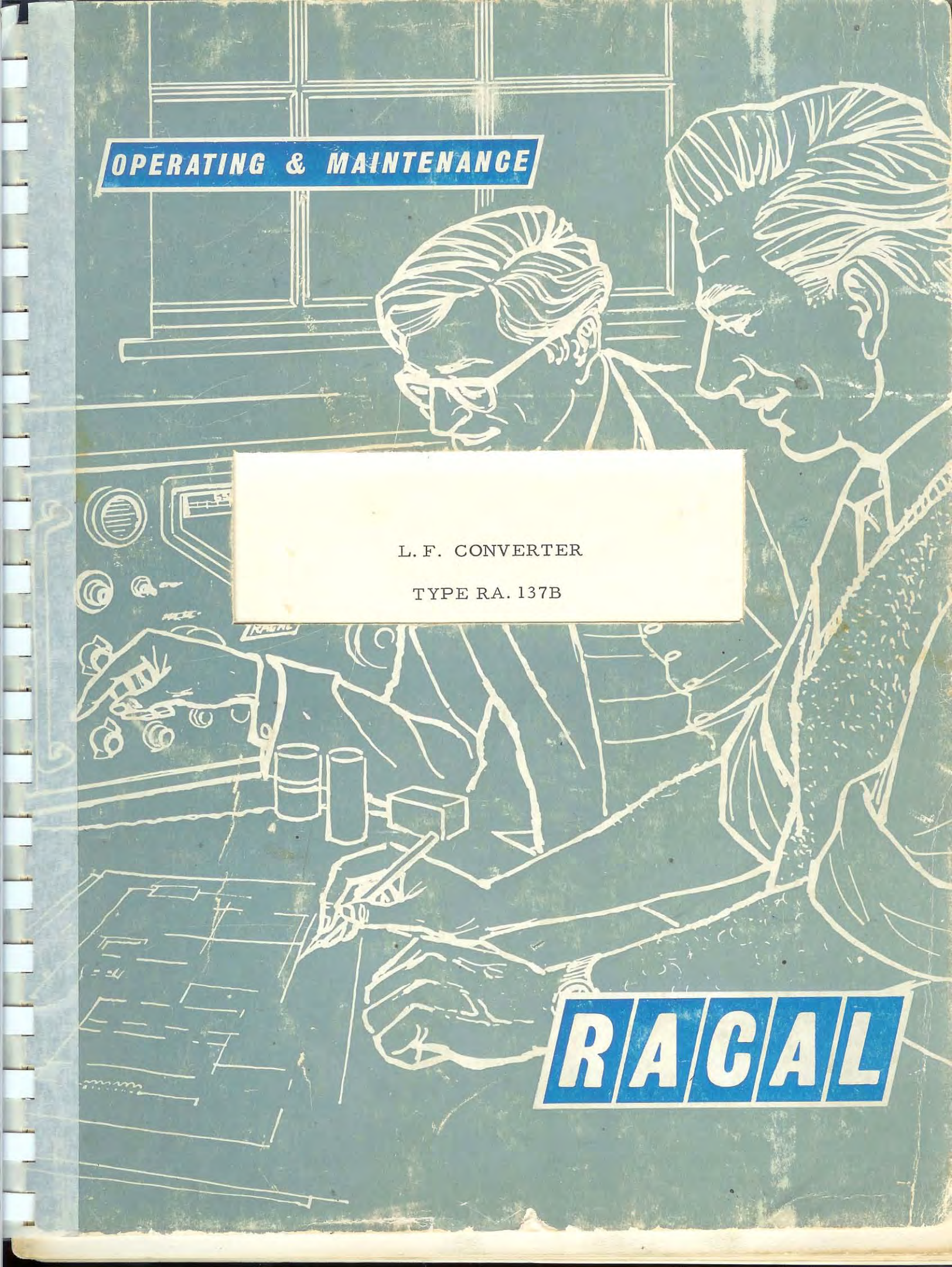


**OPERATING & MAINTENANCE**

L. F. CONVERTER

TYPE RA. 137B

**RACAL**



# **K4XL's** **BAMA**

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L. F. CONVERTER

TYPE RA. 137B

Operating and Maintenance Manual

Technical Handbooks Department

RACAL ELECTRONICS LIMITED

Western Road,  
Bracknell, Berkshire,  
England.

L.F. CONVERTER

TYPE RA. 137

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TECHNICAL SPECIFICATION

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SECTION 2	MAINTENANCE

SECTION 1  
=====

INSTALLATION AND OPERATION  
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TECHNICAL SPECIFICATION

CHAPTER 1      GENERAL DESCRIPTION

CHAPTER 2      INSTALLATION

CHAPTER 3      OPERATION

CHAPTER 4      BRIEF TECHNICAL DESCRIPTION

CHAPTER 5      DETAILED CIRCUIT DESCRIPTION

## TECHNICAL SPECIFICATION

(When used in conjunction with an RA. 17 receiver).

Frequency range: 10 to 980 kc/s.

Stability: After warm-up time of  $1\frac{1}{2}$  hours, overall drift less than 50 c/s under conditions of constant supply voltage and ambient temperature.

Input impedance:  $75\Omega$  unbalanced.

Tuning - RA. 137: 6 ranges, displayed over 6 in.

10-20 kc/s  
20-40 kc/s  
40-210 kc/s  
210-500 kc/s  
500-980 kc/s

Calibration accuracy better than 1%.

Tuning - RA. 17: Effective scale length of approximately 145 feet, i. e. about 6 inches of scale length corresponds to 100 kc/s.

Sensitivity: A1 reception, bandwidth 3 kc/s;  
 $1\mu\text{V}$  for 15dB signal-to-noise ratio.  
A2 reception, 30% modulated, bandwidth 3 kc/s;  
 $3\mu\text{V}$  for 15dB signal-to-noise ratio.

Image Response: With tuned input, external image signals are reduced by at least 100dB.

Power supply: 100-125 and 200-250 volts, 45-65 c/s.  
Power consumption 11W approximately. H. T supply from RA. 17 receiver.

Dimensions: For rack mounting:

Height	Width	Depth	
$3\frac{1}{2}$	19	13	in.
9	48.25	33	cm.

Cabinet containing RA. 17 and RA. 137.

Height	Width	Depth	
16	$20\frac{1}{2}$	22	in.
40.6	52	55.6	cm.

Weight:

Rack mounted 13 lb. (6 kg.).

In cabinet with RA. 17, 110 lb. (50 kg.).

CHAPTER 1

GENERAL DESCRIPTION

CONTENTS

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## CHAPTER 1

### GENERAL DESCRIPTION

#### Introduction

1. The L. F. Converter Type RA. 137 is designed primarily to extend the low frequency limit of the RACAL RA. 17 Communications Receiver from 980 kc/s to 10 kc/s. The addition of the converter to the RA. 17 receiver in no way impairs its performance.
2. The equipment, which is basically a frequency converter for raising the frequency of incoming signals by 2 Mc/s, derives h. t. supplies from the RA. 17 receiver and heater supplies from a built-in mains transformer.
3. The RA. 137 is assembled on a 19 in. panel for rack mounting. It can be supplied complete with the RA. 17 receiver in a bench mounting cabinet.
4. An alternative version, Type RA. 137B employs North American valves and aerial connectors. The differences between this version and the converter RA. 137 are described in this handbook

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## CHAPTER 2

### INSTALLATION

1. After carefully unpacking the equipment, ensure that all valves and screening cans are firmly in place and that no packing materials remain.

#### Supply

2. Check that the l. t. transformer taps are set to the correct supply voltage. Connect a mains lead (not provided) to the 3-pin plug already installed in the mains input socket. On North American versions of the RA. 137 a mains lead is already fitted to the equipment which can be connected directly to the available supply

#### Fuse

3. Ensure that the rating of the supply fuse (FS1) is correct, viz. 250mA.

#### Aerial

4. Connect a suitable aerial to the AERIAL input plug on the rear of the unit. The input impedance of the converter at the coaxial aerial plug is designed to match a  $75\Omega$  unbalanced transmission line.

#### Connections to RA. 17

5. The following connections between the RA. 137 and the RA. 17 (fig. 1) should be made with the connectors supplied:-

(a) Coaxial connectors

RA. 137	RA. 17
R. F. OUTPUT	R. F.
1 MC/S INPUT	1 MC/S

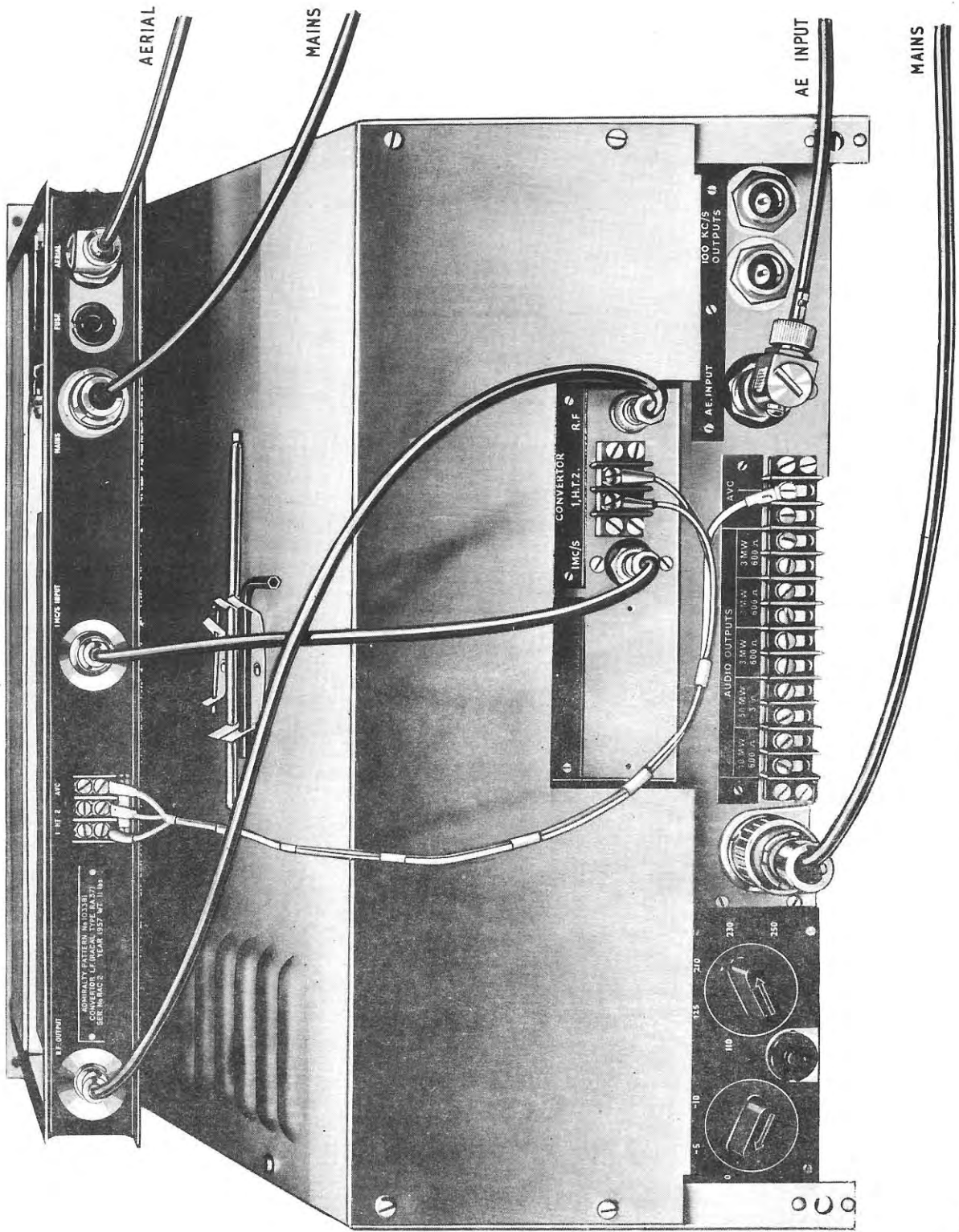
(b) 3-way connector

RA. 137	RA. 17
HT 1	HT 1
HT2	HT2
AVC	AVC

6. The two coaxial connectors are of different length and the correct one to use will be obvious. The 3-way connector consists of two red wires and a white wire coded at either end with coloured sleeves to aid identification. The white wire should be used for the AVC connection.

Installation of RA. 17

7. The RA. 17 receiver should be installed and connected in accordance with the instructions in the RA. 17 handbook.



INTERCONNECTIONS BETWEEN RA.17 & RAJ37

Fig.1

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Aerial Filter	9

## CHAPTER 3

### OPERATION

1. The instructions should be used in conjunction with those for the RA.17 Receiver, all controls of which remain operative, when operating between 10 kc/s and 980 kc/s, with the exception of MEGACYCLES, AE. TUNE (ANT TUNE), AE. RANGE MC/S (ANT RANGE MC/S) and AE. ATTENUATOR (ANT ATTENUATOR). Control designations shown in brackets apply to North American versions of the RA.17 receiver and RA.137 converter.

#### Switching on

2. (1) Set the RA.17 MAINS (POWER) switch to "on" ("down" for British).  
(2) Set the RA.137 MAINS (POWER) switch to "on" ("up" for North American).

#### Tuning - 10 to 980 kc/s

3. (1) Set RA.137 OPERATION switch to 10 KC/S -980 KC/S. Set RA.137 AE. RANGE (ANT RANGE) to WIDEBAND or to the desired frequency band. The tuned aerial input circuits are intended for use where strong adjacent channel interference is present.  
(2) Set the RA.137 AE. ATTENUATOR (ANT ATTENUATOR) to MIN.  
(3) Adjust the calibration of the RA.17 Receiver in accordance with the instructions in the RA.17 handbook.  
(4) Set the RA.17 System switch to MAN.  
(5) Rotate the KILOCYCLES control to the desired setting on the red scale.  
(6) If the AE. RANGE (ANT RANGE) switch is not set to WIDEBAND, adjust the AE. TUNE (ANT TUNE) control on the RA.137 for maximum signal (or noise).  
(7) Set the RA.17 System switch to A. V. C. if required.
4. All remaining adjustments on the RA.17 Receiver are carried out in accordance with the RA.17 handbook.

### Tuning - 980 kc/s to 30 Mc/s

5. (1) Set RA. 137 OPERATION switch to 980 KC/S-30 MC/S.
6. Operate the RA. 17 Receiver in accordance with the RA. 17 handbook.

### Aerial Tuning

7. If maximum sensitivity is not required, the aerial need not be tuned except when strong unwanted signals are present. The presence of very strong signals, anywhere within the spectrum, may cause cross-modulation unless the aerial is tuned. Under these conditions, CARE MUST BE TAKEN TO AVOID TUNING THE INPUT TO THE INTERFERING SIGNALS instead of the signal required.

### Aerial Attenuator

8. The AE. ATTENUATOR (ANT ATTENUATOR) control enables the operator to reduce the level of all incoming signals when very strong unwanted signals are present which cannot be rejected sufficiently by tuning the aerial. It should also be employed if the required signal is causing overloading in the early stages of the receiver.

### Aerial Filter

9. The aerial filter, which is in circuit on ranges 10 to 500 kc/s or wideband with filter, attenuates by an average of 40dB signals at frequencies greater than 500 kc/s. This is to reduce interference from powerful signals usually over 500 kc/s. Rejection frequencies of the filter are at 560 and 680 kc/s but should extra rejection be required at frequencies near to these, say  $\pm 5\%$ , the appropriate cores should be re-adjusted to reject the undesired frequency. L2/C4 and L4/C6 reject 680 kc/s and L3/C5 reject 560 kc/s.



CHAPTER 4

BRIEF TECHNICAL DESCRIPTION

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Harmonic Generator and Filter	3
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Cathode-Follower	5

## CHAPTER 4

### BRIEF TECHNICAL DESCRIPTION

1. This Chapter describes, with the aid of the block diagram (fig. 5), the basic operation. For a more detailed explanation of the converter, Chapter 5 (DETAILED CIRCUIT DESCRIPTION) should be read.

#### R. F. Amplifier and Filter

2. Input signals from the aerial are applied via the aerial attenuator to the R. F. Amplifier. Wideband (with or without filter) or tuned (10 to 980 kc/s) amplification can be selected according to reception conditions. The output is passed through a 1 Mc/s low-pass filter to eliminate image signals.

#### Harmonic Generator and Filter

3. Output from the 1 Mc/s crystal oscillator of the RA. 17 receiver is fed to the harmonic generator. The band-pass filter in the output circuit selects the 2 Mc/s second harmonic.

#### Mixer

4. The output from the 1 Mc/s low-pass filter is mixed in M5 with the output from the 2 Mc/s band-pass filter. The selected output from the mixer is the sum frequency in the band 2.010 to 2.98 Mc/s.

#### Cathode-Follower

5. The output from the mixer is applied to a cathode-follower, the low-impedance output of which is applied to the input of the second I. F. amplifier (2-3 Mc/s) stage of the RA. 17 receiver at low impedances. The required signal is finally selected in the interpolation stage of the RA. 17 receiver by tuning the KILOCYCLES scale.

CHAPTER 5

DETAILED CIRCUIT DESCRIPTION

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1 Mc/s Low-Pass Filter	3
Harmonic Generator and 2 Mc/s Band-Pass Filter	4
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Cathode-Follower	6
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## CHAPTER 5

### DETAILED CIRCUIT DESCRIPTION

Reference should be made to the circuit diagram (fig. 6) at the end of the handbook.

#### Aerial Circuit

1. A signal source, normally of 75 ohms impedance, is connected to the AERIAL socket SK1 and fed via the five position AE. ATTENUATOR switch (S1), covering an attenuation range of 0 to 40dB, to the 500 kc/s low-pass filter. The AE. RANGE switch (S2) selects wideband amplification, with or without filter, or any one of the six tuned aerial sections. The 500 kc/s filter is selected by the AE. RANGE switch for five of the six tuned bands, it is inoperative on the highest band (500-980 kc/s). The aerial coils are trimmed by C7 and C24 for the range 10-20 kc/s, C8 and C19 for the range 20-40 kc/s, C9 and C20 for the range 40-90 kc/s, C10 and C21 for the range 90-210 kc/s, C11 and C22 for the range 210-500 kc/s and C12 and C23 for the range 500-980 kc/s.

#### R. F. Amplifier

2. In the WIDEBAND position, the signal from the aerial attenuator is fed via capacitor C26 and grid stopper R14 to the control grid of the r. f. amplifier (V1). This grid is returned to the a. v. c. line via R13 and R12. When tuned input is employed, one end of the selected tuned circuit is connected to the control grid and the other is returned to the earth line. There are two stages of filtering in the a. v. c. line, they are C28, R12 and C27, R123; R123 is situated in the RA. 17 receiver. The anode load resistor R17 matches the output impedance of the amplifier to the characteristic impedance of the filter. R18 allows the screen potential of V1 to rise when a. v. c. is applied, thereby controlling the effective a. v. c. action.

#### 1 Mc/s Low-Pass Filter

3. The amplified signal is fed to a low-pass filter consisting of three constant-K sections preceded and terminated by m-derived end-sections. Cut-off takes place at 980 kc/s. The output from the filter is fed via the coupling capacitor C47 to the filter terminating resistor R24.

#### Harmonic Generator and 2 Mc/s Band-Pass Filter

4. The 1 Mc/s crystal-controlled output from the RA. 17 receiver is fed via capacitor C33 and grid stopper R22 to the control grid of the harmonic generator (V2). R21, decoupled by C33, provides bias for this valve which operates in a non-linear

condition. The anode load consists of a tuned circuit (L29, C42) which is the first stage of a 2 Mc/s band-pass filter. The second tuned circuit of the filter is formed by L30, L31 and C46 coupled by L31 to the third tuned circuit L31, L33, C48 and C50. Inductive coupling is provided to the balanced output winding L34. This filter has a passband of 50 kc/s, ensuring that only the 2 Mc/s harmonic is fed to the mixer.

### Balanced Mixer

5. The signal across the terminating resistor R24 is fed via the grid stopper R25 (omitted in North American versions) to the control grid of V3. V3 and V4 form a balanced mixer in which the incoming signal is mixed with the output of the 2 Mc/s band-pass filter to produce an output lying between 2 and 3 Mc/s. The 2 Mc/s voltage is applied to grid 3 of V3 and V4 in anti-phase. R27 and R29 provide a correctly balanced load for the harmonic generator output. The 2 Mc/s component produced in the mixer balances out in the common anode load of V3 and V4. This anode load consists of L32 and R31. L32 (adjustable by iron dust core) is tuned by stray capacitance to 2.7 Mc/s and is heavily damped by R31 to produce wideband tuning covering the frequency range 2-3 Mc/s. The potentiometer RV1 equalizes the gains of V3 and V4, and the differential capacitor C52 equalizes the phase-shifts in these two valves to enable a precise balance to be achieved. The h. t. supply for the valves is stabilized by V5. The 2-3 Mc/s output from the mixer is fed via C57 and the grid stopper R36 to the control grid of the cathode-follower.

### Cathode-Follower

6. The cathode-follower stage (V6) enables the signal to be fed to the low-impedance tapping in the 2-3 Mc/s band-pass filter in the RA. 17 receiver. The cathode load is formed by L36 and the input impedance of the band-pass filter. Resistor R38 is included to bias the valve to the correct operating conditions.

### Power Supplies

7. The h. t. supply is obtained from the RA. 17 receiver by setting the OPERATION switch to 10-980 kc/s. When the switch is in this position, h. t. is disconnected from the first V. F. O. unit and the 2nd mixer in the receiver and is applied to the converter.

8. The heater supply is obtained from a mains transformer contained within the l. f. converter.

9. The mains input switch is interlocked with the h. t. circuit to prevent h. t. being fed to the converter when heater voltage is not applied to the valves.

SECTION 2

MAINTENANCE

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CHAPTER 2	VALVE DATA
CHAPTER 3	TYPICAL PERFORMANCE
CHAPTER 4	FAULT LOCATION
CHAPTER 5	REPRESENTATIVE TEST DATA
CHAPTER 6	ALIGNMENT PROCEDURE
CHAPTER 7	LIST OF COMPONENTS

## IMPORTANT NOTE

The RA.137 converter is designed for use with the Racal RA.17 Communications Receiver. The ensuing Chapters assume that this converter is connected to a receiver which is operating to the correct specification.

CHAPTER 1

TEST EQUIPMENT REQUIRED FOR MAINTENANCE



## CHAPTER 1

### TEST EQUIPMENT REQUIRED FOR MAINTENANCE

1. The following items of test gear are required to carry out the maintenance described in this part of the handbook:-
  - (a) Valve voltmeter reading up to 5.0 volts at frequencies up to 3.0 Mc/s.
  - (b) Signal Generator capable of operating on fundamental frequencies up to 3.0 Mc/s, output impedance 75 ohms.
  - (c) Multi-range meter measuring a. c. and d. c. up to 500 volts with resistance of 20 000 ohms per volt.
  - (d) Voltage changing auto-transformer, preferably of the continuously variable type, operating up to 250 volts and supply 120 watts.
  - (e) Coupling aids: viz. 0.1 $\mu$ F capacitor, 330 ohm resistor, 75 ohms matching pad for the Signal Generator.

CHAPTER 2  
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VALVE DATA  
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Valve complement and typical voltages (British)	2
Valve connections (American)	3
Valve complement and typical voltages (American)	4

## CHAPTER 2

### VALVE DATA

#### Introduction

1. Details of valves used in the RA.137 are given in Tables 1 and 2 below and those for the RA.137B in Tables 3 and 4 overleaf. Voltages were obtained from a B7G stand-off valve base using a 20 000 ohms/per volt meter on the optimum range in each case. Valve pin numbers are indicated in brackets in Tables 2 and 4.
2. The I.F. GAIN control on the receiver was set at MAX and RVI in the i.f. converter set to its mid position.

TABLE 1

VALVE CONNECTIONS (British)

Pin No.	CV138 EF91	CV154 EF93	CV1832 150C2	CV2209 6F33
1	Grid 1	Grid 1	Anode	Grid 1
2	Cathode	Grid 3	Cathode	Cathode
3	Heater	Heater		Heater
4	Heater	Heater		Heater
5	Anode	Anode	Anode	Anode
6	Grid 3	Grid 2		Grid 3 Diode
7	Grid 2	Cathode	Cathode	Grid 2
Base	B7G	B7G	B7G	B7G

TABLE 2

VALVE COMPLEMENT AND TYPICAL VOLTAGES (British)

Cct. Ref.	CV No.	Equivalent	Anode	Screen	Cathode
V1	CV454	EF93	155(5)	95(6)	0.85(7)
V2	CV138	EF91	205(5)	100(7)	-
V3	CV2209	6F33	150(5)	150(7)	2.0(2)
V4	CV2209	6F33	150(5)	150(7)	2.0(2)
V5	CV1832	150C2	150(1)	-	-
V6	CV138	EF91	205(5)	195(7)	1.25(2)

TABLE 3

VALVE CONNECTIONS (American)

Pin No.	6BA6	6AU6	6AS6	OA2
1	Grid 1	Grid 1	Grid 1	Anode
2	Grid 3	Grid 3	Cathode	Cathode
3	Heater	Heater	Heater	I. C.
4	Heater	Heater	Heater	-
5	Anode	Anode	Anode	Anode
6	Grid 2	Grid 2	Grid 2	I. C.
7	Cathode	Cathode	Grid 3	-
Base	B7G	B7G	B7G	B7G

TABLE 4

VALVE COMPLEMENT AND TYPICAL VOLTAGES (American)

Cct. Ref.	Anode	Screen	Cathode	American Type	Equivalent
V1	150(5)	85(6)	0.8(7)	6BA6	EF93
V2	190(5)	55(6)	-	6AU6	EF94
V3	150(5)	100(6)	1.5(2)	6AS6	-
V4	150(5)	100(6)	1.5(2)	6AS6	-
V5	150(1)	-	-	OA2	-
V6	180(5)	135(6)	0.8(7)	6AU6	EF94

# CHAPTER 3

## TYPICAL PERFORMANCE

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Sensitivity	2
Selectivity	3 and 4
Cross Modulation	5
Image and Spurious Responses	6
Automatic Volume Control	7

## CHAPTER 3

### TYPICAL PERFORMANCE

#### Stability

1. After a warm-up time of  $1\frac{1}{2}$  hours, overall drift is less than 50 c/s under conditions of constant supply voltage and ambient temperature.

#### Sensitivity

2. A1 emission, bandwidth 3 kc/s;  
1 $\mu$ V for 15dB signal-to-noise ratio.  
A2 emission, 30% modulation, bandwidth 3 kc/s;  
3 $\mu$ V for 15dB signal-to-noise ratio.

#### Selectivity

- |    |            |          |                    |
|----|------------|----------|--------------------|
| 3. | Position 1 | 100 c/s  | Less than 1.5 kc/s |
|    | " 2        | 300 c/s  | Less than 2 kc/s   |
|    | " 3        | 1.2 kc/s | 8 kc/s             |
|    | " 4        | 3 kc/s   | 15 kc/s            |
|    | " 5        | 6.5 kc/s | 20 kc/s            |
|    | " 6        | 13 kc/s  | 28 kc/s            |
4. The centre frequency on the crystal bandwidths does not change by more than 50 c/s when the bandwidth is changed.

#### Cross Modulation

5. Using the aerial attenuator with a tuned input, an i. f. bandwidth of 3 Kc/s and a wanted signal amplitude of 1mV then an unwanted signal, differing by 10 kc/s and modulated 30%, must have a level of at least 40dB greater than the wanted signal in order to produce a cross modulation output equivalent to 1% modulation of the wanted signal.

#### Image and Spurious Responses

6. Rejection is greater than 60dB with a tuned input. Internally generated spurious responses are not greater than 1dB above noise.

## Automatic Volume Control

7. An increase in signal level of 70dB results in an increased audio output of less than 6dB.

CHAPTER 4

FAULT LOCATION

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Signal Input Circuits	1
R. F. Stage	2
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FAULT LOCATIONSignal Input Circuits

1. If the R. F. stage is functioning correctly, a rise of noise will occur when the input circuit is tuned through the frequency to which the kilocycle scale is set. Should this not occur, check the aerial input and the attenuator circuits.

R. F. Stage

2. Should no signal be received, switch on the b. f. o. and set the RED KILOCYCLES scale to zero. A strong 2 Mc/s carrier from the harmonic generator should be heard. If this signal is received, adjust the balanced mixer in accordance with paras. 12. to 18., Chapter 6. If the mixer can be balanced, the fault is in the R. F. stage or the 1 Mc/s low-pass filter.

Mixer Stage

3. If the 2 Mc/s signal is not received, carry out the following check:-
4. Ensure that the stabilizer V5 has ignited. Check with the valve voltmeter that at least 2 volts of 1 Mc/s drive is present at PL2. Remove V3, V4 and V5 and check that 0.5 volts at 2 Mc/s appears at pin 6 of the valve holders of both V3 and V4.
5. Should this drive be present the fault lies in the balanced mixer, the cathode-follower, or the connection between the R. F. OUTPUT socket and the 2-3 Mc/s band-pass filter in the RA. 17 receiver.

Voltage Stabilizer

6. Should V5 fail to function then the balance will drift rapidly.

CHAPTER 5

REPRESENTATIVE TEST DATA

## CHAPTER 5

REPRESENTATIVE TEST DATA

Signal Input To	Frequency	Input	Output	Remarks
(a)Grid V6 (1)	2.0 Mc/s	220 $\mu$ V	100 $\mu$ A R. F. level	3 kc/s bandwidth system switch to MAN:
	2.5 Mc/s	225 $\mu$ V	100 $\mu$ A R. F. level	I. F. GAIN MAX; B. F. O. OFF!
	3.0 Mc/s	250 $\mu$ V	100 $\mu$ A R. F. level	1 Mc/s input to PL2 dis- connected.
(b)Drive to PL2	1.0 Mc/s	20. V	0.5V at V3 (6) 0.5V at V4 (6)	System switch to MAN; use valve voltmeter.
(c)Grid V3 (1)	10 kc/s	200 $\mu$ V	100 $\mu$ A R. F. level	3 kc/s bandwidth; system switch to MAN;
	500 kc/s	150 $\mu$ V	100 $\mu$ A R. F. level	I. F. GAIN MAX; B. F. O. OFF;
	980 kc/s	200 $\mu$ V	100 $\mu$ A R. F. level	1 Mc/s input to PL2.
(d)Aerial socket PL1	10 kc/s	20 $\mu$ V	100 $\mu$ A R. F. level	3 kc/s bandwidth system switch to MAN;
	500 kc/s	15 $\mu$ V	100 $\mu$ A R. F. level	I. F. GAIN MAX; B. F. O. OFF;
	980 kc/s	20 $\mu$ V	100 $\mu$ A R. F. level	1 Mc/s input to PL2: RA. 137 AE. RANGE (ANT RANGE) to WIDE- BAND; RA. 137 AE. ATTENUATOR (ANT ATTENUATOR) to MIN.

Note ...

The numerals in brackets indicate the valve pin number.

# CHAPTER 6

## ALIGNMENT PROCEDURE

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## CHAPTER 6

### ALIGNMENT PROCEDURE

#### Standardization of RA. 17 Sensitivity

1. Connect the signal generator (matched to 75-ohms) via a 0.1 $\mu$ F capacitor to the R. F. socket of the RA. 17 receiver. Set the I. F. GAIN to maximum, the BANDWIDTH to 3 kc/s, the meter switch to R. F. LEVEL and the System switch to MAN.
2. Record the c. w. input required to produce 100 $\mu$ A of diode current in the R. F. LEVEL meter at 2.0 Mc/s, 2.5 Mc/s and 3.0 Mc/s (i. e. with the RED scale set to 0 kc/s, 500 kc/s and 1,000 kc/s respectively).
3. Connect the RA. 137 converter correctly to the RA. 17 receiver, but do not connect an aerial.

Note: The above results should be used as standards during subsequent measurements described below.

#### Harmonic Generator

4. Ensure that the dust covers are fitted to the harmonic generator. Set C52 to the mid-position. Connect the valve voltmeter between grid 3 of V3 (pin 6) and earth.
5. Adjust L29, L30 and C50 (fig. 2) in turn to obtain maximum output. With the correct adjustment this output should not be less than 0.5V.
6. Remove the valve voltmeter from V3 and connect it to grid 3 of V4 (pin 6).

#### Balanced Mixer Anode Circuit

7. Disconnect the coaxial lead between the R. F. OUTPUT socket of the RA. 137 and the R. F. socket of the RA. 17.
8. Connect the valve voltmeter in parallel with a 330-ohm resistor across the R. F. OUTPUT socket of the RA. 137. Connect the signal generator (set to C. W.) via a 0.1 $\mu$ F capacitor to grid 7 of V3 (pin 1). Set the valve voltmeter to the 1.5V range.
9. Observe that the frequency response is sensibly level as the signal generator frequency is swept over the range of 2-3 Mc/s. Adjust L32 to obtain maximum output at 2.7 Mc/s.

10. Disconnect the valve voltmeter and replace the coaxial lead between the R. F. OUTPUT socket of the RA. 137 and the R. F. socket of the RA. 17.
11. With correct alignment, the input required to produce 100 $\mu$ A of diode current should be approximately those stated in the table below:-

<u>Sig. Gen.</u> <u>Frequency</u>	<u>RED Scale</u> <u>Setting</u>	<u>Max. input relative to</u> <u>that obtained in paras. 1. to 3.</u>	
		RA. 137	RA. 137B
2.0 Mc/s	0 kc/s	-6dB	-8dB
2.5 Mc/s	500 kc/s	-10dB	-12dB
3.0 Mc/s	1000 kc/s	-10dB	-12dB

### Balanced Mixer adjustment and Drift Measurements

12. Set the RED KILOCYCLES scale on the RA. 17 receiver to zero, the I. F. GAIN control to MIN and the meter switch to R. F. LEVEL. Connect the mains supply to the RA. 17 and RA. 137 via a voltage changing auto-transformer and set the transformer to supply the voltage to which theappings of the receiver and converter transformers are set.
13. With no signal input, adjust RV1 and C52 (fig. 3) alternately to obtain minimum diode current, increasing the setting of the I. F. GAIN control as necessary.
14. Reduce the input voltage by 10% and allow sufficient time for the heater temperature to stabilize. Adjust the I. F. GAIN to provide a suitable reference reading on the R. F. LEVEL meter. Disconnect the coaxial lead from the R. F. OUTPUT socket on the RA. 137 and connect the lead via a 0.1 $\mu$ F capacitor to the signal generator. Tune the signal generator to 2 Mc/s (C. W.).
15. The output required to produce the reference R. F. LEVEL current should not exceed 50mV.
16. Repeat with the mains input voltage set to 10% above the nominal supply voltage.
17. The output required from the signal generator should not exceed 50mV as above.
18. Replace the coaxial lead on the R. F. OUTPUT socket.

### 1 Mc/s Low-Pass Filter

19. Set the I. F. GAIN to MAX., the System switch to STANDBY and connect the 1 MC/S output plug (RA. 17) to the 1 MC/S OUTPUT plug (RA. 137). Connect

the signal generator (75-ohms output impedance) to the RA. 137 AERIAL plug (ANTENNA socket) and set the AE. ATTENUATOR (ANT ATTENUATOR) to MIN. Set the RA. 137 AE. RANGE switch (ANT RANGE) to WIDEBAND without filter. Remove V3 and connect a valve voltmeter to grid 1 (pin 1) of the valveholder. Remove V4 and V5.

20. Set the System switch to MAN. Adjust the frequency of the signal generator to precisely 1030 kc/s (C. W.). Tune the RA. 17 receiver and adjust the signal generator output until the valve voltmeter reads 2V approximately.
21. Increasing the signal generator output as necessary to a limit of 800mV, adjust L26 to obtain minimum indication on the valve voltmeter.
22. Repeat the above procedure with the signal generator frequency set precisely to 1080 kc/s, adjust L22 to obtain minimum output.
23. Set the signal generator to 500 kc/s with an output of 100mV. Ensure that the valve voltmeter reading is not less than 0.8V.
24. Explore the passband from 10 kc/s to 980 kc/s. The response obtained should be within the limits of +1dB and -3dB relative to the level at 500 kc/s. Adjust L23, L24 and L25 as necessary to correct the response in the region of 900-980 kc/s.
25. With an input level of 800mV, ensure that no indication is obtained, on the 1.5V range of the valve voltmeter, above 1020 kc/s.
26. Remove the valve voltmeter and signal generator, replace V3, V4 and V5.

#### R. F. Tuned Circuit

27. Remove V1 and connect a valve voltmeter shunted to 6.8pF to pin 1 (grid) of V1. Connect a signal generator to the RA. 137 AERIAL plug (ANTENNA socket). Set the OPERATION switch to 10-980 kc/s the RA. 137 AE. RANGE (ANT RANGE) switch to 500-980 kc/s and set the scale pointer to 500 kc/s.
28. Set the signal generator to 500 kc/s and adjust the cores of L15 and L21 (fig. 4) for maximum output in the valve voltmeter. Reset the scale pointer and signal generator to 980 kc/s and adjust capacitors C12 and C23 for maximum output in the valve voltmeter. Check the l. f. end and adjust if necessary at the h. f. end.
29. Repeat the above procedure for the remaining aerial coils and their associated capacitors at ranges and frequencies stated in the table below.

Note: It will be found that on range 10-20 kc/s the adjustment of L5 and C7 is very flat and consequently is not critical.

<u>Range</u>	<u>Frequency</u>	<u>Adjustment</u>
210-500 kc/s	120 kc/s	L13-L20
	500 kc/s	C11-C22
90-210 kc/s	90 kc/s	L11-L19
	210 kc/s	C10-C21
40- 90 kc/s	40 kc/s	L9-L18
	90 kc/s	C9-C20
20- 40 kc/s	20 kc/s	L7-L17
	40 kc/s	C8-C19
10- 20 kc/s	10 kc/s	L5-L16
	20 kc/s	C7-C24

Ensure that the input required to produce a 1.0V deflection on the valve voltmeter does not exceed the value stated in the table below:-

<u>Range</u>	<u>Frequency</u>	<u>Max. input relative to 1<math>\mu</math>V</u>
10-20 kc/s	10 kc/s	90dB
	20 kc/s	90dB
20-40 kc/s	20 kc/s	92dB
	40 kc/s	92dB
40-90 kc/s	40 kc/s	94dB
	90 kc/s	94dB
90-210 kc/s	90 kc/s	92dB
	210 kc/s	92dB
210-500 kc/s	210 kc/s	94dB
	500 kc/s	94dB
500-980 kc/s	500 kc/s	102dB
	980 kc/s	100dB

30. Remove the valve voltmeter and signal generator. Replace V1 and balance the mixer by adjusting RV1 and C28 for minimum current in the R. F. LEVEL meter in accordance with paras. 12. to 18.



## CHAPTER 7

### LIST OF COMPONENTS

Note: It is recommended that users quote the Serial No. of the equipment on all orders for spare parts.

\* Indicates component used in RA. 137B Converters

+ Indicates component used in RA. 137 Converters

Cct. Ref.	Value	Description	Rating	Tol. %	Manufacturer
<u>Resistors</u>					
R1	100Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R2	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R3	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R4	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R5	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R6	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R7	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R8	150Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R9	100Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R10	2.2kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R11	2.2MΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R12	82kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R13	2.2MΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R14	68Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R15	68Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R16	2.2kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R17	4.7kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R18	33kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R19+	33kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R19*	47kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R20	33kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R21	330kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R22	68Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R23	2.2kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R24	4.7kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R25+	180Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R25*	DELETED				
R26+	180Ω	carbon	$\frac{1}{4}$ W	10	Erie 16

Cct. Ref.	Value	Description	Rating	Tol. %	Manufacturer
R26*	DELETED				
R27	220Ω	High Stab.	1/8W	1	Erie 109
R28+	82Ω	High Stab.	1/8W	5	Erie 109
R28*	33Ω	carbon	$\frac{1}{2}$ W	5	Erie 8
R29	220Ω	High Stab.	1/8W	1	Erie 109
R30+	180Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R30*	DELETED				
R31	10kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R32+	180Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R32*	DELETED				
R33	4.7kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R34	1.8kΩ	wirewound	$4\frac{1}{2}$ W	5	Welwyn Electrical
R35	470kΩ	carbon	$\frac{1}{4}$ W	10	Erie 16
R36	68Ω	carbon	$\frac{1}{4}$ W	10	Erie 16
R37	2.2kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R38+	82Ω	High Stab.	1/8W	5	Erie 109
R38*	39Ω	High Stab.	1/8W	5	Erie 109
R39+	4.7kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R39*	15kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
R40*	6.8kΩ	carbon	$\frac{1}{2}$ W	10	Erie 8
<u>Potentiometers</u>					
RV1	100Ω	wirewound		10	Colvern CLR. 3001/11S
<u>Capacitors</u>					
C1	3750pF	silv'd mica	200V	2	JMC. C22R
C2	5550pF	silv'd mica	200V	2	JMC. YC. 41R
C3	6300pF	silv'd mica	200V	2	JMC. YC. 41R
C4	4350pF	silv'd mica	200V	2	JMC. C22R
C5	4650pF	silv'd mica	200V	2	JMC. C22R
C6	4350pF	silv'd mica	200V	2	JMC. C22R
C7	22pF	trimmer	400V		Mullard AC2002/22
C8	22pF	trimmer	400V		Mullard AC2002/22
C9	22pF	trimmer	400V		Mullard AC2002/22
C10	22pF	trimmer	400V		Mullard AC2002/22
C11	22pF	trimmer	400V		Mullard AC2002/22
C12	22pF	trimmer	400V		Mullard AC2002/22
C13	68pF	silv'd mica	350V	2	Lemco 1106S
C14	523pF	variable (2-gang)			Wingrove & Rogers C73-02/ 101
C15	8.2pF	ceramic	750V	10	Erie P. 100K
C16	4.7pF	ceramic	750V	10	Erie P. 100K
C17	3.3pF	ceramic	750V	10	Erie P. 100K

Cct. Ref.	Value	Description	Rating	Tol. %	Manufacturer
C18	68pF	silv'd mica	350V	2	Lemco 1106S
C19	22pF	trimmer	400V		Mullard AC2002/22
C20	22pF	trimmer	400V		Mullard AC2002/22
C21	22pF	trimmer	400V		Mullard AC2002/22
C22	22pF	trimmer	400V		Mullard AC2002/22
C23	22pF	trimmer	400V		Mullard AC2002/22
C24	22pF	trimmer	400V		Mullard AC2002/22
C25	See C14				
C26	0.001 $\mu$ F	ceramic	350V		Erie Hik/AD
C27	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C28	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C29	10 $\mu$ F	electrolytic	25V		Hunts UB59KY
C30	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C31	0.05 $\mu$ F	paper	350V	20	Hunts W49/B511K
C32	68pF	ceramic	750V	5	Erie N750L
C33	68pF	ceramic	750V	10	Erie N750K
C34	0.05 $\mu$ F	paper	350V	20	Hunts W49/B511K
C35	0.01 $\mu$ F	paper	400V	20	Hunts BM21K
C36	47pF	ceramic	750V	5	Erie N750K
C37	2 $\mu$ F	electrolytic	350V		Hunts Z. 145010
C38	68pF	ceramic	750V	5	Erie N750L
C39	0.05 $\mu$ F	paper	350V	20	Hunts W49/B511K
C40	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C41	0.05 $\mu$ F	paper	350V	20	Hunts W49/B511K
C42	100pF	ceramic	350V	2	Lemco CMMIG
C43	68pF	ceramic	750V	5	Erie N750L
C44	47pF	ceramic	750V	5	Erie N750K
C45	120pF	ceramic	750V	5	Erie N750L
C46	100pF	silv'd mica	350V	2	Lemco CMMIG
C47	0.01 $\mu$ F	paper	400V	20	Hunts BM21K
C48	100pF	silv'd mica	350V	2	Lemco CMMIG
C49	10 $\mu$ F	electrolytic	25V		Hunts Z. 145097
C50	33pF	trimmer			Wingrove & Rogers C31-01/1
C51	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C52	34.5pF	trimmer	1000V		Oxley Circular
C53	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C54	0.05 $\mu$ F	paper	350V	20	Hunts W49/B511K
C55	15pF	ceramic	750V	10	Erie NPOK
C56	0.1 $\mu$ F	paper	150V	20	Hunts W49/B500K
C57	120pF	ceramic	750V	20	Erie N750L
C58	2 $\mu$ F	electrolytic	350V		Hunts Z. 145010
C59	8 $\mu$ F	electrolytic	350V		Hunts JB. 403T
C60	0.01 $\mu$ F	paper	750V	20	Lemco 420K
C61	0.01 $\mu$ F	paper	750V	20	Lemco 420K

Cct. Ref.	Value	Description	Rating	Tol. %	Manufacturer
C62	0. 1 $\mu$ F	paper	350V	20	Hunts W49/B512K
C63	0. 01 $\mu$ F	paper	400V	20	Hunts BM21K
C64	0. 01 $\mu$ F	paper	400V	20	Hunts BM21K
C65	0. 01 $\mu$ F	paper	400V	20	Hunts BM21K

### Switches

S1	Attenuator	Racal AA8034
S2	Aerial Range	Racal BSW. 14436
S3	Mains and h. t. interlock	NSF. Z. 510554
C4	Operation	NSF. Z. 510554

### Plugs and Sockets

PL1+	Aerial (fixed)	NSF. Z. 450101
SK1+	Aerial (free)	NSF. Z. 549028
PL1*	Aerial (free)	Films and Equipment
SK1*	Aerial (fixed)	Films and Equipment
PL2+	1 Mc/s Input (fixed)	Power Controls
SK2+	1 Mc/s Input (free)	Power Controls
PL2*	1 Mc/s Input (free)	Amphenol UG260B/U
SK2*	1 Mc/s Input (fixed)	Amphenol UG1094/U
PL3+	Mains (fixed)	Plessey Z560060
SK3+	Mains (free)	Plessey Z560100
PL3*	R. F. Output (free)	Amphenol UG260B/U
SK3*	R. F. Output (fixed)	Amphenol UG910/U
PL4+	R. F. Output (fixed)	Power Controls
SK4+	R. F. Output (free)	Power Controls
	Socket outlet accessories set	15295/93-98

### Valves

V1+	R. F. Amplifier	Mullard EF93
V1*	R. F. Amplifier	Mullard 6BA6
V2+	Harmonic Generator	Mullard EF91
V2*	Harmonic Generator	Mullard 6AU6
V3+	Balanced Mixer	Mazda 6F33
V3*	Balanced Mixer	Mullard 6AS6
V4+	Balanced Mixer	Mazda 6F33
V4*	Balanced Mixer	Mullard 6AS6
V5+	Stabilizer	Mullard 150C4
V5*	Stabilizer	Mullard OA2
V6+	Cathode Follower	Mullard EF91
V6*	Cathode Follower	Mullard 6AU6

Cct. Ref.	Description	Manufacturer
<u>Valveholders and Screening Cans</u>		
V1	Screening Can Valveholder	McMurdo Z. 563003 McMurdo Z. 560127
V2	Screening Can Valveholder	McMurdo Z. 563003 McMurdo Z. 560127
V3+ and V4	Screening Can Valveholder	McMurdo Z. 563003 McMurdo XM7/UXT1
V3* and V4	Screening Can Valveholder	McMurdo Z. 560145 McMurdo XM7/UXT1
V5	Screening Can Valveholder	McMurdo Z. 563005 McMurdo Z. 560127
V6	Screening Can Valveholder	McMurdo Z. 563003 McMurdo Z. 560127

Inductors

L1	Filter Coil Assembly	Racal AA14822/C
L2	Filter Coil Assembly	Racal AA14822/A
L3	Filter Coil Assembly	Racal AA14822/B
L4	Filter Coil Assembly	Racal AA14822/A
L5 )	Coil Assembly	Racal BA14663/A
L6 )		
L7 )	Coil Assembly	Racal BA14663/B
L8 )		
L9 )	Coil Assembly	Racal BA14663/C
L10 )		
L11 )	Coil Assembly	Racal BA14663/G
L12 )		
L13 )	Coil Assembly	Racal BA14663/H
L14 )		
L15	Coil Assembly	Racal AA15233/A
L16	Coil Assembly	Racal BA14663/D
L17	Coil Assembly	Racal BA14663/E
L18	Coil Assembly	Racal BA14663/F
L19	Coil Assembly	Racal BA14663/J
L20	Coil Assembly	Racal BA14663/K
L21	Coil Assembly	Racal AA15233/B
L22	Coil Assembly	Racal AA7842

Cct. Ref.	Description	Manufacturer
L23	Coil Assembly	Racal AA7843
L24	Coil Assembly	Racal AA7843
L25	Coil Assembly	Racal AA7843
L26	Coil Assembly	Racal AA8029
L27	Filter Coil Assembly	Racal AA4655
L28	Choke	Bulgin Q. 602/AS. 9197
L29	Coil Assembly	Racal AA9199
L30	Coil Assembly	Racal AA7844
L31+	Coil Assembly	Racal AA7845
L31*	Coil Assembly	Racal AA8313
L32	Coil Assembly	Racal AA8030
L33 )	Coil Assembly	Racal AA7846
L34 )		
L35	Filter Coil Assembly	Racal AA4655
L36	Choke	Bulgin Q. 602/AS. 9197
L37	Choke	Bulgin Q. 602/AS. 9197

#### Transformer

T1	Mains	Racal BT8288
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#### Fuse and Fuseholder

F1	Fuse 250mA Fuseholder	Belling Lee L. 338 Belling Lee L. 356
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#### Lamps and Lampholders

LP1 and LP2	Indicator lamp 8V., 0.156A 10 mm. tub. (M. E. S.)	
LP1 and LP2	Lampholder	Bulgin M. E. S. 55R

#### Miscellaneous

	Knob Assembly (for S1 and D2)	Racal AA15472
	Knob (tuning)	Racal AA6817
	Coaxial Cable	Uni Radio UR. 70
	Slow motion tuning drive	Jackson DR. 645
	Barrier terminal strip	Cinch 77/508/3
	+ 1 Mc/s connecting cable	Racal AA8026/A
	* 1 Mc/s connecting cable	Racal AA8026/B

Cct. Ref.	Description	Manufacturer
+ R. F.	output cable	Racal AA8027/A
* R. F.	output cable	Racal AA8027/B
	H. T. and A. V. C. cableform	Racal AA8028
	Attenuator switch assembly	Racal AA8034
	Harmonic generator filter assembly	Racal AA7848
	Low-pass filter assembly	Racal BA7530
	Electrostatic screen assembly	Racal AA11016
+ Front Panel	(engraved)	Racal CD14376/A
* Front panel	(engraved)	Racal CD14376/B
+ Rear Panel	(engraved)	Racal BD7527
* Rear Panel	(Engraved)	Racal BD7529
	Cover, bottom (harmonic generator)	Racal BD7508
	Cover, top (harmonic generator)	Racal BD8025
	Cover, top (Main component box assembly)	Racal BD14818
+ Cover, bottom	(Main component box assembly)	Racal BD7506
* Cover, bottom	(Main component box assembly)	Racal BD14499

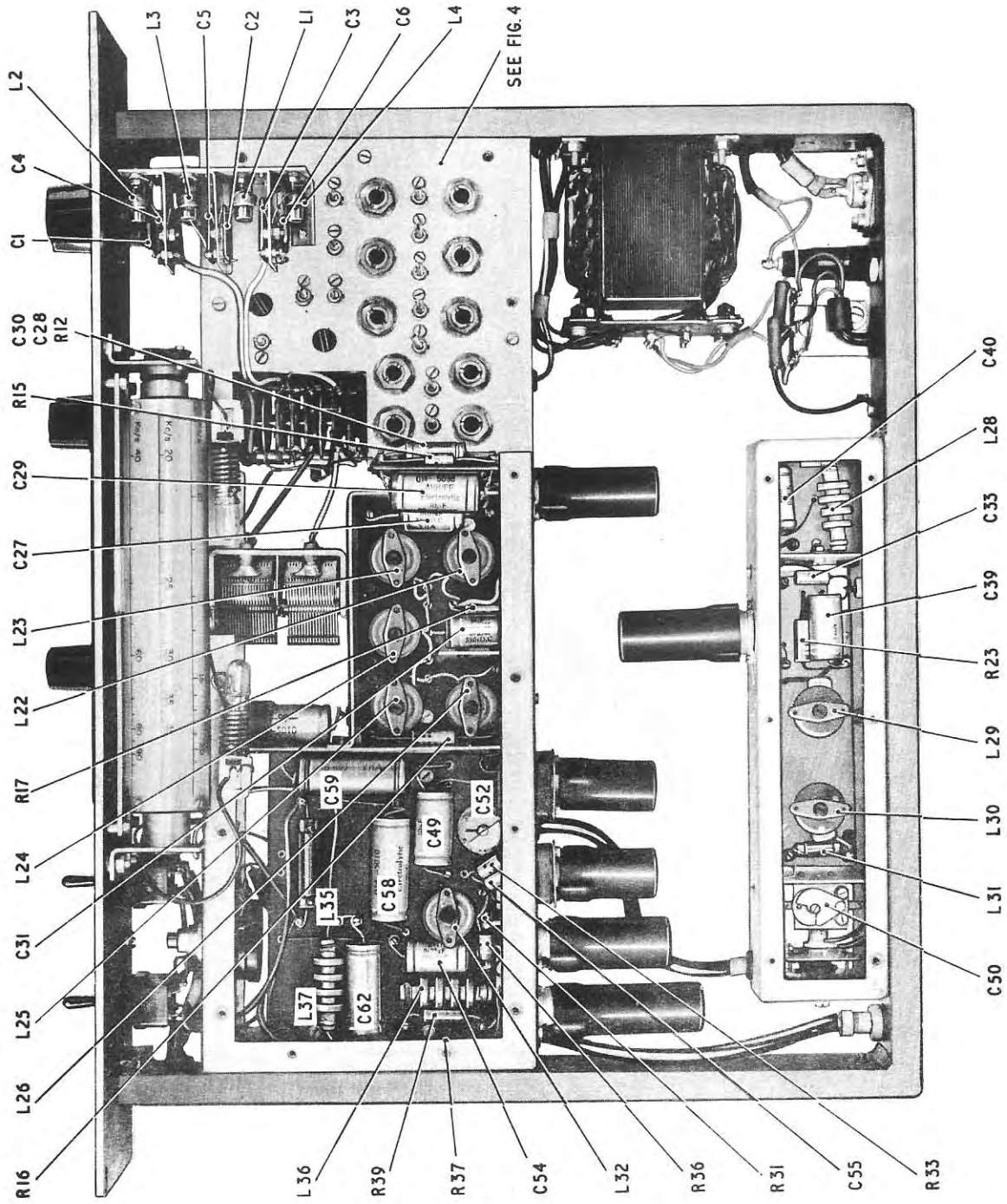
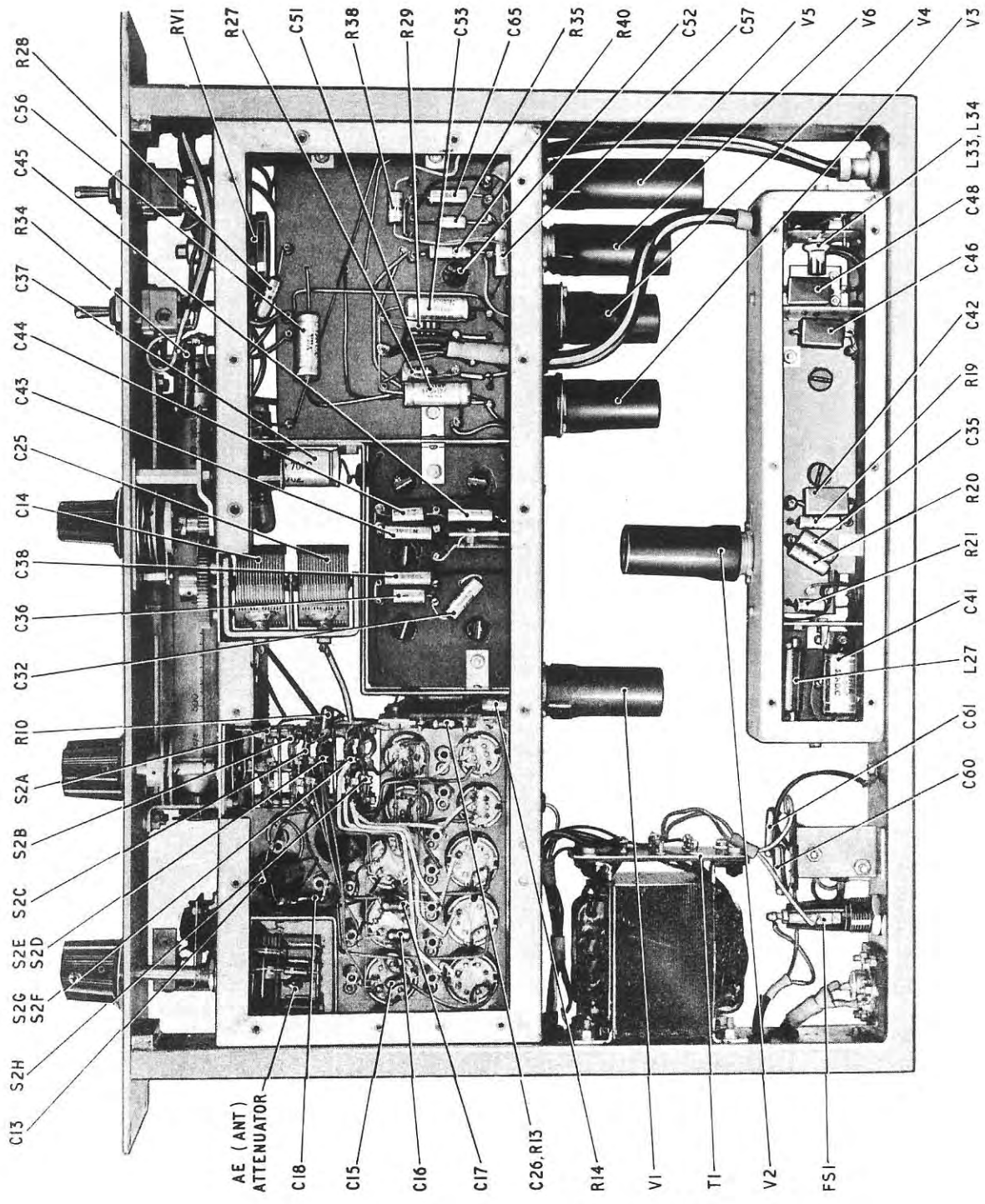


Fig. 2

RA.137 Chassis - top





C13 S2H S2G S2E S2C S2B S2A R10 C32 C36 C38 C14 C25 C43 C44 C37 R34 C45 C56 R28

RV1 R27 C51 R38 R29 C53 C65 R35 R40 C52 C57 V5 V6 V4 V3

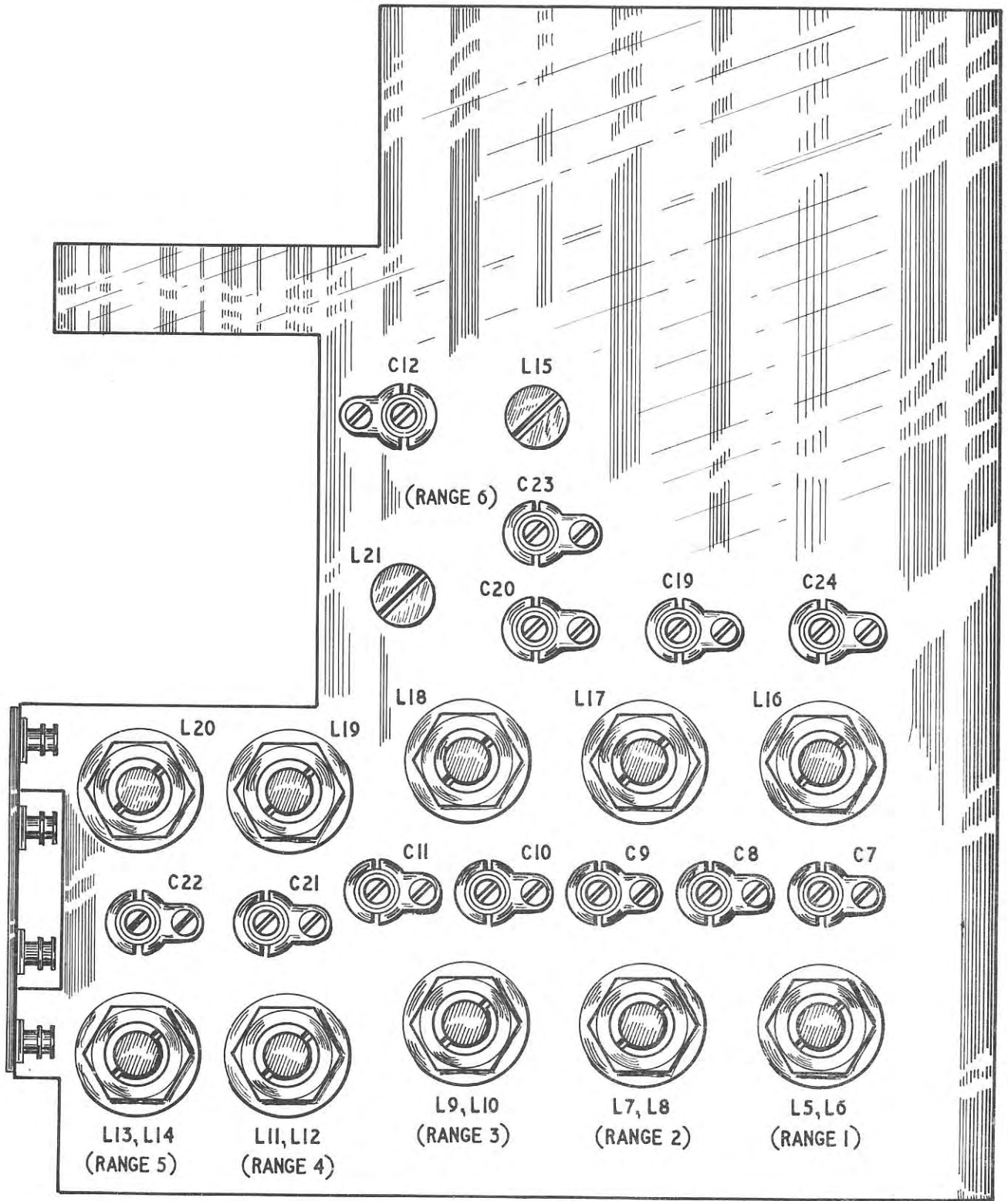
AE (ANT)  
ATTENUATOR

C18 C15 C16 C17 C26, R13 R14 V1 T1 V2 FS1

C60 C61 L27 C41 R21 R20 C35 R19 C42 C46 C48 L33, L34

RA.137 Chassis - underside

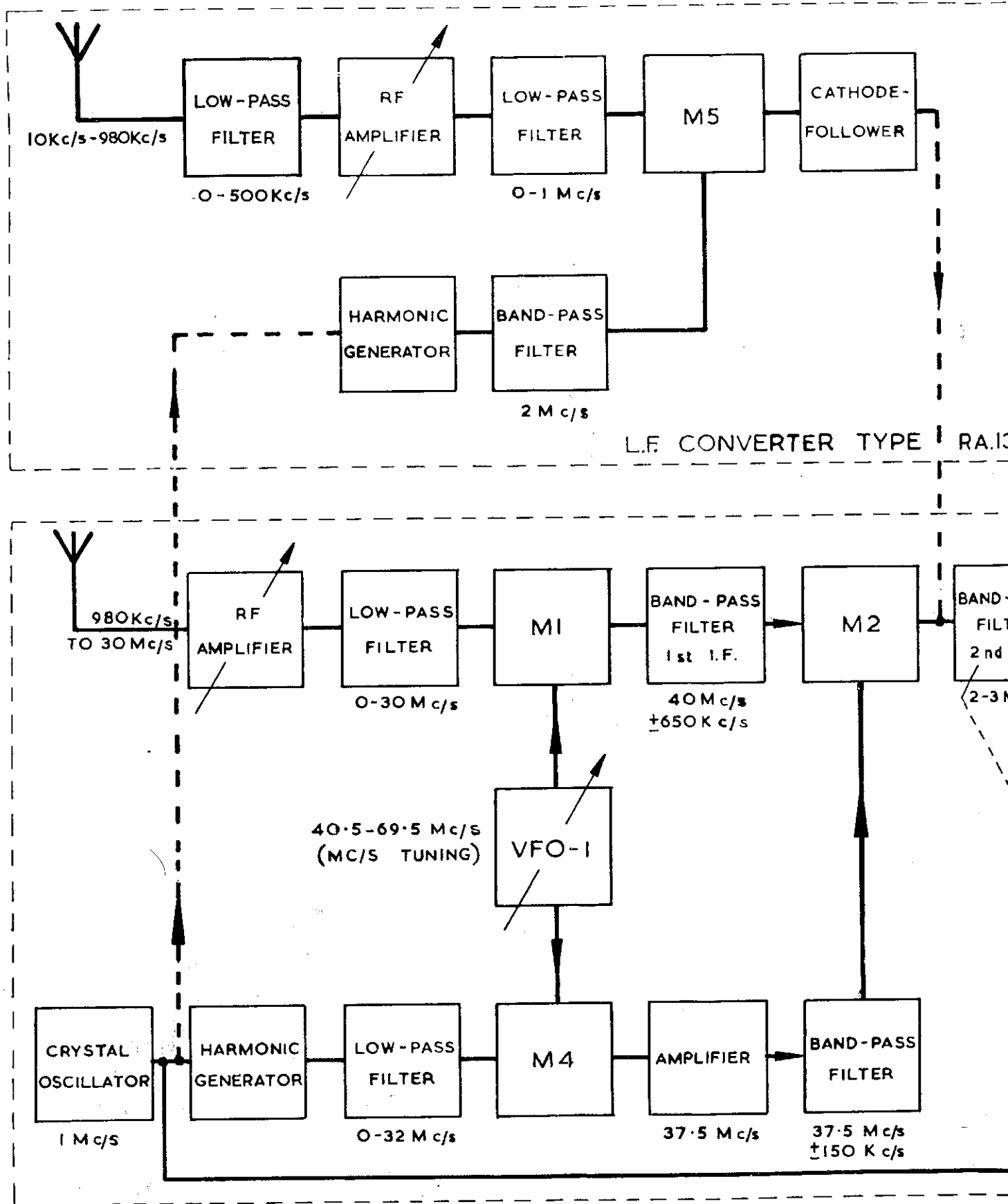
Fig.3



I26014

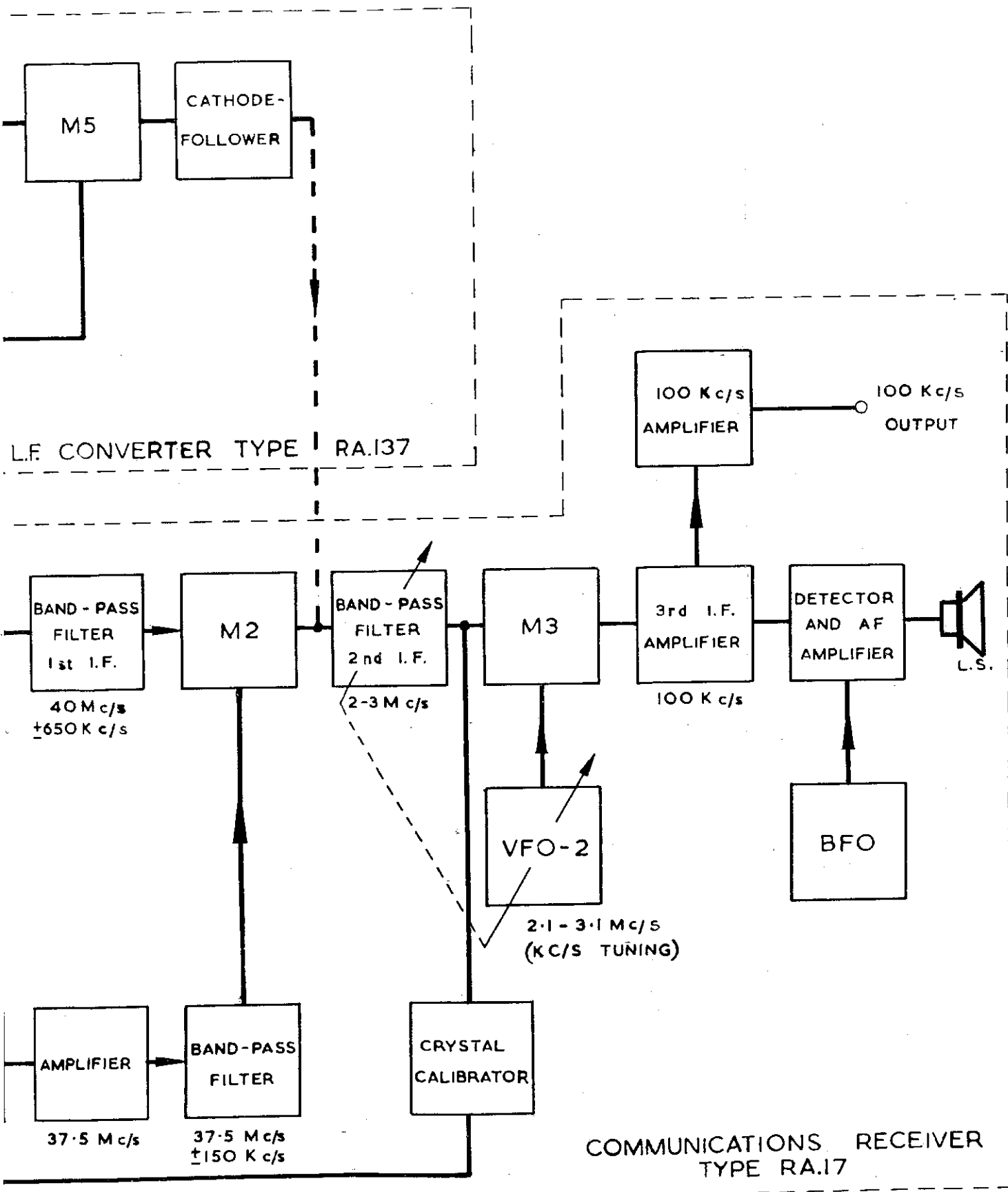
R.F. coil chassis assembly

Fig. 4



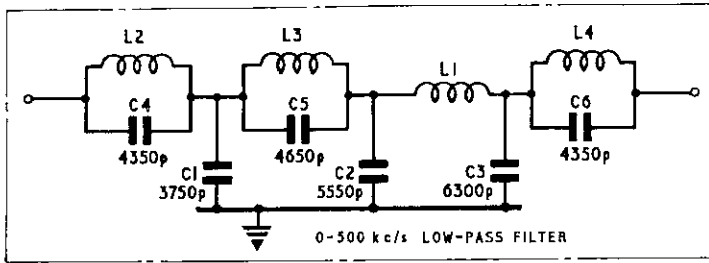
12604

BLOCK DIAGRAM

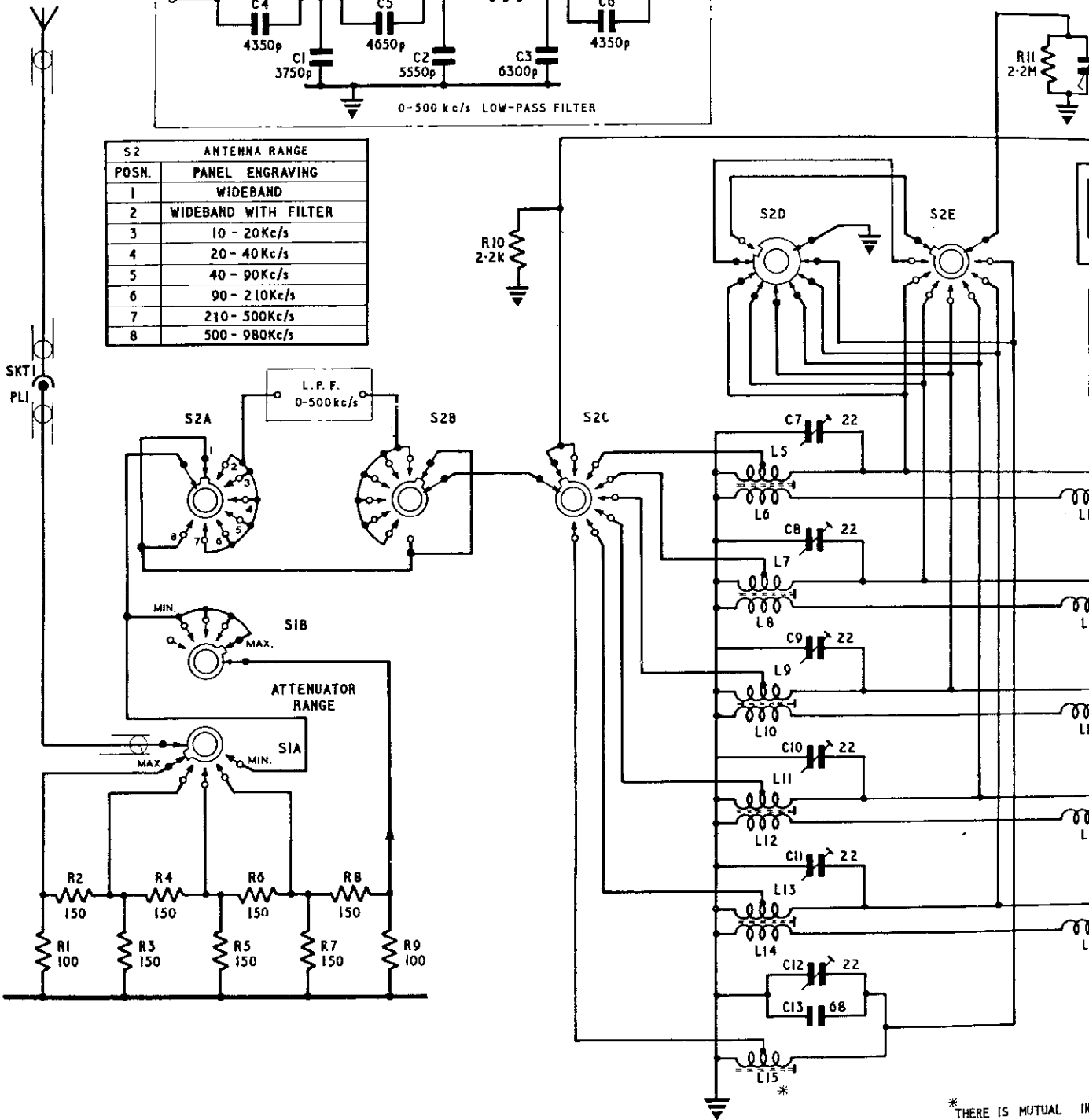


LOCK DIAGRAM

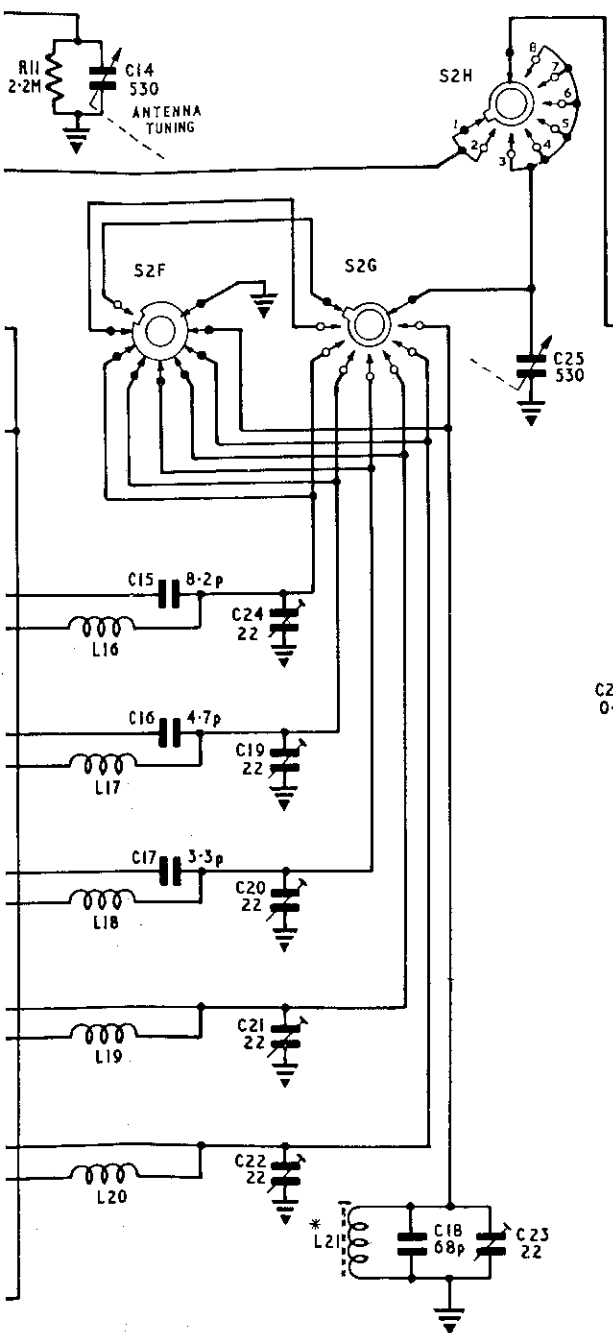
FIG. 5



S 2 ANTENNA RANGE	
POSN.	PANEL ENGRAVING
1	WIDEBAND
2	WIDEBAND WITH FILTER
3	10 - 20Kc/s
4	20 - 40Kc/s
5	40 - 90Kc/s
6	90 - 210Kc/s
7	210 - 500Kc/s
8	500 - 980Kc/s



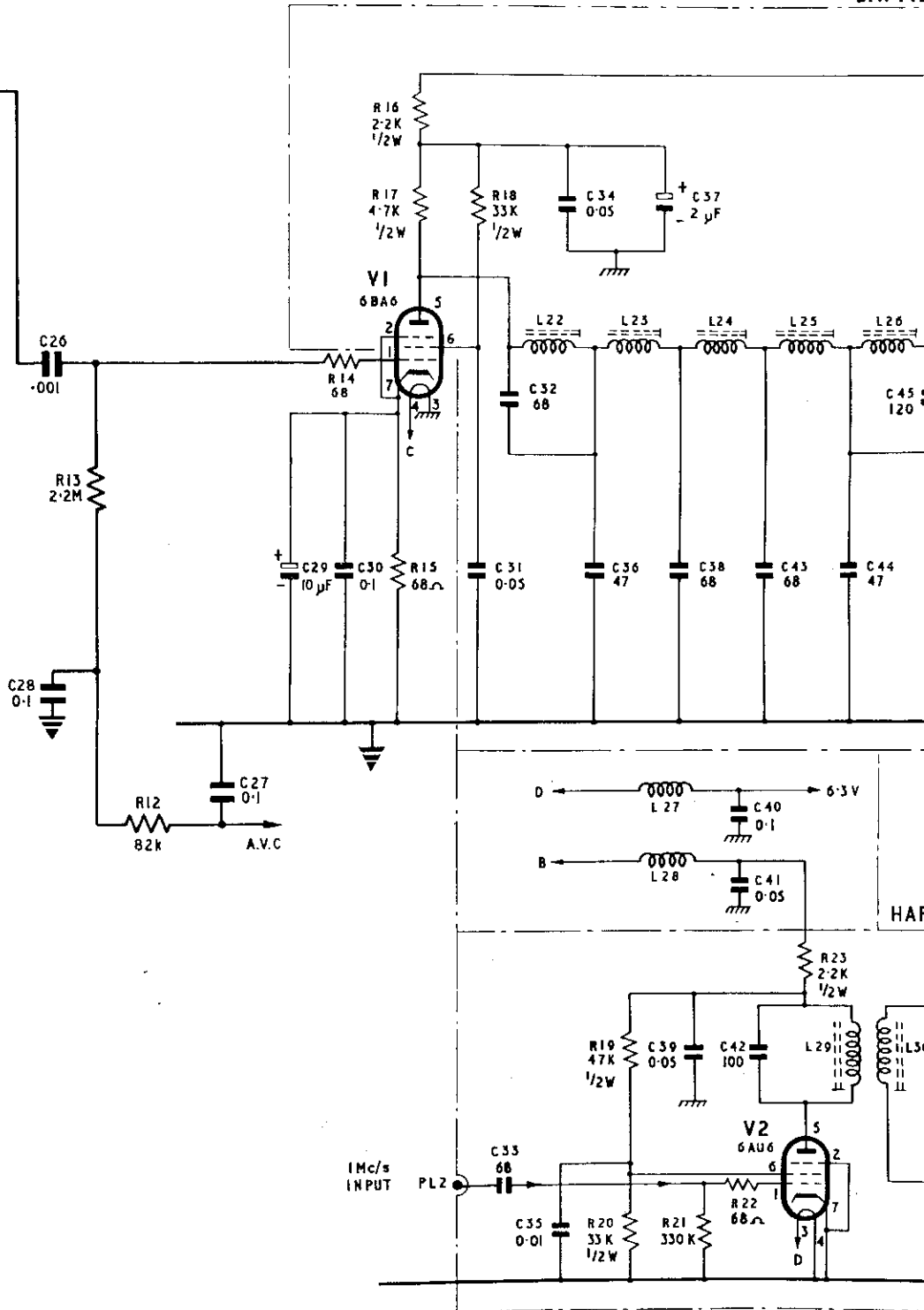
\* THERE IS MUTUAL IN



\* MUTUAL INDUCTANCE BETWEEN L15 and L21

R. F. AMPLIFIER

L. P. FILTER



L. F. CONVERTER TYPE RA.137B

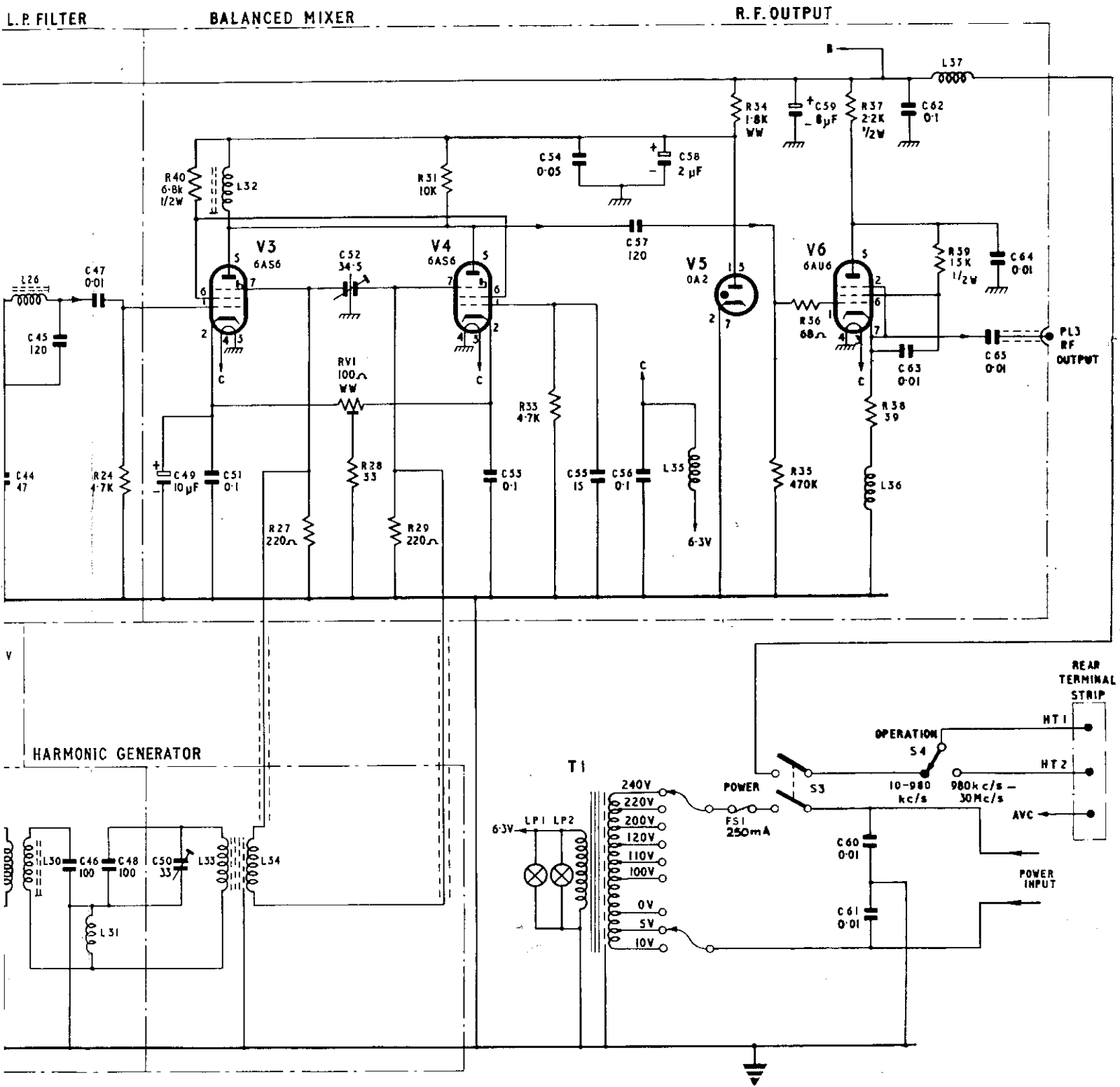


FIG.6

# Guarantee

We, Racal Electronics Limited, guarantee, subject to the following terms, to replace or, at our option, repair, free of charge, any components or parts of any goods supplied which fail within 12 months of the date of despatch solely as a result of faulty materials or bad workmanship.

1. Defective components or parts must be returned to our factory carriage paid, and any labour costs involved in refitting into an equipment will be chargeable to the customer.
2. Damage caused by unauthorised alteration or substitution of non-standard parts by incorrect installation or any third party or consequential damage or loss is not covered by this guarantee.
3. This guarantee will apply only if the equipment is bought from Racal Electronics Limited or an authorised vendor at the appropriate prices and terms.
4. Components such as electric bulbs and valves are covered by such guarantee as is given by the manufacturers of those components.
5. This guarantee cannot be altered by any person or Company other than Racal Electronics Limited.

PLEASE COMPLETE FORM BELOW AND RETURN TO SUPPLIER  
TEAR OFF HERE

---

## REGISTRATION FORM

Name of Purchaser.....

Address of Purchaser.....

Equipment Type.....

Equipment Serial Number.....

Date of Purchase.....

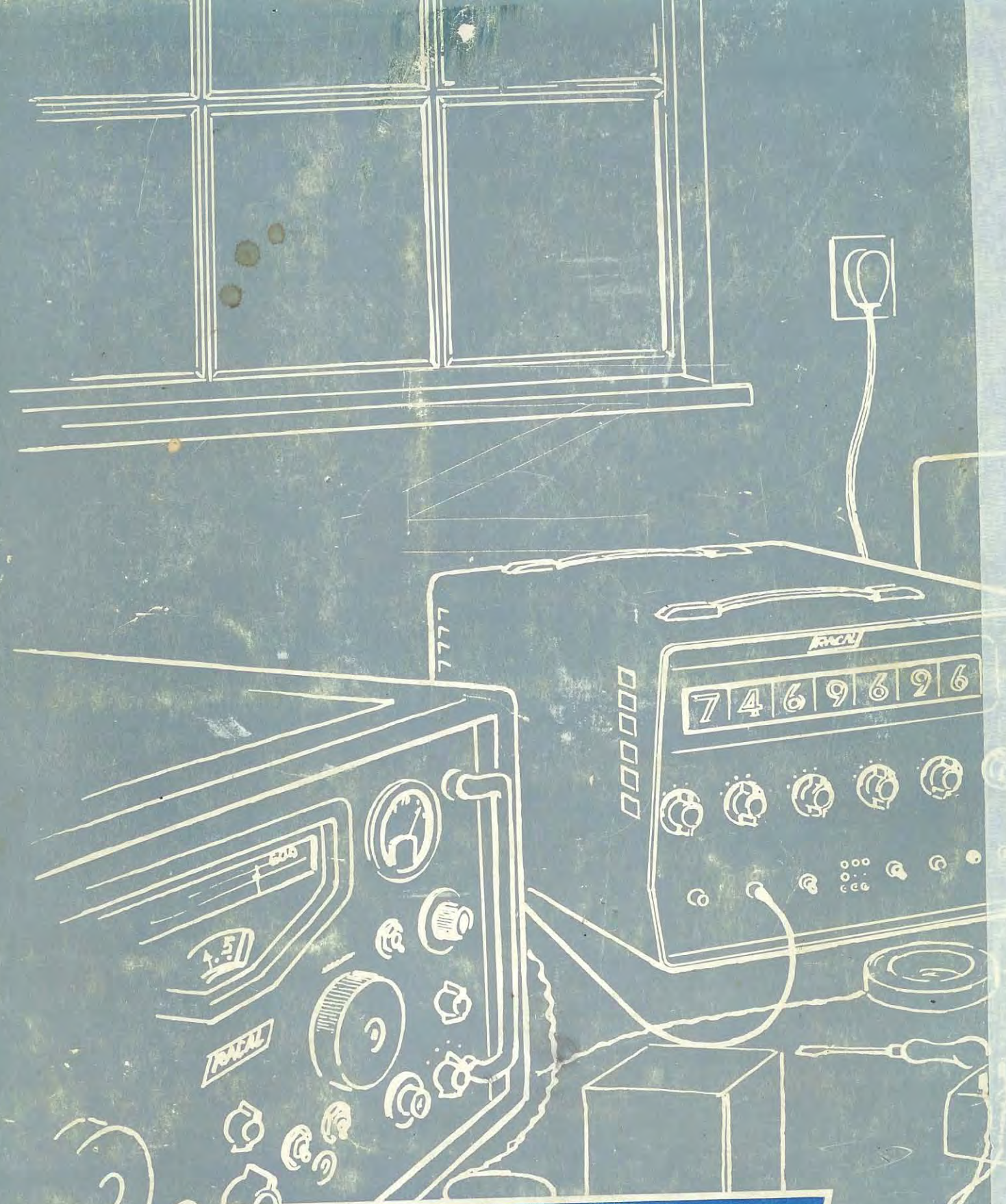
Name of Supplier.....

Address of Supplier.....

The guarantee for this equipment will not be effective unless this form is returned duly completed.

RACAL ELECTRONICS Ltd., WESTERN ROAD, BRACKNELL, BERKS.





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