Collins

INSTRUCTION BOOK

COMMUNICATIONS RECEIVER

51J-4

COLLINS RADIO COMPANY

GUARANTEE

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory, transportation prepaid, provided

(a) Notice of the claimed defect is given Collins within one (1) year from date of delivery and goods are returned in accordance with Collins' instructions.

(b) Equipment, accessories, tubes, and batteries not manufactured by Collins or from Collins' designs are subject to only such adjustments as Collins may obtain from the supplier thereof.

(c) No equipment or accessory shall be deemed to be defective if, due to exposure or excessive moisture in the atmosphere or otherwise after delivery, it shall fail to operate in a normal or proper manner.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins or its authorized service center.

No other warranties, expressed or implied, shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any other cause.

HOW TO RETURN MATERIAL OR EQUIPMENT. If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Type number, name, and serial number of equipment
(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins' number (and name) of unit sub-assemblies involved in trouble
(J) Remarks

HOW TO ORDER REPLACEMENT PARTS. When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Quantity required
(B) Collins' part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins' type number, name, and serial number of principal equipment
(E) Unit sub-assembly number (where applicable)

CUSTOMER PUBLICATIONS SERVICE

This Instruction Book contains all essential information for the installation, operation and maintenance of your Collins Radio Equipment.

Collins' Research and Development and Manufacturing Divisions have designed and built equipment of the highest possible quality for your use. Many pieces of information have been assembled by the Publications Engineering Department; this book has also been tested against a similar quality standard.

With these production goals achieved, it would be easy to regard all tasks as completed.

Collins Radio does not do so. Engineers, in the laboratories and the field, are continuing to explore every possible step that may add a detail of perfection to your equipment. Production experts are constantly seeking improved manufacturing methods.

You may also have ideas about new applications and improvements in your equipment. Collins Radio will be happy to hear them.

Our own advanced development and your suggestions may well result in new or additional information for this book.

Collins Radio wishes to pass such information to you as quickly as possible. This book has been published in loose-leaf form, so that it may be kept up to date by the addition of pages, or by substitution of revised pages.

To make certain that you receive all additional or revised pages for this Instruction Book, please tear out and return the post card. It is important that we know:

- ☆ **Your Name and Address**
- ☆ **The Type Number and Serial Number of your equipment**

CUSTOMER PUBLICATIONS SERVICE REGISTRATION CARD

Date .....

COLLINS

We have purchased the following unit(s) of Collins Radio Equipment:

Type Number .....

Date Purchased ..... Serial Number .....

We request that you register our ownership of this equipment, and provide Customer Publications Service.

Owner's Name .....

Address .....

BE SURE TO SUPPLY ALL EQUIPMENT SERIAL NUMBERS. THANK YOU.

Postage
Will Be Paid
by
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No
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Necessary
If Mailed in the
United States

BUSINESS REPLY CARD

FIRST CLASS PERMIT No. 236 CEDAR RAPIDS, IOWA

COLLINS RADIO COMPANY

Cedar Rapids, Iowa

INSTRUCTION BOOK

COMMUNICATIONS RECEIVER

51J-4

CEDAR RAPIDS, IOWA, U.S.A.

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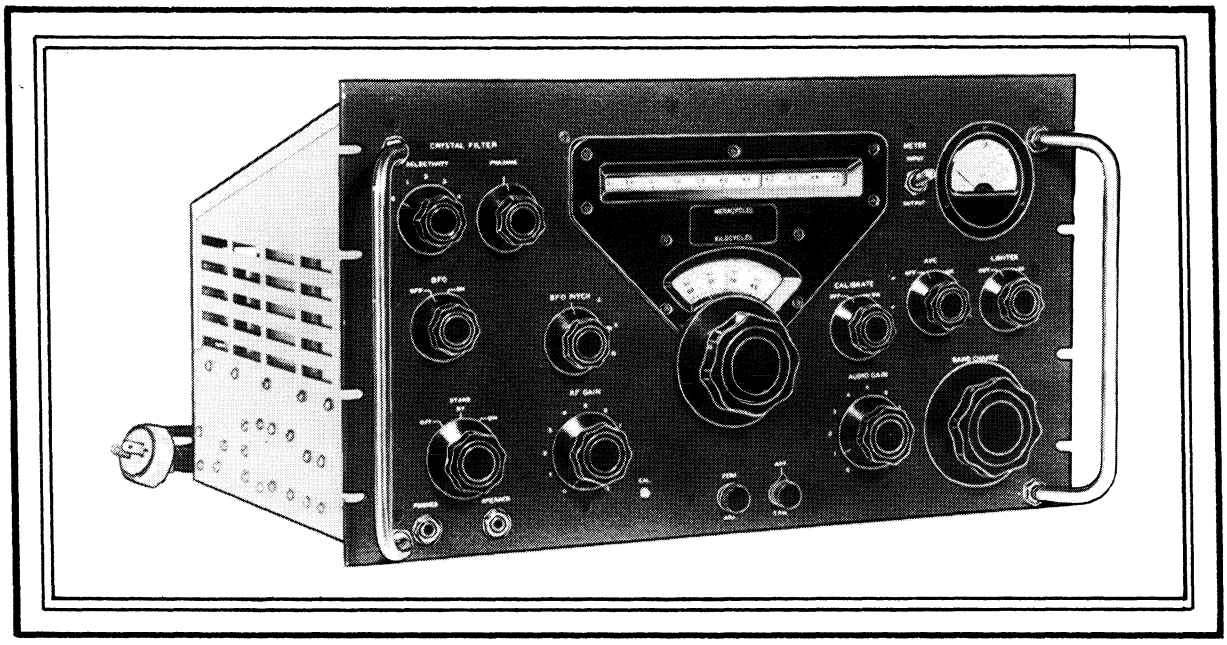

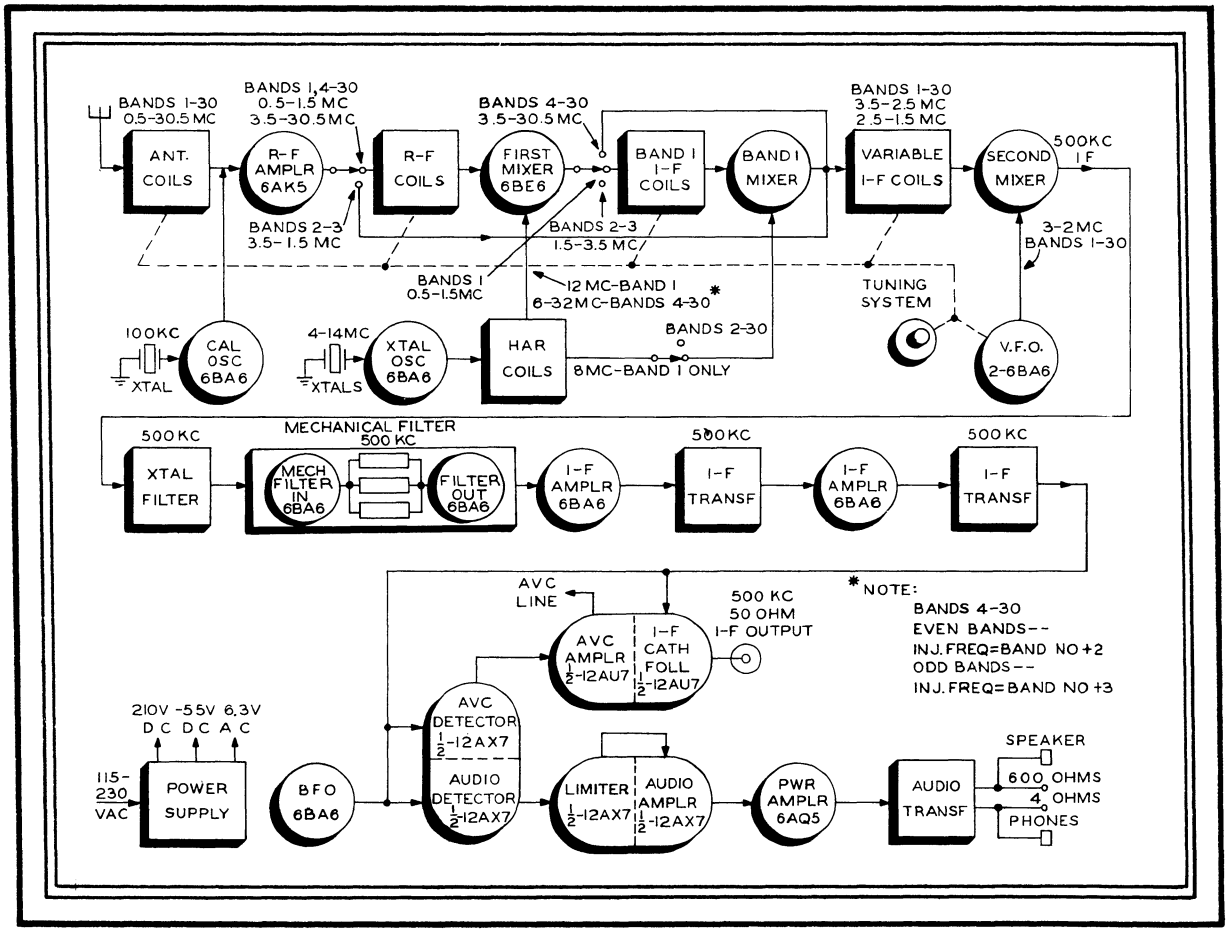

Figure 1-1. 51J-4 Receiver, Front View and Block Diagram

SECTION I
GENERAL DESCRIPTION

1.1. GENERAL.

1.1.1. PURPOSE OF BOOK. - This instruction book has been prepared to assist in the installation, operation and maintenance of the Collins Model 51J Radio Communications Receiver.

1.1.2. PURPOSE OF EQUIPMENT. - Collins 51J-4 Receiver is designed for communication applications where stability and dial accuracy of the highest order are the prime requisites. Under normal operating conditions, the receiver operates in the range of 540 kc to 30.5 mc with a total setting error and drift of less than 1 kc at any frequency within its range. The receiver is designed for amplitude-modulated and continuous wave reception, although its accuracy and stability make it suitable for many applications where it is desired to receive or set definite frequencies without searching or making frequent adjustments. This receiver incorporates the new mechanical filter in the intermediate frequency range to obtain the desirable rectangular-shaped passband.

1.1.3. DESCRIPTION.

(a) MECHANICAL. - The 51J-4 Receiver is available in two styles. One is a panel and shelf assembly suitable for mounting in a standard rack cabinet. Over-all panel dimensions are: width, 19 inches; height, 10-1/2 inches; and depth behind panel, 13-1/2 inches. A dust cover that fits over the top of the chassis is removable from the rear. The other assembly is in a cabinet suitable for table-mounting. Outside cabinet dimensions are: width, 21-1/8 inches; height, 12-3/8 inches and depth, 13-1/8 inches. Available on special order is a speaker that matches this cabinet. The speaker's dimensions are: width, 13 inches; height, 11 inches; depth, 7 inches. The speaker, the cabinet of the table-mounting assembly, and the front panel of the rack-mounting receiver are finished in St. James Gray wrinkle.

The following controls are located on the front panel:

R-F GAIN	CRYSTAL FILTER PHASING
AUDIO GAIN	OFF-ON-STANDBY
BFO ON-OFF	MEGACYCLE TUNING (BAND SWITCH)
CALIBRATE ON-OFF	KILOCYCLE TUNING
BFO PITCH	ZERO ADJ
AVC ON-OFF	METER OUTPUT-INPUT
LIMITER OUT-IN	CAL (100 K-C ADJUSTMENTS)
ANT. TRIM	FILTER SELECTOR
CRYSTAL FILTER SELECTIVITY	

The operating range of 540 kc to 30.5 mc is covered by 30 one-megacycle bands that are selected by the band switch knob and indicated by a slide rule dial having graduations of one-tenth megacycle (100-kc) intervals. The main tuning control covers each of these megacycle ranges with 10 turns of a 100 division dial calibrated at one-kilocycle intervals. The receiver's frequency stability is consistent with this finely divided calibration even at the highest frequencies.

A four-ohm headphone jack and a 600-ohm speaker jack are provided on the front panel. The antenna connector, 50-ohm i-f output connector, breakin relay terminals and four-ohm and 600-ohm audio output terminals are provided on the rear. A heavy duty a-c power cord extends from the rear of the chassis.

(b) ELECTRICAL. - When advantageous, the Model 51J-4 Communications Receiver uses single, double, or triple conversion in tuning the entire frequency spectrum of 540 kc to 30.5 mc. Nineteen tubes, three of which are dual, are employed in the receiver. With the exception of the rectifier tube, all are of the miniature type.

The receiver r-f circuits tune from .5 to 30.5 mc, thus Band 1 is referred to as covering the range .5 to 1.5 mc. However, the lower end of the operating range is considered to be 540 kc rather than 500 kc because of the questionable operation in the extreme low end of the band where frequencies approach the receiver i-f frequency of 500 kc. Limited operation at the extreme low end is possible with somewhat reduced performance.

The frequency range of the 51J-4 Receiver, .5 to 30.5 mc, is divided into 30 one-megacycle bands by a system of switches and coils which form the r-f amplifier and first mixer circuits. Band changing consists of moving powdered iron "slugs" into the coils in one megacycle steps until inductance limits of the coils are reached, then changing coils and repeating. Injection voltage for the first mixer is obtained from the fundamental or harmonic output of an oscillator, the frequency of which is controlled

by one of ten quartz crystals selected by the MEGACYCLE band switch. The main tuning control is a vernier dial calibrated in 100 one-kilocycle divisions. This control operates through a differential mechanism to move the band change "slugs" in the coils enough to cover the range between the one-megacycle band change steps. Thus the Band Switch selects coils and crystals and also roughly positions the tuning slugs. At the same time one of the two ranges (1.5 to 2.5 mc or 2.5 to 3.5 mc) of the variable i-f channel is selected and tuned along with the r-f coils.

The crystal frequencies for the first mixer injection are so chosen that the frequency produced by the first mixer will always fall in the 1.5 to 2.5 mc or 2.5 to 3.5 mc range of the variable i-f channel.

Exceptions to the operation just described are bands 1, 2, and 3. Band 1 (.5 to 1.5 mc) uses an intermediate mixer between the first mixer and the variable i-f coils. This mixer accepts frequencies in the range 10.5 to 11.5 mc from the first mixer. A 12-mc signal developed by the crystal controlled oscillator is applied to the first mixer to determine these frequencies. The crystal controlled oscillator also applies an 8-mc voltage to the intermediate frequency mixer to produce a signal within the range of the variable frequency i-f coils which tune the 2.5 to 3.5 mc spectrum. Bands 2 and 3, which cover 1.5 to 2.5 mc and 2.5 to 3.5 mc respectively, are identical in span to each band of the variable i-f coils and thus feed through to the second mixer without utilizing the first mixer.

Following the variable i-f and the second mixer are the crystal filter and a four stage fixed intermediate frequency amplifier containing mechanical filters. Conversion to the fixed i-f of 500 kc is accomplished by injecting a 2 to 3 mc signal from a Collins 70E-15 oscillator to produce a difference of 500 kc from the frequency existing in either band of the variable i-f amplifier. Tuning of the 70E-15 oscillator is done by the "kilocycle" tuning control in step with all other circuits.

Stability of the 70E-15 oscillator is assured by temperature-compensated components operating in a sealed and moisture-proof housing.

Separate rectifiers are used to produce automatic volume control and audio voltages. D-c amplification of the automatic volume control voltage is provided to obtain essentially uniform input to the detector. Audio power output is held within 3.5 db over signal input voltage ranges of five to 125,000 microvolts at the antenna terminals. A series type noise limiter clips modulation at 50-85 percent. This allows good reception in the presence of strong noise pulses.

1.1.4 EQUIPMENT SUPPLIED. - The following table lists the equipment supplied.

TYPE	DESCRIPTION	COLLINS PART NUMBER
51J-4	Radio receiver complete with tubes, dust cover for rack mounting, and one mechanical filter to be selected from list below.	522 0144 096
	OR	
51J-4	Radio receiver mounted in cabinet complete with tubes, dust cover, and one mechanical filter to be selected from list below.	522 0144 086
	Instruction Book for 51J-4	520 5014 00

1.1.5 ACCESSORIES AVAILABLE. -The following table lists the accessory equipment available for the 51J-4.

TYPE	DESCRIPTION	COLLINS PART NUMBER
270G-3	Matching speaker (desk mounted)	522 0149 00
271B-3	Dual speaker (rack mounted) Panel space required is 7 inches.	522 8123 004
271B-4	Single speaker (rack mounted) Panel space required is 7 inches.	522 8350 002
	Cabinet for 51J-4 complete with mounting hardware.	505 5959 003
	Set of spare tubes for 51J-4	541 1619 002
F500B-14	1400 cycle plug-in filter for 51J-4	522 9030 002
F500B-31	3100 cycle plug-in filter for 51J-4	522 9008 002
F500B-60	6000 cycle plug-in filter for 51J-4	522 9009 002
	Headphones, 600 ohm	273 0003 00

1.2. VACUUM TUBE TABLE.

The following table lists the tubes employed in the ciruits just described.

SYMBOL DESIGNATION	TUBE TYPE	FUNCTION
V101	6AK5	Radio-frequency amplifier
V102	6BE6	First mixer
V103	6BE6	Band 1 mixer
V104	6BA6	Calibration oscillator
V105	6AK5	High-frequency crystal oscillator
V106	6BE6	Second mixer
V301	6BA6	First 500 kc i-f amplifier
V302	6BA6	Second 500 kc i-f amplifier
V108	6BA6	Third 500 kc i-f amplifier
V109	6BA6	Fourth 500 kc i-f amplifier
V110	12AX7	Detector and A.V.C. rectifier
V111	12AU7	A.V.C. amplifier and i-f output cathode follower
V112	12AX7	Noise limiter and first audio amplifier
V113	6AQ5	Audio power amplifier
V114	6BA6	Beat frequency oscillator
V115	5V4	Power rectifier
V116	0A2	Voltage regulator
V001	6BA6	Variable frequency oscillator
V002	6BA6	Oscillator isolation amplifier

1.3. REFERENCE DATA.

OPERATING RANGE: 540 kc to 30.5 mc
TYPE OF RECEPTION: AM, CW or MCW
CALIBRATION: Direct reading in megacycles and kilocycles
TUNING: Linear tuning with uniform bandspread
FREQUENCY STABILITY: Dial calibration at room temperature is within 300 cps if the nearest 100 kc calibration point is used to adjust the fiducial.
TEMPERATURE RANGE: -20°C to +60°C
SENSITIVITY: Band 1 - Less than 15 uv gives 1 watt with 10 db s/n
Band 2 to 30 - Less than 5 uv gives 1 watt with 10 db s/n
SELECTIVITY: A complete chart of selectivity characteristics is given in paragraph 5.3.7. of this book.
SPURIOUS FREQUENCY RESPONSE: Down at least 40 db
AUTOMATIC VOLUME CONTROL: Less than 3.5 db increase in audio power output with an increase in r-f signal from 5 to 125,000 uv
S METER: Meter calibrated in 20, 40, 60, 80, 100 db above AVC threshold and -10 to +6 db audio level with 6 mw as reference
NOISE LIMITER: Series type ahead of the first audio stage
AUDIO POWER OUTPUT: 1-1/2 watts at 1000 cps with less than 15% distortion
AUDIO FREQUENCY RESPONSE (Overall): Not more than 3 db at 200 cps and not more than 7 db at 2500 cps when 6 kc filter is used
AUDIO OUTPUT IMPEDANCE: 4 and 600 ohms
I-F OUTPUT IMPEDANCE: 50 ohms
R-F INPUT IMPEDANCE: Designed to operate into a high impedance whip or single-ended antenna
POWER REQUIREMENTS: 85 watts at 115 volts 45/70 cps. Same power required when reconnected for 230 volt 45/70 cps operation
DIMENSIONS: Panel - 10-1/2 inches high, 19 inches wide, notches for standard rack mounting
WEIGHT: 43 pounds