective crystal filter is also provided to give additional selectivity when required.

A headphone jack is provided on the front panel with the four ohm speaker output disconnected when the head phones are used. In addition to the speaker terminals a 500 ohm audio output, 300 ohm r-f input, and terminals for standby operation are provided on the rear of the chassis. Spare terminals are provided to allow other functions to be brought out as required for special applications. A heavy duty a-c power cord extends from the rear of the chassis.

The 51J-3 is constructed in a standard panel and shelf assembly suitable for mounting in a standard rack cabinet. Overall dimensions are 19 inches panel width, 10½ inches panel height, and 13 inches depth behind the panel. Damage from dust and other foreign matter is prevented by a dust cover which fits over the top of the chassis. Optionally the 51J-3 can be supplied in a table mounting cabinet with separate speaker.

Accessory items such as racks, panel mounted speakers, and diversity combining panels are also available.

The 51J-3 also available in a cabinet model for table mounting, together with matching speaker.

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51J-3 RECEIVER
CONDENSED SPECIFICATIONS

FREQUENCY RANGE: .54 to 30.5 megacycles.
TYPE OF RECEPTION: AM, CW, MCW and FSK.
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.
SENSITIVITY: 5 microvolts or less for 10 db sig/noise ratio and 500 mw output into 600 ohms, except band 1 (.54 to 1.5 mc) 15 microvolts or less.
SELECTIVITY: 5.5 to 6.5 kilocycles wide at 6 db down.
17 to 20 kilocycles wide at 60 db down.
IMAGE RESPONSES: .54 to 7 mc –90 db or more.
7 to 14 mc –70 db or more.
14 to 30.5 mc –40 db or more.
AUTOMATIC GAIN CONTROL: Not more than 3.5 db increase in audio power output with increase in RF input signal from 5 to 100,000 microvolts.
INPUT-OUTPUT METER: Input calibrated in db above AVC threshold.
Output calibrated –10 db to +6 db (6 mw ref. level)
LIMITER: Improved series diode type.
AUDIO OUTPUT: 4 and 600 ohms impedance. 1½ watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.
AUDIO FREQUENCY RESPONSE: (Overall) 200 cps less than 3 db down.
2500 cps less than 7 db down.
RF INPUT: High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.
CLIMATIC CONDITIONS: –20 to +60 deg C — up to 95% relative humidity.
POWER REQUIREMENTS: 85 watts 45/70 cps, 115 volts or 230 volts by reconnection on power transformer.
DIMENSIONS: Panel—10½ inches high, 19 inches wide, notched for rack mounting. Optional metal cabinet—21⅛ inches wide, 12¼ inches high and 13⅛ inches deep. Speaker available in metal cabinet 15 inches wide, 10⅝ inches high and 9⅛ inches deep.
WEIGHTS: Receiver—35 pounds, cabinet—20 pounds.
Speaker and cabinet—12½ pounds.

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