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REDIFON

Technical Information

Instruction Manual
for
10 CHANNEL MF/HF
SSB RECEIVER
Type R499.A

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Addendum No 1 to
Handbook No 887-1
For N.Z. D.C.A. R499

Remote Control Circuit
for N.Z. D.C.A. Receiver Type R499

Contents

SAFETY FIRST

The operation of electronic equipment involves the use of voltages which may be sufficiently high to endanger human life. Although every practicable safety precaution has been incorporated in this equipment the following rules should be observed:—

The power should be removed completely and any high voltage capacitors in power supplies discharged manually with a shorting bar before changing valves or making internal adjustments.

Under no circumstances should any person reach within a unit for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

Under no circumstances should interlock switches be removed, short circuited or tampered with in any way by other than authorised maintenance personnel; nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

1 Introduction

This addendum describes additional circuits added to an R499 receiver to provide remote facilities via cables having a loop resistance of 2500 ohms.

The controls concerned are BFO ON/OFF and Pitch, RF Gain/Squelch, and Fine Tune.

2. Operation

Refer to R499A Handbook Chapter 5

2.1 R499A Controls. For remote operation set:-

(a) Standby/Off/On switch to ON

(b) Local/Remote switch to REMOTE

(c) RF Gain Control to maximum clockwise with switch operated.

(d) AF Gain control to Red Spot

(e) The Audio switch to the mid position

(f) AGC switch to NORMAL

(g) The preset Squelch control as for local use

(h) BFO control to maximum counterclockwise

Note that BFO remote is only operative if R499 service switch is set to CW

2.2 Remote Controls

BFO On/Off and Pitch

Clockwise rotation of the BFO control from fully counterclockwise first operates a switch to turn the BFO ON: further rotation varies the pitch of the CW note.

RF Gain and Squelch Control

Counter clockwise rotation of the RF Gain control from the fully clockwise position first operates a switch to remove squelch; further rotation reduces the R499 RF Gain.

Fine Tune

Rotation of this control varies the reinsertion oscillator above or below nominal. Full excursion approximately 100Hz.

3 Circuit Description

3.1 Connections to R499

Fig 1 shows the connections of the remote control PCB, to the R499 Referring to R499 Fig 10.3, the IF, detector and AF circuits, the following circuit alterations are made to allow connection of the PCB

(a) Connection removed between Reinsertion Oscillator Pin 18 and BFO Pin 1.

(b) Connection removed between SKF20 and line to TSA-30 (R179 slider).

(c) Earth removed and SKF11 linked to TSA18.

(d) Local/Remote switch SH is converted to four pole two way.

(e) Remote Control Connections (Fig 1) are soldered connections to the R499 wiring and not via interconnection sockets or terminals. Terminal 4 of the BFO (R499 Fig 6.6) is the junction of C1 and C2ab.

3.2 BFO ON/OFF and Tone Control

When RV1 switch (Fig 2) is operated at the remote site, the line to R499 SKF13 is energised. The Schmitt trigger VT1, VT2 (Fig 3) operates and current amplifier VT3 applies approx. +19V to Pin 1 of the BFO, at the same time the base of current amplifier VT4 is made positive. Movement of RV1 slider (Fig 2) allows VT3 to remain hard on, but varies the current through VT4. VT4 in turn controls the capacitance of varactor diodes MR2 and MR3, (MR1 is a linearizing diode) which are effectively across the BFO inductor L1. The BFO frequency is therefore controlled from RV1 over a range of 1·4MHz ±3kHz.

The +20V supply for VT1 to VT3 (Pin 4) is taken effectively, from the CW position of R499 service switch SB2 and the BFO is therefore only on for CW service.

Fig 1 shows contacts SHc of the Local/Remote switch, in the Local position SHc connects pins 1 and 2 of the remote control unit. This sets the Schmitt trigger on and the varactor capacitance to minimum. The BFO is then controlled locally via R499 front panel control of C1.

3.3 RF Gain and Squelch Control

When RV2 switch (Fig 2) is operated at the remote site, the line to R499 SKF20 is energised. The Schmitt trigger VT7, VT8 operates and VT9 is turned hard on via zener MR4, the squelch line of the R499 is then earthed via TSA22. Movement of RV2 slider allows VT9 to remain hard on but varies the output of amplifier VT5, VT6, and thus the potential at the slider of the R499 RF Gain control R179.

Fig 1 shows contacts SHd of the Local/Remote switch, in the local position the +20V supply is removed and VT5 to VT9 are disabled, restoring control to the R499.

3.4 Fine Tune

The remote Fine Tune control is the standard R499 system, but is now routed via SKF11.

4 Installation

The remote control circuit board is mounted on the right hand side member of the R499 chassis in the compartment containing the channel crystal oven. In cases where the BFO board is not required, its control circuitry is still contained on the remote control board so that it can be added later, with a minimum of additional wiring.

The remote lines are all taken from SKF as follows:-

BFO ON/OFF & Pitch Control	SKF13
RF Gain/Squelch	SKF20
Fine Tune	SKF11

The loop resistance for each control circuit can be up to 2500 ohms without significant deterioration in performance, for loop resistances above this limit, the Schmitt triggers may not operate reliably, but the 20V supply voltage at the remote control end could be increased to overcome this.

The earth return path for each loop can be common if a low resistance earth (say up to 500 ohms) exists between sites, otherwise a separate earth line for each loop should be provided. These separate earths would all be commoned at the R499 earth terminals of SKF which are pins 16, 23 and 25.

5 Servicing Information

The following circuit voltages are provided as a guide when servicing. Refer to Fig 3. Test equipment AVO 8 or similar and remote controls similar to Fig 2, but with a 2kΩ resistor in series with each slider to simulate long lines. For test purposes the 20V supply can be taken from the R499 SKF 17.

Set R499 to remote and switch on, set BFO control to minimum capacity (+ on control knob), set RF gain control squelch position.

(a) BFO Circuits

Pin 2	3•5V to 16•5V	excursion of remote BFO pitch control.
VT4 Base	2•5V to 10V	excursion of remote BFO pitch control.
VT4 Collector	9•25V to 17V	excursion of remote BFO pitch control.
VT4 Emitter	2V to 9V	excursion of remote BFO pitch control.

BFO Frequency Excursion 1•4MHz ±3kHz approx.

VT4 Base 3•5V Turns trigger on and drops to 3•0V

VT4 Base 2•4V Trigger OFF Trigger minimum operating

VT4 Base 2•6V Trigger ON Conditions.

VT1 Collector 2•0V Trigger ON

VT1 Collector 11•0V Trigger OFF

VT2 Collector 19•5V Trigger ON

VT2 Collector 2•5V Trigger OFF

VT3 Emitter 19•0V Trigger ON

VT3 Emitter 2•0V Trigger OFF

(b) RF Gain & Squelch Circuits

Pin 3 4•0V to 17•0V excursion of Remote Gain Control

VT5 Base 4•0V to 15•5V excursion of Remote Gain Control

VT5 Collector 15•0V to 19•5V excursion of Remote Gain Control

VT5 Emitter 3•5V to 14•5V excursion of Remote Gain Control

VT6 Base 0•5V to 10•5V excursion of Remote Gain Control

VT6 Collector 11•5V to 19•5V excursion of Remote Gain Control

VT6 Emitter 0•3V to 10•0V excursion of Remote Gain Control

VT7 Base 3•5V turns trigger on and drops to 3•0V

VT7 Base 2•4V Trigger OFF) Trigger minimum

VT7 Base 2•6V Trigger ON) operating conditions.

VT7 Collector 2•0V Trigger ON

VT7 Collector 11•0V Trigger OFF

VT8 Collector 15•0V Trigger ON

VT8 Collector 2•5V Trigger OFF

VT9 Base 0V Trigger OFF

VT9 Base 0•7V Trigger ON

VT9 Collector 0V Trigger ON

VT9 Collector 18•5V Trigger OFF

6 Component List Remote Control Unit

Capacitors

C1	•047μF ±20% 100V PMA0•047M100 STC
C2	•047μF ±20% 100V PMA0•047M100 STC
C3	2200pF ±2% PF/AB/G SUFLEX
C4	•047μF ±20% 100V PMA0•047M100 STC

Resistors

R1	1kΩ 5% Electrosil TR5
R2	10kΩ 5% Electrosil TR5
R3	10kΩ 5% Electrosil TR5
R4	1kΩ 5% Electrosil TR5
R5	10kΩ 5% Electrosil TR5
R6	10kΩ 5% Electrosil TR5
R7	2•2kΩ 5% Electrosil TR5
R8	68kΩ 5% Electrosil TR5
R9	1kΩ 5% Electrosil TR5
R10	1kΩ 5% Electrosil TR5
R11	100kΩ 5% Electrosil TR5
R12	1MΩ 5% Electrosil TR5
R13	10kΩ 5% Electrosil TR5
R14	1kΩ 5% Electrosil TR5
R17	2•2kΩ 5% Electrosil TR5
R18	1kΩ 5% Electrosil TR5
R19	10kΩ 5% Electrosil TR5
R20	10kΩ 5% Electrosil TR5
R21	1kΩ 5% Electrosil TR5
R22	10kΩ 5% Electrosil TR5
R23	10kΩ 5% Electrosil TR5

Transistors

VT1	Mullard BC107
VT2	Mullard BC107
VT3	Mullard BFY51
VT4	Mullard BC107
VT5	Mullard BC107
VT6	Mullard BFY51
VT7	Mullard BC107
VT8	Mullard BC107
VT9	Mullard BFY51

Diodes

MR1	Hughes HG5007
MR2	Hughes HC7002
MR3	Hughes HC7002
MR4	Mullard BZY88C15
MR5	Mullard BZY88C3V9

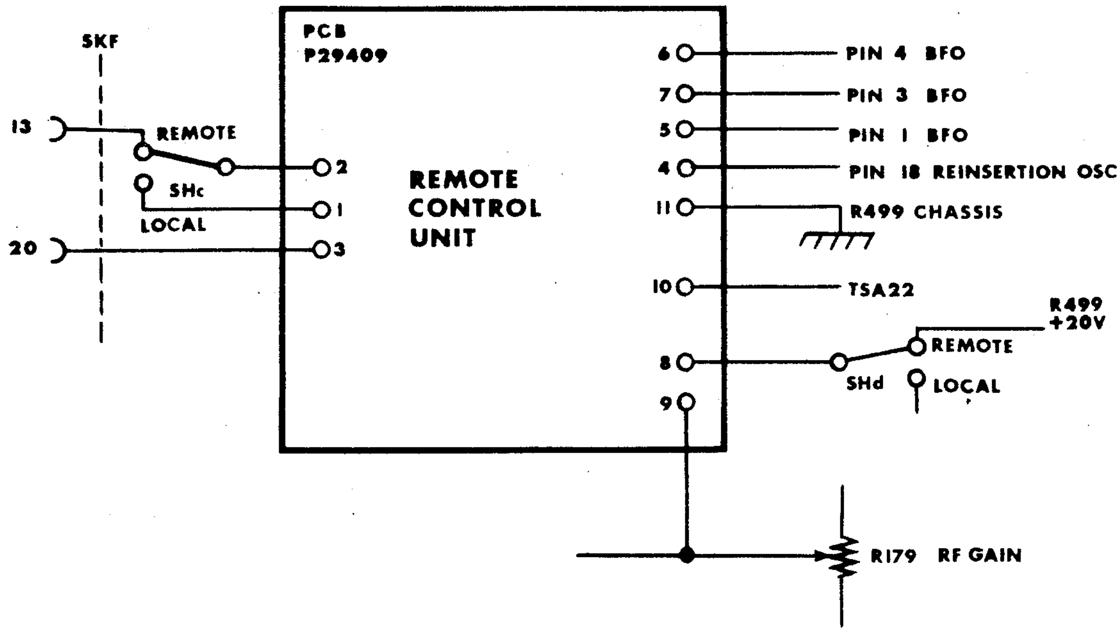


FIG. 1 REMOTE CONTROL CONNECTIONS

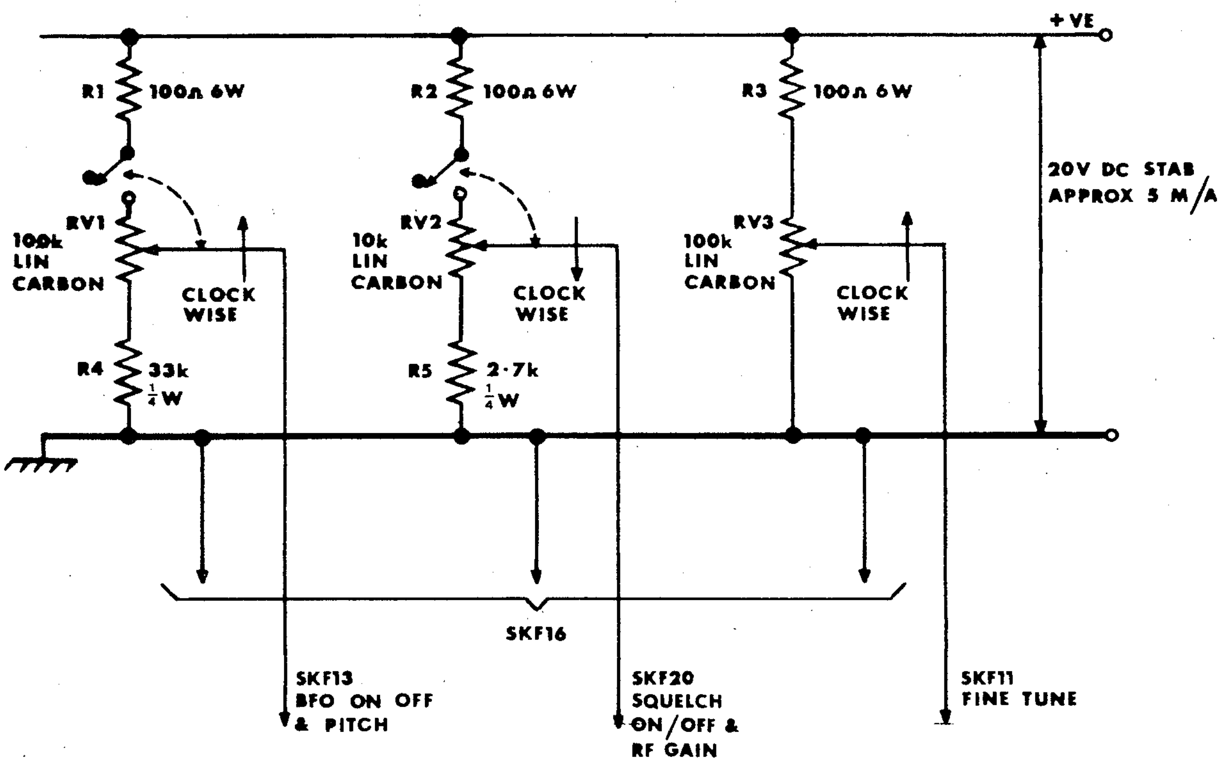
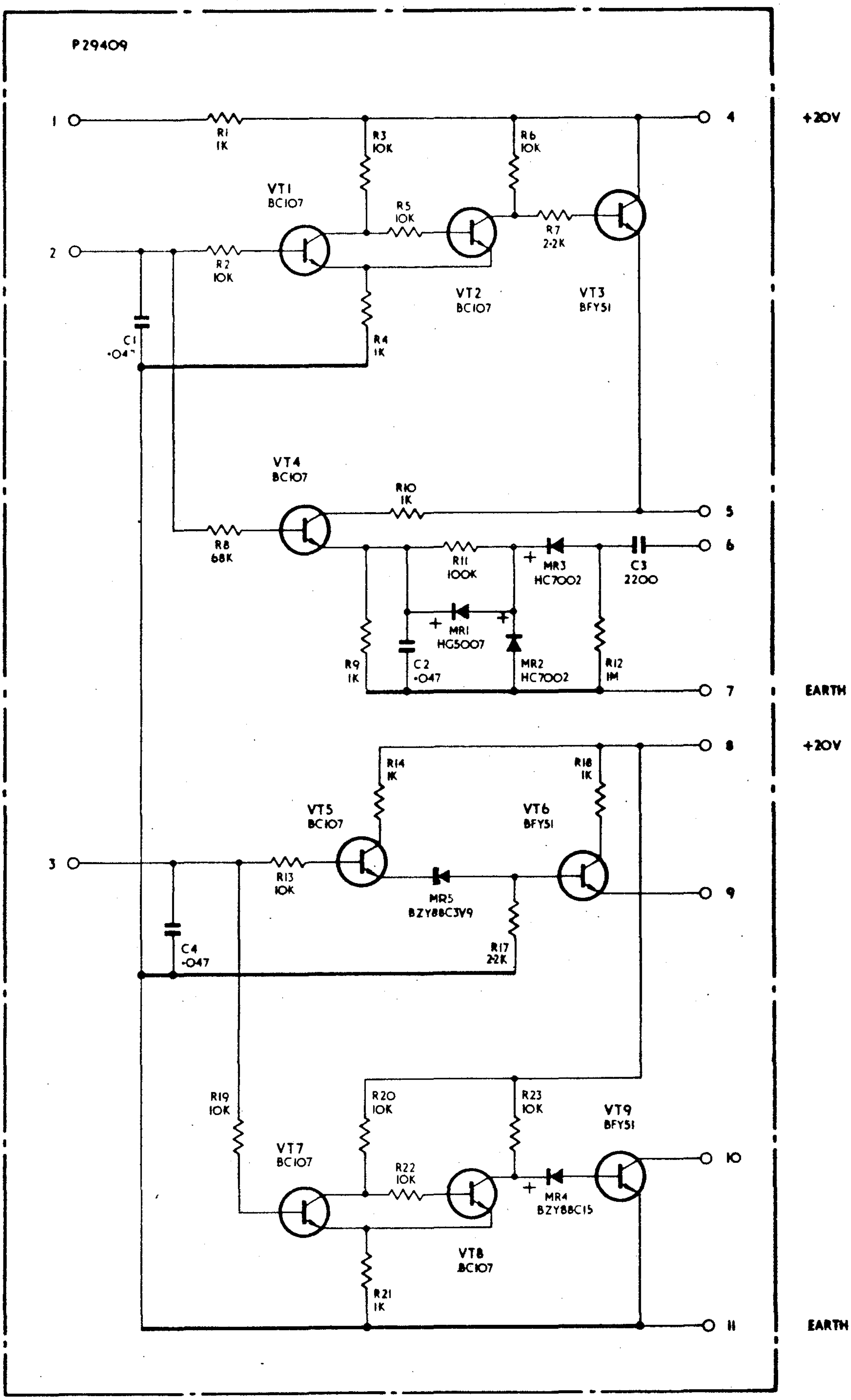
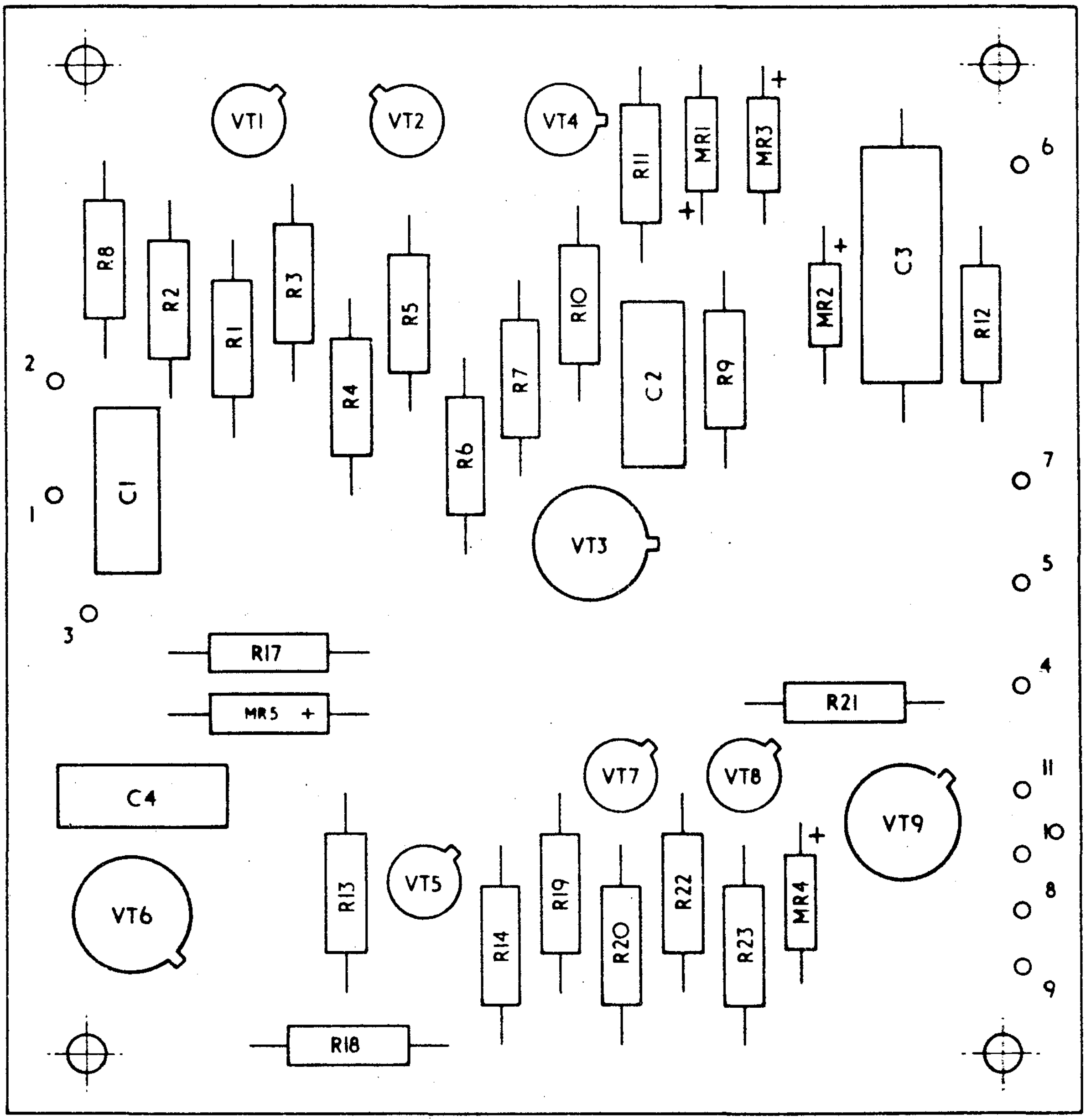


FIG. 2 REMOTE CONTROLS



887-1 Circuit Diagram of Remote Control Unit Fig 3



 Component Layout of Remote Control Unit Fig 4

AMENDMENT

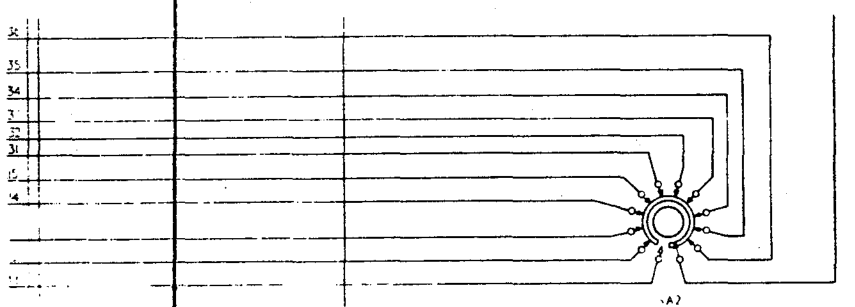
Handbook No. & Issue... 887-1
Handbook Title... R499A RECEIVER
Amendment Sheet No.... 1
Date of Issue... MARCH 1970

Page/Drg. reference	Details of Amendment(s)
Fig. 10.2 Circuit diagram of RF AMPLIFIER, FREQUENCY CHANGER AND POWER UNIT.	Transistor VT8. Amend type to read "40235". Diodes MR34 and MR37. Amend type to read "BYX38-600R" Add Ferrox sleeve, (FX2) to the relay end of the lead connecting pin 1 of socket SKF to relay RLA/1.
Fig. 10.3. Circuit diagram of IF DETECTOR AND A.F. STAGES	Add Ferrox sleeve, (FX1), to the capacitor end of the "I.F. OUT" screened lead connecting C57 to socket SKE. Resistor R95. Amend value from 5.6K to 3.3K. Delete lead connecting pin 3 of switch SB6 to junction of R79/R80. Show pin 3 of SB6 as connected to the lead from the junction of R80/R81 to pins 4 and 5 of this switch. Delete the earth braid connection from the coaxial lead terminating on pin 5 of switch SB7
Fig. 10.5 REMOTE CONTROL SYSTEM	<u>RC116/ISB CONTROL UNIT</u> Resistors R1, R3, R4, R5 and R8. Amend value of these resistors to read 330 ohms. Plug PLA, pins 6 and 14. Amend pin 6 to read U.S.B. and pin 14 to read L.S.B.
Component List for RECEIVER R499A (CLA5642-1).	
Page 11-2	Resistor R95. Amend value from 5.6 Kohm to 3.3 Kohm.
Page 11-3	Thermintor TH1. Amend description to read :- "Mullard VA 1038". Resistor R180. Amend value from 470 ohm to 820 ohm. Resistor R181. Amend value from 820 ohm to 470 ohm.
Page 11-4	Transistor VT8. Amend description to read :- "RCA 40235". Diodes MR34 and MR37. Amend description to read :- "Mullard BYX38-600R".
Page 11-5	Add under new sub-heading "FERROX CUBE TUBE" the following items :- FX1 Mullard FX1243. FX2 Mullard FX1243". Switch SC. Amend description to read :- "Fujisoku MST 205 P". Switch SD. Amend description to read :- "Fujisoku MST 205N". Switch SF. Amend description to read :- "Fujisoku MST 105E". Crystal Oven 1. Amend description to read :- "To Spec. 2/OP9293/S". Crystal Oven 2. Amend description to read :- "Cathodeon type D4. 12/24V. 75 C.

AMENDMENT

Handbook No. & Issue... 887-1
Handbook Title... R499A RECEIVER
Amendment Sheet No.... 2
Date of Issue... MARCH 1970

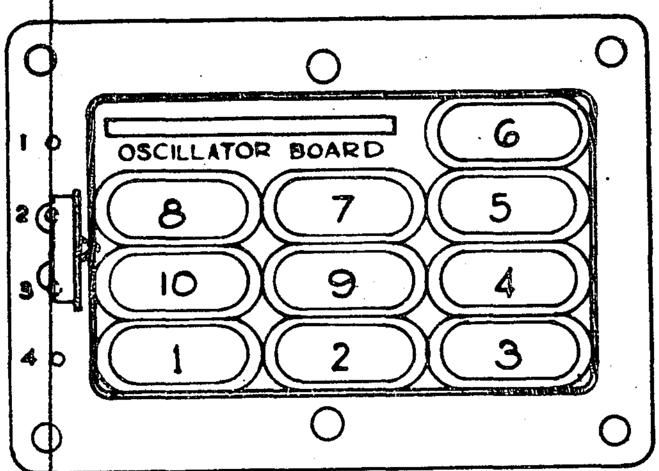
Page/Drg. reference	Details of Amendment(s)
Component List for REMOTE CONTROL UNIT RC116A (CLA5652-1). Page 11-6	Switches SA and SE. Amend description to read :- "Fujisoku MST 115D" Switch S3. Amend description to read :- "Fujisoku MST 105E". Resistors R1 R3, R4, R5 and R8. Amend value of these resistors from 180 ohm to 330 ohm, and increase tolerance from ± 5% to ± 10% Add new item as follows :- "SKTA - SOCKET, 18-way, Belling Lee, L656/S"
Component List for MOTOR SWITCHING UNIT (REMOTE CONTROL SYSTEM R116) (CLA 5653-1) Page 11-6	Add new item as follows :- "PLA - PLUG, 18 way, Belling Lee, L656/P".
Chapter 8. Page 8-2	AUDIO SYSTEM; Squelch System. Under Sub-heading "FURTHER TEST", in line 2 of instruction (1), amend "SKP" to read "SKF". I.F. AMPLIFIER. In instruction (3) delete last sentence beginning "If the meter ...., and substitute new sentence "Failure of the meter to deflect indicates a fault in the reinsertion oscillator."
Fig. 10.7 Circuit diagram of I.F. FILTER C.W.	Transformers T1 and T2. The cores of these transformers should be shown as adjustable.
Fig. 10.2 RF Amplifier, Frequency Changer and Power Unit.	Mixer Sub-Assembly. Change diodes quad (Comprising MR6-7-8-9) HBX31 to BAX41.
Component List Section 11, Page 11-4	Diodes MR6, 7, 8 and 9. Delete Hughes HBX31 and insert S.G.S. (U.K.) BAX41.
Fig. 10.5 Remote Control System. Motor Switching Unit.	Motor switching units produced after December 1969 have six additional wires connected to switch SA2, illustrated below. Units incorporating this modification will have the figure 1 struck through on the modification record label. Wires 31 to 36 are only required when the switching unit is fitted onto a GK202A equipment. When used in conjunction with the R499A these six wires may be removed or alternatively they may be connected to a single isolated terminal.



AMENDMENT

Handbook No. & Issue... 887-1
Handbook Title... R499A RECEIVER
Amendment Sheet No.... 3
Date of Issue... MARCH 1970

Page/Drg. reference	Details of Amendment(s)
Fig. 10.5	Amend page titling to read REMOTE CONTROL SYSTEM.
Page 11-6 Component List Remote Control Unit RC116A.	Under DIODES amend MR3 to read Mullard BZY95-C20
Fig. 10.5 Remote Control System	Diodes MR3 amend to read BZY95-C20.
Page 6-6 Circuit Description. Fig 10.2	Refer to Channel Oscillator section. Crystal Oven switch SA4. The following diagram should be used to assist correlation of positions 1 to 10 of the Channel Oscillator switch and crystal sockets within the crystal oven.



AMENDMENT

Handbook No. & Issue... 887-1
Handbook Title... INSTRUCTIONAL MANUAL FOR 10 CHANNEL MF/HF SSB RECEIVER TYPE R499A
Amendment Sheet No.... 4-1
Date of Issue... APRIL 1972

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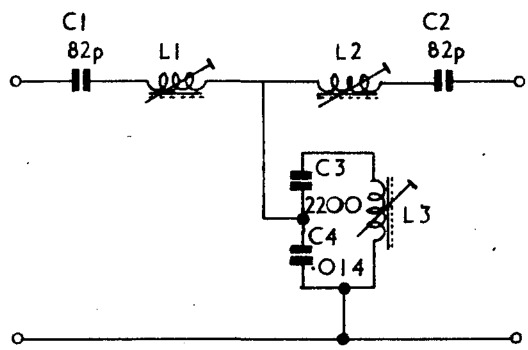
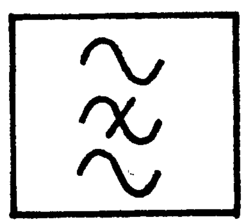
Page/Drg. reference	Details of Amendment(s)
SECTION 3. PAGE 3-2 Para 2.	Amend line 1 to read : For signal frequencies above 16 MHz, Amend line 5 and 6 to read : For signal frequencies below 16 MHz, the frequency of
CIRCUIT DIAGRAM 1.4 MHz BANDPASS FILTER FL2. FIG. 10.6 (CDA5662/S)	The filter has been redesigned in order to stop mixer leakage at 30 MHz from exceeding the A.G.C. threshold of the I.F. amplifier by improving attenuation of the I.F. filter above 20 MHz. This change constitutes Modification No.3 to the R499A and when embodied the figure 3 is struck through on the Modification Record Label.



Page/Drg. reference	Details of Amendment(s)
R.F. AMPLIFIER, FREQUENCY CHANGER AND POWER UNIT FIG. 10.2	R.F. Amplifier Board : Transformers T2, T6 and T7 have been replaced by auto transformers to give improved signal to noise ratio. See attached Drawing No.CDA.5642/X Sheet 1.
Block Diagram FIG. 10.1	R.F. Board : The symbol detail at the I.F. Trap and Image Filter depicts Band Pass when it should indicate Band Stop. e.g.



E. Briggs (P.D.S. Engineer)

AMENDMENT

Handbook No. & Issue. . 887-1
Handbook Title. . INSTRUCTIONAL MANUAL FOR 10 CHANNEL MF/HF SSB RECEIVER TYPE R499A
Amendment Sheet No. . . 4-2
Date of Issue. . . APRIL 1972

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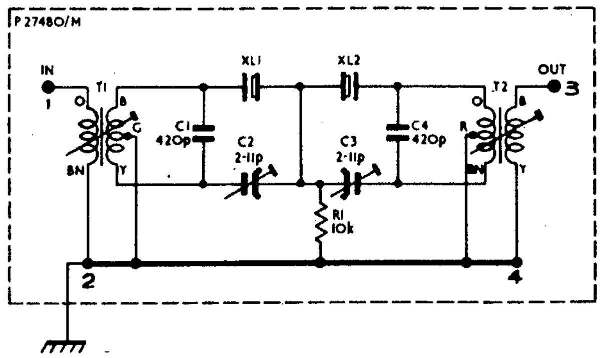
Page/Drg. reference	Details of Amendment(s)
IF FILTER CW FIG. 10.7 CDA5647/S	Circuit diagram. Add the following annotations. Immediately below the IN terminal add the numeral 1. Immediately below the OUT terminal add the numeral 3. At the junction where connection BN on T1 joins the chassis rail add the numeral 2. At the junction where connection Y on T2 joins the chassis rail add the numeral 4. 
REMOTE CONTROL SYSTEM FIG. 10.5	Resistors R5 and R6 amend value to read 10Ω.
COMPONENT LIST MOTOR SWITCHING UNIT. PAGE 11-6	Under RESISTORS amend R5 and R6 value to read 10Ω This change constitutes modification No.2 to the Motor Switching Unit, part of the Remote Control System RC116 and when embodied the figure 2 must be struck through on the Modification Record Label.
COMPONENT LIST RECEIVER R499A PAGE 11-5	Crystal Ovens. Oven 2 amend Redifon Spec. 2/OP9293/S to read 5/OP5704/S.
COMPONENT LIST MOTOR SWITCHING UNIT PAGE 11-6	Under RELAYS amend to read : RLA Redifon to Spec. OP.5638/S
R499A IF DETECTOR AND AF STAGES FIG. 10.3	Hybrid X2 : Connections 1 and 2, 9 and 10 are now transposed, in order to correct an original circuit error. See attached diagram CDA.5642/X Sheet 2, FIG.10.3

E. Briggs (P.D.S. Engineer)

AMENDMENT

Handbook No. & Issue. . 887-1
Handbook Title. . INSTRUCTION MANUAL FOR 10 CHANNEL MF/HF SSB RECEIVER TYPE R499A
Amendment Sheet No. . . 4-3
Date of Issue. . APRIL 1972

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Page/Drg. reference	Details of Amendment(s)
SECTION 6 CHANNEL OSCILLATOR PAGE 6-6	Introduction. Amend second line to read : on two printed circuit boards P27471 and P27472, as shown in Fig. 10.2. Basic Oscillator. Para 3. Line 5 delete: oscillator and substitute signal.
COMPONENT LIST R499A PAGE 11-5	Under SWITCHES, against SC delete details and amend to read : FUJISOKU MST 205P SD delete details and amend to read : FUJISOKU MST205N SF delete details and amend to read : FUJISOKU MST 205E
REMOTE CONTROL SYSTEM FIG. 10.5	Capacitor C1 amend value to read 470
COMPONENT LIST MOTOR SWITCHING UNIT PAGE 11-6	Under CAPACITORS delete all details against C1 and insert the following 470 µF $^{+100\%}_{-20\%}$ 63V Plessey 439/1/15621/451
COMPONENT LIST RECEIVER R499A CLA. 5642-1 PAGE 11-1	Under CAPACITORS amend the tolerances of the following to read + 100% - 20% C12, C55, C61, C67, C83. Amend C29, C47, value to read 4.7 µF Amend C65, C66, C73, C85 and C87 value to read 47 µF.
PAGE 11-2	Under RESISTORS amend the value of R95 to read 3.3 KΩ R180 to read 820Ω R181 to read 470Ω Under THERMISTORS TH1 amend to read Mullard VA1038
PAGE 11-4	Under TRANSISTORS amend VT8 details to read RCA.40235 Under DIODES amend MR6, 7, 8 and 9 details to read S.G.S. (U.K.) BAX41. Amend MR34 and MR37 details to read Mullard BYX38-600R

E. Briggs (P.D.S. Engineer)

AMENDMENT

Handbook No. & Issue... 887-1
Handbook Title... INSTRUCTION MANUAL FOR 10 CHANNEL MF/HF SSB RECEIVER TYPE R499A
Amendment Sheet No.... 4-4
Date of Issue... APRIL 1972

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Page/Drg. reference	Details of Amendment(s)
PAGE 11-5	Immediately above SOCKETS add : FERROX CUBE TUBE FX1 Mullard FX1243 FX2 Mullard FX1243 Under CRYSTAL OVENS amend Oven 1 details to read : 24V 75 C to Redifon Spec. 2/OP9293/S.
PAGE 11-6 REMOTE CONTROL UNIT. RC116A	Under RESISTORS amend R1, 3, 4, 5 and 8 value to read 330Ω and tolerance to read 10% Under DIODES amend MR3 details to read : Mullard BZY95-C20 Under SWITCHES amend details to read : SA FUJISOKU MST115D SB FUJISOKU MST105E SE FUJISOKU MST115D
PAGE 11-6	Under JACK SOCKETS and immediately below JKA add : SKTA 18 Way Belling Lee L656/S
COMPONENT LIST MOTOR SWITCHING UNIT.	Under SOCKETS and immediately below SKA add : PLUGS PLA 18 way Belling Lee L656/P.

E. Briggs (P.D.S. Engineer)

AMENDMENT

Handbook No. & Issue...887-1
Handbook Title...INSTRUCTION MANUAL FOR 10 CHANNEL MF/HF SSB RECEIVER TYPE R499A
Amendment Sheet No....5
Date of Issue...APRIL 1972 (APPLICABLE TO S.O.60883 AND S.O.60844 ONLY)

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Page/Drg. reference	Details of Amendment(s)
REDIFON PARTS LIST PL5653 EdnB. CIRCUIT DIAGRAM CDB5653/M.	MODIFICATION KIT FOR MOTOR SWITCHING UNIT FOR R499A AND GK.202A COMBINATION. To facilitate the use of the GK.202A 10 Channel Drive Unit when used in conjunction with the R499A receiver a Modification Kit is required.
REMOTE CONTROL SYSTEM, FIG. 10.5 COMPONENT LIST MOTOR SWITCHING UNIT (CLA5653-1), PAGE 11-6	The Mod. Kit comprises the items listed at page 11-6 in the R499A handbook less items MR5 and MR6, switch sections SA1 and SB1. Additional items are : 2 switch sections SA1, SB1 to drg.P29349/S as replacements for the original existing switch sections SA1, SB1 1 23 way terminal strip TSb, comprising 2 12 way Belling Lee type L1350. 1 Adaptor plate to drg.P29350/M 1 Label engraved to drg 338/OP5721/S 2 Cable clips INSULOID type NX2A

E. Briggs (P.D.S. Engineer)

CONTENTS

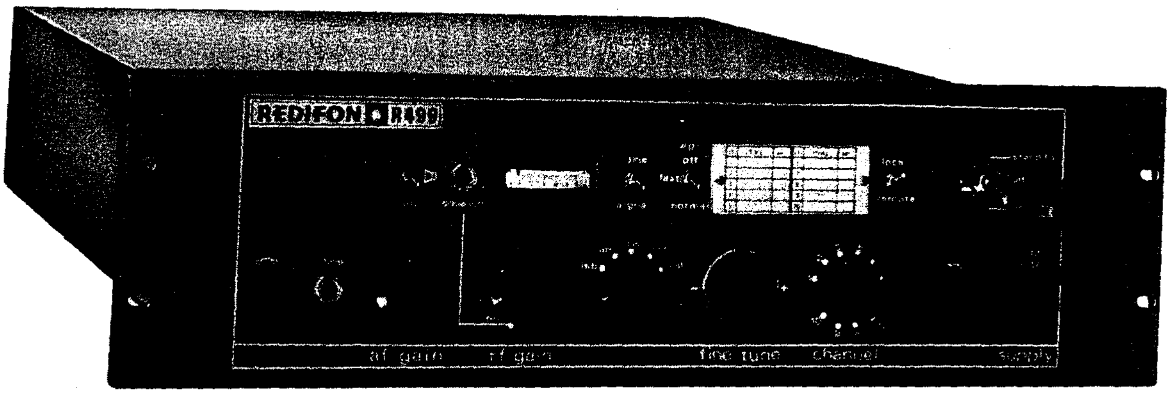


Fig. 1.1 R499A RECEIVER 887–1

1 INTRODUCTION AND SPECIFICATION

1 INTRODUCTION AND SPECIFICATION

GENERAL

This handbook describes:—

(1) the standard R499A receiver and the remote control system (comprising motor switching unit and RC116A control unit)

(2) the ISB version of the receiver (designated R499/ISB) and remote control system (comprising motor switching unit and RC116/ISB control unit)

The ISB version of the receiver is intended for use with the ARU10A ISB Adaptor which is described in a separate handbook entitled ISB ADAPTOR Type ARU10A.

The R499A is a solid state receiver designed for a variety of applications in point-to-point communications. It is especially adaptable to the requirements of individual systems. The receiver employs single frequency conversion and a nominal IF of 1.4 MHz, with an AM detector and a separate product detector for reception of SSB signals. The basic version is for SSB service, but by appropriate specification of optional filters and BFO as internal sub-units, full CW and DSB modes of reception are possible. When used in conjunction with the type ARU10A ISB Adaptor unit, the receiver can be used for the reception of ISB transmissions.

FREQUENCY COVERAGE

The basic frequency coverage is 1.5 MHz to 30 MHz, but filters can be fitted to give additional coverage of the 255 kHz to 525 kHz band. Pre-aligned HF filter sets are available for fitting after the receiver has been installed, if desired.

RECEPTION MODES

Crystal filters are fitted according to the services required, and are available for CW, SSB, DSB and ISB modes of operation. The CW filter is optional for all versions of the R499, as is also the BFO module. The CW filter and two other filters can be fitted.

By suitable choice of local oscillator crystals, to translate the wanted signal to an IF signal within the 3 kHz passband of the SSB filter, and by selecting the frequency of the re-insertion oscillator (two frequencies are available, selected as required by the Channel switch), the SSB filter may be used for the reception of the modes of transmission detailed in the specification.

For optimum reception of A1 however, use of the CW filter with a 200 Hz bandwidth, is recommended. For A3, optimum performance is achieved by use of the DSB filter which has a 6 kHz bandwidth.

AGC

Comprehensive distributed AGC is employed with different decay and attack times for various modes of operation. The full decay time is dependent upon accumulation of signal for 200 msec or more, which prevents short bursts of noise from paralysing the receiver. The decay time is automatically selected by a front-panel Service switch, but an additional switch enables the decay time-constant to be divided by three, and is of use during rapid fading. The AGC can be switched off when not required.

Two AGC systems are incorporated. One is operated by the output from the RF amplifier and controls an attenuator at the front end. The other is fed from the last IF stage and is applied in sequence over three IF stages, as well as supplementing the front-end AGC action. Thus the aerial circuit is capable of withstanding an input of 30V e.m.f. from a 50 ohm source.

IF AND AF GAIN

In addition to selecting the bandwidth and AGC constants appropriate to the required service, the Service switch also adjusts IF and AF gain so that:
(1) All services give virtually the same AF output level (provided only that the signal is above AGC threshold).
(2) Any signal which is large enough to provide approximately 14 dB signal-to-noise ratio also provides full AF output e.g. for a given signal-to-noise ratio, a much smaller signal is required in CW mode than in, for example, AM mode; this is because of the narrower bandwidth of CW filters. Thus, the IF gain is increased for CW reception so that a small CW signal can be heard.

SQUELCH

A squelch system is incorporated. To guard against incorrect setting of the squelch control and consequent loss of wanted signals, the squelch does not completely cut off all output, but reduces it by approximately 30 dB so as to keep the audio noise output below annoyance level. This serves as an indication that the receiver is still operative and allows wanted signals to be heard even if the squelch has been set at too high a level.

OPTIMUM CONTROL SETTINGS

To assist operators unfamiliar with the receiver, typical or normal settings of controls are indicated by red spots. Once the controls are set to the indicated positions, relatively few adjustments to the controls need be made. As a built-in check, the Service switch has a TEST setting at which an output from the carrier reinsertion oscillator is injected into the first IF stage. Correct operation of the IF stages at this setting is indicated by a 'test' reading on the front panel S-meter.

ADDITIONAL FACILITIES

For ISB reception, the ARU10A Adaptor is employed. One sideband filter is fitted in the R499A and the other in the ARU10A. Sideband filters for this purpose are available with bandwidths of 2.75kHz or 5.75 kHz. The R499A and the ARU10A have separate AGC systems and line outputs with associated level adjustments. In addition, each unit has its own meter for monitoring of incoming signals and line levels. The internal loudspeaker in the R499A can be switched to monitor the output from either unit.

2 INSTALLATION

2 INSTALLATION

UNPACKING

On receipt of the equipment, check the packing cases for signs of damage and the contents for shortages. The carriers should be notified within three days if severe damage or shortage exists.

INSPECTION OF EQUIPMENT

The receiver is supplied wired and fitted with the filters and crystals necessary to meet the requirements specified in the customer's order.

Remove the top cover from the receiver and check that the following items are securely inserted.

Channel oscillator crystals
HF filter sets
Power supply relay RLC
Indicator lamps

Check that the frequencies and services listed on the front panel chart are as ordered.

Check that the fuses are intact, are secured in their holders, and are of the specified rating.

Fuse	*Location*	*Rating*
FS1	on RF board	100mA
FS2	on rear panel	0.5A anti-surge 200-250V
FS3	on rear panel	1A anti-surge 100-125V
FS4	on rear panel	4A
FS5	on front panel	1A

Remove the cover from the motor switching unit (if fitted) and ensure that the plug-in relay RLA is securely inserted.

MOUNTING OF EQUIPMENT

The receiver and the remote control unit are both designed for 19 inch rack mounting and can be accommodated in a rack or in a desk type cabinet. The receiver must never be fixed in such a way that all the weight is taken by the front panel; if rack mounted, it should be supported on slides or runners. The motor switching unit, when supplied, is attached to the back of the receiver.

PLUG AND SOCKET CONNECTIONS

The following standard connections are made at the rear panel of the receiver.

AE A coaxial socket (SKA) for connecting the 50 ohm aerial feeder to the receiver. The type of free mating plug supplied for the socket is 50 ohm BNC.

IF OUT A coaxial socket (SKE). The IF output at a nominal frequency of 1.4MHz and 100mV level across 50 ohm is available at this socket. The type of free mating plug supplied for the socket is 50 ohm BNC.

PLA A 3-pin plug for connection of the mains supply. The type of free mating socket for the plug is Bulgin P430.

SKF A 25-way socket for the connection of the ISB Adaptor ARU10A (if used) to the receiver. The optional d.c. supply is also connected via this socket. The type of free plug supplied for the socket is Belling Lee L1328/S. It should be noted that external facilities such as muting and sidetone are also routed through the connector.

The following optional sockets may be fitted to the rear panel.

ISB OUT A coaxial socket (SKD) through which the lower sideband from the hybrid splitter (if fitted) in the receiver, is routed to the ISB Adaptor ARU10A.

EXT OSC A coaxial socket (SKG) through which an external oscillator signal can be applied to the channel oscillator (1.7V r.m.s. ± 2dB across 50 ohm)

EXT OSC A coaxial socket (SKH) through which an external oscillator signal can be applied to the reinsertion oscillator (1.2V r.m.s. ± 2dB across 50 ohm)

The following standard connections are made at the front panel of the receiver.

HEADSET SOCKET (1) A phone jack socket to the left of the panel for connection of a 600 ohm headset.

HEADSET SOCKET (2) A phone jack socket to the right of the panel for connection of a 600 ohm headset. This socket is not fitted if the optional BFO facility is incorporated.

The following standard connection is made on the front panel of the RC116A system control unit.

HEADSET SOCKET A phone jack socket to the left of the panel for connection of a 600 ohm headset.

The following standard connections are made at the rear panel of the RC116A system control unit.

SKA An 18-way socket for connecting the motor switching unit to the control unit.

BUZZER Two screw terminals, 2 and 3 on TS1, for the connection of an external warning buzzer which indicates that a signal is being received. The buzzer circuit is completed by an external switch connected to terminals 1 and 3 on TS1 (100mA max.).

LOUDSPEAKER Two terminals, 5 and 6 on TS1, for the connection of a 3 ohm external loudspeaker.

EARTHING ARRANGEMENTS

The receiver is earthed through the earth lead of the 3-core mains cable. This, however, may not be considered an adequate earth and an earthing bolt is provided on the back panel for the connection of a reliable earth.

When the receiver is used in a system with other equipment, in particular, transmitters, a separate earth for the receiver is necessary and connection should be made with copper braid or strip of low ohmic resistance.

If, for any reason a direct earth connection is undesirable, connection should be made through two low inductance capacitors of 0.5uF and 0.05uF in parallel.

If both a receiver and a transmitter are connected to the same earth, care must be taken to ensure that no part of the transmitter ground path runs through the earth lead of the receiver.

POWER SUPPLIES

The receiver operates from a.c. mains or from a 24V d.c. source. Transformer taps are adjusted for a.c. input in the ranges 100-125V and 200-250V to within 5V. If both a.c. and d.c. supplies are connected, a relay ensures that the a.c. supply is used, but if the a.c. supply fails or is disconnected, the receiver automatically operates from the d.c. supply. The receiver operates from d.c. only, without circuit modification.

The equipment meets all parts of the specification (Chapter 1) when operated at a battery voltage of 24V ± 10%. The minimum voltage for operation is 21V.

At a voltage of 24V, the peak current drawn by the equipment is as follows.

R499A	1560mA
R499A/ISB+ARU10A	1850mA
R499A/ISB+ARU10A+RC116/ISB	2100mA

INTERCONNECTIONS

Receiver (only)

(1) Connect the aerial to socket AE using the 50 ohm BNC plug to terminate the coaxial feeder.

(2) If the signal available at the IF OUT socket is to be fed to associated equipment, terminate the required length of 50 ohm coaxial cable with the 50 ohm BNC plug provided and connect to the IF OUT socket.

(3) To prepare the receiver for operation on a.c. mains, solder the links on the transformer taps to suit the a.c. supply voltage, and connect up the 3-pin plug with the required length of 3-core cable.

The connections are:—

red to *live*
black to *neutral*
green to *earth*

Do not apply mains to the receiver at this stage.

(4) To prepare the receiver for operation from a 24V d.c. source, connect a length of 2-core cable to the free 25-way plug. The connections are:—

positive to pin 6
negative to pin 16

Do not apply d.c. voltage to the receiver at this stage.

Receiver + ISB Adaptor

Interconnections between the receiver and ISB adaptor are made through a 25-way cable, terminated with the necessary plug and socket: this is supplied with the ISB adaptor.

If the equipment is to be operated from a d.c. source, the plug end of the cable should be dismantled and the d.c. source connected to pin 6 (positive) and pin 16 (negative).

An external loudspeaker may be connected to pins 8 and 9 of the plug.

Table 2.1 gives the wiring details of the 25-way cable connector and indicates the function of each circuit.

TABLE 2-1 Inter-unit Connections Receiver + ISB Adaptor

Receiver SKF	25-way cable SIA/5654/L PLF		SKA	ISB Adaptor PLA	Function
1	1	External aerial mute (3W d.c. > 0.5A or 110V)	1	1	Not used
2	2		2	2	24V unstabilised supply
3	3	External Channel-In-Use lampe or call bell (0.5A 24V)	3	3	
4	4		4	4	Channel-In-Use (LSB) line from squelch relay in ARU10A
5	5	600 ohm line output	5	5	
6	6		6	6	Not used
7	7		7	7	
8	8	To external loudspeaker (3Ω) To external loudspeaker	8	8	
9	9		9	9	
10	10		10	10	
11	11		11	11	Earth
12	12	External sidetone input (OdBm). External sidetone input	12	12	
13	13		13	13	Earth (braids of 14, 15, 18 and 24)
14	14		14	14	Audio output from ARU10A
15	15		15	15	600 ohm audio from ARU10A
16	16	Earth	16	16	Not used
17	17		17	17	+20V from R499 ISB
18	18		18	18	AGC from ARU10A to R499 ISB
19	19		19	19	AGC to ARU10A
20	20		20	20	RF Gain
21	21		21	21	ARU10A Squelch ON-OFF
22	22		22	22	Re-insertion oscillator input to ARU10A
23	23		23	23	Earth (braid of 22)
24	24		24	24	Common audio
25	25		25	25	Earth at R499

Receiver + ISB Adaptor + Remote Control System

The motor switching unit is attached to the rear of the receiver and will normally be supplied with the wire connections already made to tag strip TSA.

The remote control unit is connected to the receiver (and ISB adaptor if used) by an 18-core cable, which is supplied in the length ordered. The maximum length normally supplied is 200 yards.

Increased cable lengths are permissible provided the line loop resistance values of the circuits tabulated in Table 2.2 are not exceeded.

Table 2.2 18-core Cable, maximum circuit resistance.

Function	Motor switching unit SKA lines used	Recommended max. line resistance (Ω)
fine tune	2, 1	250
on/off	4, 9	20
audio monitor	6, 14	60
service change	9 to 10 to 13, in turn	100
channel change	9 to 15 to 18, in turn	100
channel-in-use	9 to 5 and 7, in turn	20

It may be necessary to cut off the plug at one end of the cable to facilitate its routeing during installation.

Table 2.3 gives the colour coding of the conductors in relation to the plug pins.

Table 2.3 18-core Cable, conductor coding.

Cable conductor	Terminal strip
Black	1
White	2
Orange	3
Red Yellow	4
Blue	5
Light Green	6
Violet	7
Red Brown	8
Red	9
Yellow	10
Green	11
Pink	12
Brown	13
Red/Black	14
Red/White	15
Red/Green	16
Red Blue	17
Slate	18

After terminating the cable, the insulation resistance between pins should be checked: it should not be less than 5 megohm.

The circuit of the remote control system is shown in Fig. 10.5 which clearly indicates the connections made between the control unit and the motor switching unit on the receiver.

When the ISB adaptor is not included in the installation some of the facilities on the remote control unit are omitted.

CHECKS BEFORE OPERATION

Receiver (only)

When all the required connections have been made, the equipment should be checked for operational readiness.

(1) Start with the Standby-Off-On switch set to OFF.

(2) Apply the a.c. and/or d.c. supply voltages and set the Standby-Off-On switch to STANDBY.

(3) Check that the front-panel indicator lamp is illuminated and that both crystal ovens become warm.

(4) Set the AF Gain and RF Gain controls to the red spots above the knobs and switch the Standby-Off-On switch to ON.

(5) Check that noise is audible from the loudspeaker.

(6) If both a.c. and d.c. supplies are connected, switch off the a.c. supply and check that the equipment remains operational.

Receiver + ISB Adaptor

The receiver checks have been covered in the above paragraph: proceed to the ARU10A.

(1) Set the AF Gain control to the red spot.

(2) Plug a headset into the front-panel and check that noise can be heard.

Receiver + ISB Adaptor + Remote Control System

To check the remote control unit:—

(1) Apply a.c. and/or d.c. to the receiver and switch it ON. The Emergency Supply lamp on the remote control unit should light when:—
(a) d.c. only is applied to the receiver, or:
(b) d.c. and a.c. is applied to the receiver and the a.c. is removed, provided that:
(c) the receiver Standby-Off-On switch is at ON or STANDBY.

(2) Set the Local-Remote switch on the receiver to REMOTE and verify that the RX On lamp on the remote control unit is illuminated.

3 SYSTEM DESCRIPTION

3 SYSTEM DESCRIPTION

INTRODUCTION

The R499A is a 10-channel MF/HF SSB receiver. With the addition of optional filters and BFO, it also provides full CW and AM services. Reception of ISB may be obtained by the addition of the type ARU10A ISB Adaptor unit, and extended control of the R499A functions is possible using the RC116A control unit and motor switching unit.

Up to 10 channels of the R499A may be used either for HF reception (1.5 MHz to 30 MHz) or for MF reception (255 kHz to 525 kHz). Alternatively, a combination of MF and HF channels may be employed. Note that when more than six HF channels are required, the frequency of each additional channel must be within 1% of any of the first six.

A choice of IF filters is available for SSB, CW, and AM reception, as required. The receiver provides three mountings for these filters, of which one is suitable only for the CW filter. Thus, the maximum filter complement of the receiver is, the CW filter and two others. Economical use of the IF filters is possible by obtaining more than one service from any SSB filter. The method of utilizing this facility is described in the Programmed Text in Chapter 4. Note that the Programmed Text must be consulted before choosing the optional units and filter necessary to obtain the desired services from the receiver.

DESCRIPTION

Fig. 10. 1 shows the basic receiver with optional filter units. Standard and alternative signal paths are indicated by line coding detailed on the diagram. The method of incorporating the options and the additional services are dealt with in the Programmed Text in Chapter 4.

The following printed-wiring boards comprise the basic R499A:—

(a) RF board (with the RF filters, RF amplifier and front-end AGC).
(b) Crystal oscillator board and mixer-drive amplifier board (these boards constitute the channel oscillator).
(c) Mixer board.
(d) IF and audio board (containing the IF amplifiers, detector circuits, squelch circuits and AF amplifier).
(e) Re-insertion oscillator board.
(f) Stabilizer board (for power supply).

Note that the IF filters and power supply components are chassis-mounted.

RF BOARD

The received aerial signal is applied via muting relay contact RLA1, to the RF amplifier and its associated filter circuits. Separate RF filter circuits are utilized for reception of the MF and HF bands (refer to Fig. 10.1); the MF filter unit provides all RF filtering of MF signals, whereas a succession of filters are used for HF signals.

HF Band The IF trap rejects signals received at the nominal IF (1.4 MHz) of the receiver, and the output of the IF trap is fed via a signal frequency (SF) filter and AGC attenuator to the RF amplifier. After amplification, the signal is routed via an image trap and a second SF filter to the mixer. The two SF filters and IF trap constitute one HF filter set, and up to six of these sets may be fitted in the R499A. Each set covers one signal frequency, but may also be used to pass a second frequency within 1% of the first i.e. still within the filter passband. The front panel Channel switch (wafers SA6 to 10) brings the appropriate HF filter set into circuit.

MF Band The IF trap and tuned filters are not used. Instead, the signal is routed via the optional MF filter unit, which is connected into circuit by the Channel switch (wafers SA9 and 10). The MF filter unit contains two band-pass filters that provide high selectivity; one filter covers the MF range 255 kHz to 365 kHz, and the other filter, the MF range 365 kHz to 525 kHz.

The front-end AGC detects unwanted strong signals at the output of the RF amplifier, and provides a control voltage for an attenuator in the input circuit of the RF amplifier. This AGC loop prevents overloading or non-linearity of the RF amplifier for a total signal level of up to 6V e.m.f. at the aerial input.

The front-end attenuator is also driven by a feed from the main AGC system. For a signal within the IF passband, the front-end attenuator forms part of the main AGC system. For a large signal, within the RF passband but outside the IF passband, the front-end AGC system controls the front-end attenuator. If a small wanted signal and a large unwanted signal are present simultaneously, the front-end AGC system supplements the main AGC system in controlling the front-end attenuator.

MIXER AND CHANNEL OSCILLATOR

The mixer consists of a double-balanced ring modulator, which has its switching frequency supplied by the channel oscillator. This oscillator provides up to ten receiver channels, the channel oscillator frequency of each being determined by:

$$f_{co}=f_{sf}+f_{if}$$

Where f_{co}=channel oscillator frequency
f_{sf}=signal frequency
f_{if}=intermediate frequency

The channel oscillator consists of a crystal oscillator, 2nd harmonic generator, and mixer-drive amplifier. The oscillator crystal is selected by the Channel switch (wafer SA4), and the oscillator output is fed in parallel to the 2nd harmonic generator and another wafer (SA5) of the Channel switch.

For channel oscillator frequencies above 16 MHz, the frequency of the selected crystal is half the required channel oscillator frequency. The Channel switch (wafer SA5) then routes the output of the 2nd harmonic generator to the mixer-drive amplifier. For channel oscillator frequencies below 16 MHz, the frequency of the selected crystal is the same as the required channel oscillator frequency. Wafer SA5 now connects the oscillator output directly to the mixer-drive amplifier.

IF FILTERS

The RF output feeds the IF amplifier via a filter selected by the Service switch (SB); the selected IF filter passes the difference output of the mixer, i.e. $f_{co} - f_{sf}$. The Service switch has five positions, one of which is used for test purposes. The remaining positions are linked to IF filters that provide the desired services. The receiver has three separate mountings for the filters, of which one is suitable only for filter E (the CW filter). The other two mountings may hold any two of the remaining filters listed in Table 3.1. Thus the maximum filter complement is filter E and two others.

Table 3.1 The Service Filters

Filter	*Bandwidth*	*Service realised when using standard IF of 1.4 MHz*
A	2.7 kHz	USB (suppressed carrier)
B	2.7 kHz	LSB (suppressed carrier)
D	6 kHz	AM
E	200 Hz	CW
G	5.5 kHz	USB (suppressed carrier)
H	5.5 kHz	LSB (suppressed carrier)

Each signal frequency is normally associated with one channel oscillator frequency, but by changing the channel oscillator frequency, the mixer produces a different IF. These different IF's are used to obtain more than one service from any SSB filter. Each channel oscillator frequency is selected so that the resultant IF will position the required signal within the passband of the SSB filter. Thus, different types of reception may be obtained on the same signal frequency input by selecting the appropriate channel oscillator frequency with the Channel switch. Depending on the IF produced, the four SSB filters A, B, G and H (refer to Table 3.2 at the end of this Chapter) will each realise USB, LSB, AM or degraded CW service.

For CW service using an SSB filter, the effective noise level is increased and therefore the service is degraded. Filters G and H realise the AM service with optimum performance. Filters A and B give a 'compatible' AM service, because the channel oscillator frequency is offset and results in the filters passi~g the carrier with only one sideband.

For ISB reception, a hybrid network is used to split the signal between the receiver (R499/ISB) and the ISB unit option. The network is wired to position 1 of the Service switch (wafer SB8), and simultaneously feeds the mixer output to two filters—one in the receiver (R499/ISB) for USB service, and the other in the ISB unit for LSB service.

DETECTOR CIRCUITS AND REINSERTION OSCILLATOR

After five stages of amplification, the filtered IF signal is routed via the Service switch, to a conventional diode detector or to a product detector, depending on the service required. For all services except AM, the Service switch selects the product detector for the reinsertion of the carrier.

The crystal controlled reinsertion oscillator drives the product detector via a buffer amplifier, and has provision for two crystals. The appropriate crystal is selected by the Channel switch (wafers SA2 and 3) such that the re-insertion oscillator frequency is compatible with the IF signal (the Channel switch also selects the channel oscillator frequency and therefore determines the IF).

AF SECTION

The AF output of the selected detector feeds two AF amplifiers via a pre-amplifier. One AF amplifier, which is controlled by a front panel AF Gain potentiometer, drives headphones and loudspeakers (internal or external). The other AF amplifier has an independent preset level control and feeds the 600 ohm output line. The level of this line can be monitored by the meter on the front panel.

MAIN AGC SYSTEM

Main AGC is applied progressively over three IF stages and complements the front-end AGC action. The system comprises:—

(a) AGC detector.

(b) Time-constant networks selected by the Service switch.

(c) AGC switch.

(d) RF Gain control.

(e) D.C. amplifier.

(f) Three AGC attenuators.

(a) The AGC detector senses the output of the last IF stage and feeds a time-constant network, selected by the Service switch; wafer SB4.

(b) The time-constant networks feed a d.c. amplifier via the AGC switch and give decay times of 1 sec for AM and 10 sec for SSB, ISB and CW; attack times are 0.1 sec on AM and 2 to 3 msec on SSB, ISB and CW. The full 10 sec decay is dependent upon accumulation of a signal for 200 msec or more; thus short bursts of noise do not paralyse the receiver.

(c) The AGC switch can reduce the decay times by a factor of 3, or can inhibit the AGC system.

(d) The RF Gain control gives a manual control of the gain of the RF and IF stages, and at maximum gain setting the auxiliary contacts on the control switch-in the squelch circuit and override the AGC switch: thus the AGC system is operative and AGC voltage is available to un-squelch the receiver.

(e) The output of the d.c. amplifier is fed to the squelch circuit and three AGC attenuators. When the signal of the d.c. amplifier is below AGC threshold level, the squelch circuit reduces the output of the AF pre-amplifier to a low level; this effectively mutes the receiver when signals are not being received.

The low level AF output is sufficient to indicate that the receiver is still operative. Note that wanted signals are still audible even if the squelch is set at too high a level.

(f) AGC control voltage is applied progressively to the attenuators in the following order:—

(i) 4th IF stage attenuator
(ii) front-end attenuator
(iii) 2nd IF stage attenuator
(iv) 3rd IF stage attenuator

This sequence of AGC application ensures optimum signal-to-noise conditions at all times.

INTRODUCTION TO TABLE 3.2

Table 3.2 shows the various services that may be obtained from any filter, and relates the filter and services to channel oscillator (CO) and reinsertion oscillator (RO) frequencies.

The table serves three main purposes:—

(1) To select a filter for a desired service.

(2) To find the services possible with a given filter.

(3) To determine the CO and RO frequencies necessary for a filter to realise a given service.

The services available are listed in the first two columns of the table. The remaining columns list the pairs of CO and RO frequencies, that may be used with each filter (A to I) for various services. By referring to the row of the table associated with any service, the appropriate filters and relevant CO and RO frequencies may be extracted.

For ISB service, two filters are required, one realising USB service in the receiver (R499/ISB) and the other realising LSB service in the ISB Unit. The two filters are shown linked by a line, and the filter required in the ISB Unit is marked accordingly.

Abbreviations: CO =channel oscillator

RO =reinsertion oscillator

USB-SC =USB (suppressed carrier)

LSB-SC =LSB (suppressed carrier)

TABLE 3.2 Summary of Filter Services

SERVICE		IF FILTERS							
Type	*Bandwidth*	*A*	*B*	*C*	*D*	*E*	*G*	*H*	
LSB-SC	2.7 kHz	CO=SF+1.39675 MHz RO=1.39675 MHz	CO=SF+1.4 MHz RO=1.4 MHz						
	5.5 kHz						CO=SF+1.39425 MHz RO=1.39425	CO=SF+1.4 MHz RO=1.4 MHz	
USB-SC	2.7 kHz	CO=SF+1.4 MHz RO=1.4 MHz	CO=SF+1.40325 MHz RO=1.40325 MHz						
	5.5 kHz						CO=SF+1.4 MHz RO=1.4 MHz	CO=SF+1.40575 MHz RO=1.40575 MHz	
LSB	2.7 kHz	CO=SF+1.39705 MHz RO=1.39705 MHz	CO=SF+1.4003 MHz RO=1.4003 MHz						
	5.5 kHz						CO=SF+1.3948 MHz RO=1.3948 MHz	CO=SF+1.4003 MHz RO=1.4003	
USB	2.7 kHz	CO=SF+1.3997 MHz RO=1.3997 MHz	CO=SF+1.40295 MHz RO=1.40295 MHz						
	5.5 kHz						CO=SF+1.3997 MHz RO=1.3997 MHz	CO=SF+1.45200 MHz RO=1.45200 MHz	
AM	6 kHz				CO=SF+1.4 MHz No RO				
AM	5.5 kHz						CO=SF+1.39725 MHz No RO	CO=SF+1.40275 MHz No RO	
COMPATIBLE AM	2.7 kHz	CO=SF+1.3997 MHz No RO	CO=SF+1.4003 MHz No RO						
CW	200 Hz					CO=SF+1.4 MHz *RO=1.399 MHz			
DEGRADED CW	2.7 kHz	CO=SF+1.399 MHz *RO=1.4 MHz	CO=SF+1.401 MHz RO=1.4 MHz						
ISB-SC	2.7 kHz	USB-SC —— CO=SF+1.4 MHz RO=1.4 MHz	—— LSB-SC (Filter used in ISB Unit)						
	5.5 kHz						USB-SC —— CO=SF+1.4 MHz RO=1.4 MHz	—— LSB-SC (Filter used in ISB Unit)	
ISB	2.7 kHz	USB —— CO=SF+1.3997 MHz RO=1.3997 MHz	——	—— LSB (Filter used in ISB Unit)					
	5.5 kHz						USB —— CO=SF+1.3997 MHz RO=1.3997 MHz	——	—— LSB (Filter used in ISB Unit)

*This RO crystal is not required if the Optional BFO is fitted

4 SELECTION OF OPTIONS

4 SELECTION OF OPTIONS

INTRODUCTION

From the system description given in Chapter 3, it will be appreciated that the operational requirements of an installation, in terms of services and reception frequencies, may be met by the inclusion of options, filters and crystals and that in some cases there is a choice of options. In the interests of economy, it is desirable to optimize the selection of options. To this end, the text of this chapter is presented in a manner best calculated to guide the reader to a rapid assessment of the options required to meet specific operational needs.

The text is divided into blocks, each dealing with a separate topic. The selection of the various receiver facilities are dealt with on a 'question and answer' basis, so that the answers lead the reader through only those blocks of the text that are relevant to the requirements.

At the end of the chapter, three examples are given: each postulates a set of operational requirements and indicates the options that should be selected to optimize the equipment.

1 The optional units available for use with the receiver are:—

MF Filter Unit	—enables reception of MF as well as HF.
BFO Unit	—provides variable tone output for CW service.
ISB Adaptor	—detects LSB. (The receiver detects USB).
Extended Control Unit	—extends control of the receiver and ISB Adaptor (if fitted) to distances of up to 200 yards.

Proceed to Block 2

2 *From Block* 1

The basic receiver provides six HF channels in the range 1.5 MHz to 30 MHz, and with the addition of the MF filter unit, four further channels in the MF range 255 kHz to 525 kHz may be obtained. Alternatively, the receiver can be connected such that 10 HF channels are available, provided that the additional four HF channels are within 1% of any of the original six. The receiver also has facilities for the provision of 10 MF channels, or any combination of MF and HF channels not exceeding 10 in all.

Are more than 6 HF channels or any MF channels required?

YES Go to Block 5

NO Go to Block 3

3 *From Block* 2 *NO, or from Block* 5

Are any of the optional units listed in Block 1 required?

YES Go to Block 6

NO Go to Block 4

4 *From Block* 3 *NO, or from Block* 6

The basic receiver provides only one service, either USB or LSB; but with the addition of optional items, the receiver may provide all of the following services:—

Both USB and LSB

ISB

AM

CW

Are any of the above services required?

YES Go to Block 7

NO Go to Block 12

5 *From Block* 2 *YES*

Alternative arrangements for the channel complement of the receiver are:—

(a) Six HF channels plus up to four other HF channels, with the additional channels within 1% of the frequency of any of the original six; this 1% difference enables a maximum of 10 frequencies to be received, but using only six sets of tuned RF filters. (Note that if 6 or less channels are required but some of these are within 1% of the others, then less than six RF filters are necessary, e.g. 4 channels, of which 2 are within 1% of the other 2; only 2 RF filters are required). The appropriate contacts of the Channel switch wafers (SA6 to SA10) associated with the RF filters are linked; thus suitable RF filters remain in circuit for the extra HF channels.

(b) Up to 10 MF channels. Proceed as follows:—

(i) Add the optional MF filter unit.

(ii) Link the appropriate contacts of the Channel switch (wafers SA9 and SA10) to the required filter in the MF filter unit; one filter covers the range 250 kHz to 365 kHz and the other 365 kHz to 525 kHz.

(iii) Link corresponding contacts of SA7 and SA8.

(iv) Link all contacts of SA6 to C11.

(c) Any combination of MF and HF channels not exceeding 10 in all, subject to the limitations in (a) when more than 6 HF channels are employed. The HF channels are obtained as described in (a), and the MF channels as in (b).

Now go to Block 3

6 *From Block* 3 *YES*

OPTIONAL UNITS

The receiver options are listed below with the necessary items to modify the receiver.

(a) MF frequency range
 MF Filter Unit 5649/A
 Mod. Instruction; Connect filter screened leads:
 Input to 9 and 10 on SA10
 Output to 9 and 10 on SA9

(b) Extended control
 Extended Control Unit RC116A
 Motor Switching Unit 5653/A
 Cableform 5660/A (specify length)

(c) ISB or ISB—suppressed carrier Operation
 ISB Unit ARU10A
 Cableform S1A/5654/A
 Hybrid Transformer kit 5656/A

Two IF filters are required; one giving USB service in the receiver and the other giving LSB service in the ISB Unit (see Table 3.2).

(d) Variable tone for CW service.
 BFO Unit 5650/A

Now go to Block 4

7 *From Block* 4 *YES*

The basic receiver provides SSB service by employing:—

(a) IF of 1.4 MHz, which is obtained from a channel oscillator frequency = signal frequency + 1.4 MHz, and a reinsertion oscillator frequency of 1.4 MHz.

(b) The appropriate SSB filter (A, B, G or H as listed in Table 3.1).

Table 3.1 also lists two other filters (filters D and E), both of which can be fitted in addition to the SSB filter, to obtain AM and CW services respectively. Alternatively, a second SSB filter may be fitted in place of filter D; the two SSB filters enable the receiver to provide both USB and LSB service, or a SSB service with a choice of two bandwidths. Note that the receiver mounting for filter E will not accept any other IF filter. Hence the maximum IF filter complement is filter E (CW) and any two other filters.

In the foregoing method of obtaining various services, each IF filter selected provides only one service and uses an IF of 1.4 MHz. However, by using more than one IF, each SSB filter can provide several services; these services are:—

LSB

USB

AM with optimum performance (filters G and H) or 'compatible' AM (filters A and B).

Degraded CW

Separate channel oscillator frequencies and, (with the exception of AM or variable-tone CW service) reinsertion oscillator frequencies are required for the above services to be obtained from a SSB filter. The various channel oscillator and reinsertion oscillator frequencies necessary to obtain each service from the four SSB filters are listed in Table 3.2. When selecting services by this method, note that the receiver provides a maximum of 10 channel oscillator frequencies and 2 reinsertion oscillator frequencies.

The advantages and limitations of the two methods are summarised in Table 4.1.

Table 4.1 Filter Utilisation

Method	*Advantages*	*Limitations*
(a) Fitting one filter per service	Each signal frequency can use any service available in the receiver.	Number of services are limited by the IF filter complement of the receiver.
(b) Several services obtained from one or more filters.	Reduces number of filters necessary for a range of services.	Maximum number of signal frequencies that can use every service is five.

Referring to Table 4.1 which method is the most suitable (a) or (b)?

If METHOD (a) go to Block 11

If METHOD (b) go to Block 8

If NOT SURE, go to Block 8

8 *From Block 7 METHOD (b) or NOT SURE*

(1) One or more filters must be selected so that they each provide several services.

(2) The services associated with filters A and B (2.7 kHz bandwidth) and filters G and H (5.5 kHz bandwidth) are as follows:—

(a) LSB and LSB-suppressed carrier.

(b) USB and USB-suppressed carrier.

(c) AM with optimum performance (filters G and H) or 'compatible' AM (filters A and B).

(d) Degraded CW.

Up to two of these filters can be fitted in the receiver. They can then provide any of the above services, if no more than two reinsertion oscillator frequencies are required.

(3) Filters D and E provide AM (6 kHz) and CW (200 Hz) services respectively with optimum performance. For filter E to provide a fixed-tone CW service, a reinsertion oscillator frequency of 1.399 MHz is required; this does not apply to the variable-tone CW service, where the BFO Unit is used in place of the reinsertion oscillator.

(4) The channel oscillator and reinsertion oscillator frequencies required for each filter to provide the various services, are listed in Table 3.2. This table also lists the filters, and channel oscillator and reinsertion oscillator frequencies that are required for ISB and ISB-suppressed carrier operation, when using the ISB unit.

(5) Summarizing; one or more services is obtained from any signal frequency by using a corresponding number of channel oscillator frequencies. The maximum number of channel oscillator frequencies is ten, each of which is determined by SF+IF. Thus the maximum number of signal frequencies that can be received is limited by the number of channel oscillator frequencies required for the services. Note that the channel oscillator frequencies required for two different signal frequencies may coincide; this is desirable, as a greater range of signal frequencies or services results.

(6) Guidance on selecting filters:—

Are the required services common to each signal frequency?

YES Read para (7) *below*

NO Go to Block 10

(7) Are more than five signal frequencies required?

YES Go to Block 11 (*one filter per service is necessary*)

NO Go to Block 9

9 *From Block 8 para (7) NO*

(1) Select one filter (A, B, G or H) from Table 3.2 that can provide two services, of which one is obtained using an IF of 1.4 MHz. Note that an IF of 1.4 MHz need not be used if only two services are required in the receiver. Record the two sets of channel oscillator and reinsertion oscillator frequencies required for each signal frequency. Set up two channels of the receiver for each signal frequency, using the recorded figures. Thus, one of the two channels allotted to each signal frequency employs an IF of 1.4 MHz.

(2) Another filter may now be added to provide a further service, using the 1.4 MHz IF. Note that the second filter can provide two services, if the other IF is carefully chosen to suit both filters (see para (3) below). Filter E can also be added to provide full CW service from the 1.4 MHz IF.

(3) In certain instances, suitable choice of IF enables the filters to provide more than the expected number of services; two common examples are:—

(a) At an IF of 1.3997 MHz, filter A provides either USB (2.7 kHz) service or compatible AM service, and filter G provides USB (5.5 kHz) service.

(b) At an IF of 1.4003 MHz, filter B provides either LSB (2.7 kHz) service or compatible AM service, and filter H provides LSB (5.5 kHz) service.

(4) Chapter 4 Example B contains an example of one filter providing two services, and two other filters each providing one service.

(5) To calculate the crystal frequencies that are necessary to produce the channel oscillator frequencies:—

Go to Block 12

10 *From Block 8 para (6) NO*

(1) While using no more than two different reinsertion oscillator frequencies, one or more filters must be selected from Table 3.2 such that they provide all the services required. A table may be drawn, similar to Table C-1 of Example C to simplify the selection of filters and channel oscillator and reinsertion oscillator frequencies.

(2) The number of different IF's used with each signal frequency determines the number of channels allotted to it i.e. one channel for each IF.

Example C shows how the receiver was set up for a complicated arrangement of services from six signal frequencies.

(3) To calculate the crystal frequencies that are necessary to produce the channel oscillator frequencies:—

Go to Block 12

11 *From Block* 7 *METHOD* (*a*) *and from Block* 8 *para* (7) *YES*

(1) Here one filter per service is fitted.

(2) For each signal frequency, connect one channel to provide a channel oscillator frequency of SF + 1.4 MHz and reinsertion oscillator frequency of 1.4 MHz. To produce the required services on each signal frequency, fit the appropriate filters selected from Table 4,1 in Block 7.

(3) For CW service, there are two tones available as follows:—

(a) Fixed tone. Here, a second crystal of frequency 1.399 MHz must be connected in the reinsertion oscillator.

(b) Variable tone. This is provided by the optional BFO Unit, which is used instead of the reinsertion oscillator on CW service only.

(4) Example A contains an example of a receiver using one filter per service.

Go to Block 12

12 *From Block* 4 *NO and from Blocks* 9, 10 & 11

CHANNEL OSCILLATOR CRYSTALS

The channel oscillator frequency is derived, either directly from a crystal oscillator or via a 2nd harmonic generator. One crystal is used for each channel, and the channel oscillator frequency is determined by SF + the required IF. The crystal frequency depends on the channel oscillator frequency as follows:—

(a) If the channel oscillator frequency is 16MHz or less; crystal frequency = channel oscillator frequency.

The output of the crystal oscillator is linked to the appropriate position of the Channel switch (wafer SA5).

(b) If the channel oscillator frequency is greater than 16 MHz;

$$\text{crystal frequency} = \frac{\text{channel oscillator frequency}}{2}$$

The output of the 2nd harmonic generator is linked to the appropriate position of the Channel switch (wafer SA5).

EXAMPLE A

10 signal frequencies each requiring the following services:—

USB-suppressed carrier

LSB-suppressed carrier

ISB-suppressed carrier (two 2.7 kHz audio channels)

AM

CW

For each signal frequency, set up one channel with a channel oscillator frequency of SF + 1.4 MHz and a reinsertion oscillator frequency of 1.4 MHz.

To obtain AM service, fit filter D.

To obtain CW service, fit filter E.

For ISB-suppressed carrier, (when the receiver detects USB-suppressed carrier, and the ISB unit detects LSB-suppressed carrier):—

(a) Fit filter A and the hybrid network into the receiver.

(b) Connect the ISB unit to the receiver.

(c) Fit filter B into the ISB unit.

Filter A produces USB-suppressed carrier service in the receiver, and filter B produces, LSB-suppressed carrier service in the ISB unit: both filters are thus used to provide ISB-suppressed carrier service.

EXAMPLE B

5 signal frequencies each requiring the following services:—

USB-suppressed carrier

LSB-suppressed carrier

AM

CW

In this example, AM (6kHz) and variable-tone CW (200Hz), services are required with optimum performance. Also USB-suppressed carrier and LSB-suppressed carrier, services are required with 2.7kHz bandwidth.

Referring to Table 3.2, filters A, B, G and H, can each provide USB-suppressed carrier and LSB-suppressed carrier services; but only filters A and B give the required 2.7 kHz bandwidth.

Because further services are required, the filter must provide USB-suppressed carrier service or LSB-suppressed carrier service, using a channel oscillator frequency of SF + 1.4 MHz.

Filters A and B both fulfil this requirement; filter A should be chosen as it is also suitable for ISB-suppressed carrier operation which may be required at some later date. Filter A provides USB-suppressed carrier service with a channel oscillator frequency of SF + 1.4 MHz and a reinsertion oscillator frequency of 1.4 MHz, and produces LSB-suppressed carrier service with a channel oscillator frequency of SF + 1.39675 MHz and a reinsertion oscillator frequency of 1.39675 MHz.

Filters D and E give AM (6 kHz) and CW (200 Hz) services respectively, using the channel oscillator frequency of SF + 1.4 MHz. The BFO unit is connected to the appropriate Service switch position on wafer SB2 and provides variable tone for the CW service.

Two channels are set up for each signal frequency as shown in Table B-1. Each of the required services can then be obtained from each signal frequency by using either channel in conjunction with the appropriate filter.

Table B–1

Signal Frequency	*Channel*	*Filter A*	*Filter D*	*Filter G plus BFO Unit*
SF1	Channel 1 CO = SF_1 + 1.4MHz RO = 1.4MHz	USB–SC 2.7kHz	AM 6kHz	CW 200Hz variable tone
	Channel 2 CO = SF_1 + 1.39675MHz RO = 1.39675MHz	LSB–SC 2.7kHz		

Note that ISB-suppressed carrier is easily provided by adding the ISB unit, fitted with filter B, to the R499. Filter A then provides USB-suppressed carrier service in the receiver, and filter B realises LSB-suppressed carrier in the ISB unit. Thus the receiver and the ISB unit together provide ISB-suppressed carrier operation, for two 2.7 kHz audio channels.

EXAMPLE C

Variety of Services for Six Signal Frequencies

This receiver requires six signal frequencies, SF_1 to SF_6 that provide the following services:—

(a) SF_1:—USB-suppressed carrier, with 2.7 kHz and 5.5 kHz bandwidth
USB with 2.7 kHz bandwidth
Degraded CW and compatible AM

(b) SF_2:—USB-suppressed carrier, with 2.7 kHz and 5.5 kHz bandwidth

(c) SF_3:—USB with 5.5 kHz bandwidth
Compatible AM

(d) SF_4:—USB-suppressed carrier with 2.7 kHz and 5.5 kHz bandwidth
Degraded CW

(e) SF_5:—USB-suppressed carrier with 2.7 kHz and 5.5 kHz bandwidth

(f) SF_6:—USB-suppressed carrier with 2.7 kHz and 5.5 kHz bandwidth
USB with 5.5 kHz bandwidth
Compatible AM

Table C-1 is a shortened form of Table 3.2, and is used to find the minimum number of filters that provide all the required services, but necessitate no more than two reinsertion oscillator frequencies. Table C-2 is compiled in a similar manner to Table 3.2, but listing the following items only:—

(a) The required services.

(b) Any filter that can provide one of these services.

(c) All channel oscillator and reinsertion oscillator frequencies required for the filters to provide each of these services.

Table C–1

Service		*Filter*							
Type	*Bandwidth* (kHz)	*A*		*B*		*G*		*H*	
		CO(MHz)	RO(MHz)	CO(MHz)	RO(MHz)	CO(MHz)	RO(MHz)	CO(MHz)	RO(MHz)
USB–SC	2.7	SF + 1.4	1.4	SF + 1.40325	1.40325				
USB–SC	5.5					SF + 1.4	1.4	SF + 1.40575	1.40575
USB	2.7	SF + 1.3997	1.3997	SF + 1.40295	1.40295				
USB	5.5					SF + 1.3997	1.3997	SF + 1.452	1.452
Compatible AM	2.7	SF + 1.3997	None						
Degraded CW	2.7	SF + 1.399	1.4						

It can be seen from the table that filters A and G provide all the required services, but still necessitate only two reinsertion frequencies. These reinsertion oscillator frequencies are 1.4 MHz and 1.3997 MHz.

Table C-2 lists the channel oscillator and reinsertion oscillator frequencies for the channels allotted to each signal frequency.

Table C–2

Signal Frequency	*Channel*	*Filter A*		*Filter G*	
		Service	*Bandwidth*	*Service*	*Bandwidth*
SF1	Channel 1 $CO=SF_1+1.4$ MHz $RO=1.4$ MHz	USB–SC	2.7 kHz	USB–SC	5.5 kGz
	Channel 2 $CO=SF_1+1.3997$ MHz $RO=1.3997$ MHz	Compatible AM		USB	5.5 kHz
	Channel 3 $CO=SF_1+1.399$ MHz $RO=1.4$ MHz	Degraded CW			
SF2	Channel 4 $CO=SF_1+1.4$ MHz $RO=1.4$ MHz	USB–SC	2.7 kHz	USB–SC	5.5 kHz
SF3	Channel 5 $CO=SF_3+1.3997$ MHz $RO=1.3997$ MHz	Compatible AM		USB	5.5 kHz
SF4	Channel 6 $CO=SF_4+1.4$ MHz $RO=1.4$ MHz	USB–SC	2.7 kHz	USB–SC	5.5 kHz
	Channel 7 $CO=SF_4+1.399$ MHz $RO=1.4$ MHz	Degraded CW			
SF5	Channel 8 $CO=SF_5+1.4$ MHz $RO=1.4$ MHz	USB–SC	2.7 kHz	USB–SC	5.5 kHz
SF6	Channel 9 $CO=SF_6+1.4$ MHz $RO=1.4$ MHz	USB–SC	2.7 kHz	USB–SC	5.5 kHz
	Channel 10 $CO=SF_6+1.3997$ MHz $RO=1.3997$ MHz	Compatible AM		USB	5.5 kHz

5 OPERATING INSTRUCTIONS

5 OPERATING INSTRUCTIONS

INTRODUCTION

The operating instructions are preceded by a list of controls and indicating facilities with details of their functions. The ISB Adaptor ARU10A is dealt with in a separate publication.

R499 & R499/ISB CONTROLS & INDICATORS

Loudspeaker Switch

This is a 2-pole 3-position switch: one pole is associated with the internal loudspeaker, the other with an external loudspeaker through link LKA.

Position	*LKA in Circuit*		*LKA Removed*	
	Internal Loudspeaker	*External Loudspeaker*	*Internal Loudspeaker*	*External Loudspeaker*
Down	On Monitors R499	On Monitors R499	On Monitors R499	On Monitors R499
Mid	Off	On Monitors R499	Off	Off
Up	No function, unless ISB Adaptor fitted	On Monitors R499	On Monitors ISB Adaptor	On Monitors ISB Adaptor

Whether the receiver is used without the ISB Adaptor, link LKA determines whether an external loudspeaker connected across pins 8 and 9 of SKF, is to be controlled by the loudspeaker switch or is to be permanently in circuit. With LKA in position, the external loudspeaker is always on; with LKA removed, the external loudspeaker is controlled by the front panel switch.

AF Gain Control

The potentiometer controls the audio level to the front panel headset sockets and to the internal and external loudspeaker (if connected). It does not control the level to line audio-output.

RF Gain Control

The potentiometer determines the RF gain of the receiver, and is ganged to the Squelch On/Off switch.

The switch remains closed at all settings of the RF Gain control, except at the maximum clockwise setting, when it opens.

The 2 poles of the switch perform the following functions:—

(a) One pole provides an interlock circuit with the front panel AGC switch to ensure that the AGC system is not switched off by the AGC switch when the receiver is at maximum RF gain.

(b) The other pole is connected in the squelch circuit so that the receiver is un-squelched as soon as the RF control is moved to a position other than maximum.

These two contacts, in effect, function as a squelch on/off switch.

With the switch operated at maximum RF gain (open), the squelch system is activated and the receiver audio output is reduced by approximately 30dB, until a signal above the preset threshold, 'opens' the squelch and restores the audio output to normal.

Line/Signal Switch

The double-pole switch is in the circuit of the front-panel meter. When the switch is set to LINE, the meter indicates the level of the 600 ohm line audio. When the switch is set to SIGNAL, the meter indicates the voltage level of the AGC line (which may be determined by the setting of the RF Gain control).

AGC Switch

This is a three position OFF/FAST/NORMAL switch which can switch the AGC system out of circuit, or determine the time constants of the AGC system. The conditions of the AGC system at the settings of the switch are as follows:—

(a) OFF
Provided that the five-position Service switch is not set to AM and the RF Gain control is not set to maximum, the main IF derived AGC voltage is returned to earth and the controlled stages operate free from AGC.

(b) NORMAL
The AGC time constants are determined by the setting of the Service switch to suit the selected mode.

Mode	*Attack time*	*Decay time*
AM	0.1 sec	0.3 sec
All modes except AM	5 msec (approx.)	5-10 sec (approx.)

(c) FAST
All decay time constants are reduced by a factor of approximately three.

Service Switch

This switch has five settings:—

(i) ISB
When the ARU10A ISB Adaptor is used, the upper sideband of a DSB signal is fed through the IF and audio stages of the receiver, and the lower sideband via the ARU10A.

(ii) AM
For reception of AM signals. In this position, the AGC system cannot be switched off.

(iii) CW
For reception of CW signals in conjunction with the optional BFO facility.

(iv) SSB
For reception of SSB signals.

(v) TEST

An output from the internal reinsertion oscillator (or external reinsertion oscillator, if fitted) is fed into the IF stages. If the receiver is working correctly, an indication appears on the front-panel meter. The indication is arbitrary and is intended only as a test function to indicate that the IF stages are operating correctly.

Fine Tune Control

This potentiometer is in the circuit of the reinsertion oscillator. The setting of the control determines the applied voltage and hence the capacitance of Varactor diodes which, in turn, vary the frequency of the reinsertion oscillator above or below nominal; the full excursion of the control is approximately 100 Hz.

Channel Switch

This is a 10-position switch which selects the frequency channel of the receiver. Any one of up to ten channels can be selected. The mode of operation and frequency of the selected channel is indicated on the front-panel chart.

Local/Remote Switch

This switch is fitted only when the R499A is used in conjunction with the RC166A extended control facility. The switch has two poles arbitrarily numbered for the purpose of this description, 1 and 2.

Pole 1

The switch is in the unstabilized d.c. line to the internal stabilizer. When the switch is set to REMOTE, the d.c. line is completed externally, when the Standby switch on the RC116A is set to ON. In the LOCAL position of the switch, unstabilized d.c. is switched directly to the internal stabilizer.

Pole 2

The switch is in the fine tune circuit of the reinsertion oscillator. When the switch is set to REMOTE, a fine tune voltage derived from the RC116A is applied to the reinsertion oscillator. When the switch is set to LOCAL, the voltage is determined by the Fine Tune control on the R499A front-panel. When the switch is not fitted, the front-panel cut-out is blanked off by displacement of the frequency chart (alternative fixing centres are provided in the front-panel for this purpose) and internal links are fitted as follows:—

(i) Link LKD permanently connects the unstabilized d.c. to the stabilizer.

(ii) Link LKB permanently connects the voltage from the front-panel Fine Tune control to the reinsertion oscillator.

Standby/Off/On Switch

This is a four-pole switch in the power supply section of the receiver. For the purpose of this description, the poles are arbitrarily numbered 1, 2, 3 and 4.

(a) Poles 1 and 2.

Switch both sides of the input mains supply. In the OFF position, the supply is open-circuit; in both the STANDBY and ON positions, the mains are connected to the power supply transformer.

(b) Pole 3.

Switches the positive side of the d.c. input (if connected). In the OFF position, the d.c. line is open-circuit; in both the STANDBY and ON positions, the d.c. line is switched to the input line of the stabilizer.

(c) Pole 4.

Switches the unstabilized d.c. in the input line of the stabilizer. In the OFF position, the unstabilized d.c. is open-circuit. In the STANDBY position the d.c. is switched to heater elements in the two crystal ovens. In the ON position, the d.c. is switched to the stabilizer, subject to the setting of the Local/Remote switch (if fitted).

Line Control

A preset potentiometer intended for screwdriver adjustment. The setting of the control determines the 600 ohm audio line level.

Squelch Control

A preset potentiometer intended for screwdriver adjustment. The setting of the control determines the level at which the AGC operates the squelch system and removes the audio mute.

Front-panel Meter

The meter is scaled in volume units and marked at −10dBm, 0dBm and +10dBm, but does not have the ballistic characteristics of a VU meter. The indication of the meter is a function of the setting of the Line/Signal switch, and when the switch is set to SIGNAL, the meter indicates the voltage of the AGC line. If the AGC switch is set to ON, and the RF Gain control is set to less than maximum gain, the meter indicates the voltage which has the higher level i.e. the one determined by the setting of the RF Gain or the AGC system. If the AGC switch is set to OFF, the meter indicates the RF Gain control level only. When the RF Gain control is set for low gain, the meter indicates the degree of attenuation rather than signal level.

Front-panel Lamp

This lamp is energised from either the d.c. or the transformed a.c. input supply. The lamp lights when the Standby/Off/On switch is set to STANDBY or ON. It should be noted that when the lamp is energised by a.c., the voltage is applied via two contacts of a relay energised by the rectified a.c. Thus, when a.c. is applied, an energised condition of the lamp also indicates that the rectifier circuit is operating.

RC116A CONTROLS AND INDICATORS

NOTE: The different control facilities incorporated in the RC116/ISB version are also included.

Squelch Switch

The control exercised by this switch is partly a function of the R499A control of the squelch system. If the receiver conditions are such that the audio is muted, setting the RC116A Squelch switch to the upper (off) position removes the mute. However, if the receiver conditions are such that the audio is not muted, the RC116A Squelch switch cannot be used to mute the audio.

Audio Switch

This is a three-position switch. In the up position, the switch selects audio from the R499A. In the centre, OFF position, audio input lines are switched out of circuit. In the down position, the switch selects LSB audio from the ARU10A (if fitted).

AF Gain Control

The setting of this potentiometer determines the level of audio output available at the front-panel headset socket, and the rear-panel loudspeaker terminals (subject to the setting of the Audio switch). It should be noted that the level of the audio, routed to the RC116A from the R499A and the ARU10A, is determined by the settings of their AF Gain controls.

Service Switch

The control functions of this five-position switch are identical to those of the Service switch on the R499A.

Fine Tune Control

The control function of this potentiometer is identical to that of the Fine Tune control on the R499A.

Channel Switch

The functions of this 10-position switch are identical to those of the Channel switch on the R499A.

Standby/On Switch

This is a single-pole switch which, when set to the ON position, energises a relay in the motor switching unit. Contacts on the relay connect the unstabilized d.c. in the R499 to the stabilizer board.

Emergency Supply Lamp

The R499A has provision for the simultaneous connection of both a.c. mains and battery supplies. In the event of mains failure, automatic change-over from the a.c. to the d.c. supply takes place, and is indicated by the energised condition of the Emergency Supply lamp.

Standby Lamp

The lamp lights when either the a.c. or d.c. supply is connected to the receiver, and the receiver Standby/Off/On switch is set to ON, and the RC116A switch is set to STANDBY.

On Lamp

The lamp lights when the RC116A Standby/On switch is set to ON.

Channel-In-Use Lamp

This lamp lights when the condition of the squelch system in the receiver is such that the audio is not muted. The condition results when the mute is removed either dynamically by a large signal or by the setting of the RF Gain control and Squelch switch on the R499A and RC116A, respectively. Two Channel-In-Use lamps are fitted to the RC116/ISB control unit. One is controlled by the squelch system in the receiver (R499/ISB) and the other is controlled by the squelch system in the ARU10A Adaptor.

R499A OPERATING INSTRUCTIONS

Set the controls on the receiver as follows:—

(1) Loudspeaker switch to ON.

(2) AF Gain control to red spot.

NOTE: The next instructions regarding the setting of the RF Gain control include procedure which checks the operation of the double-pole switch ganged to the control.

(3) RF Gain control fully clockwise. Ensure that the clicking sound, denoting operation of the ganged switch, is heard. Then turn the control counter-clockwise (again checking for the clicking of the switch) to the red spot.

(4) Line/Signal switch to SIGNAL.

(5) AGC switch to NORMAL.

(6) Fine Tune control to red spot.

(7) Channel switch to the channel required.

(8) Service switch to the service indicated on the front-panel chart for the selected channel.

(9) BFO control (if fitted) to red spot.

(10) Standby/Off/On switch to ON. Noise output from the loudspeaker should be heard immediately.

(11) After a period of approximately 12 to 15 minutes (to allow the temperatures of the ovens to stabilize), adjust as necessary, the Fine Tune control to resolve any signal.

(12) Adjust the AF Gain control to obtain the desired audio level.

NOTE: If a signal is present, an indication should appear on the front-panel meter.

(13) If necessary, adjust the preset Line potentiometer to obtain the desired line audio output level.

(14) If squelched audio conditions are required, set the RF Gain control fully clockwise to the 'switch-operated' setting. To remove the squelch, set the control counter-clockwise to the red spot position.

(15) The level at which the squelch operates, is set as follows:—

(a) Set the RF Gain control fully clockwise.

(b) Set the Channel switch to an operational channel, but one which is not carrying traffic.

(c) Set the front-panel Squelch control fully counter-clockwise.

(d) With audio noise evident in the loudspeaker, adjust the controls slowly clockwise until the audio noise output drops sharply.

NOTE: In the presence of an extremely large input signal (greater than 6V e.m.f.) the receiver is squelched by the operation of the front-end protection circuit. Non-operation of the receiver after the occurrence of large input signals indicates that the protective fuse link on the RF board needs replacement.

R499A+RC116A OPERATING INSTRUCTIONS

Preliminaries

(1) On the RC116A, set:—

(a) The Standby/On switch to STANDBY.

(b) The Squelch switch to off.

(c) The Audio switch to the up position.

(d) The AF Gain control fully counter-clockwise.

(e) The Service switch to the required mode of operation.

(f) Fine Tune to mid position.

(2) If fitted, set the external buzzer switch to off.

(3) On the R499A, set:—

(a) The Standby/Off/On switch to ON.

(b) The Local/Remote switch to REMOTE.

(c) The RF Gain control to maximum clockwise.

(d) The AF Gain control to red spot.

(e) The Audio switch to the mid position.

(f) AGC switch to NORMAL.

(g) The preset Squelch control as described in (15) of R499A.

Operating Instructions

With the controls set as specified, ensure that the amber Standby lamp lights on the RC116A.

(4) On the RC116A, set:—

(a) The Standby/On switch to ON and ensure that the red On lamp and green Channel-In-Use lamp lights.

(b) The AF Gain clockwise and ensure that noise output is obtained at the monitor phone socket.

NOTE: When the switch is set to ON, the service and channel motors are energised and the switches in the R499A are turned to the positions determined by the settings of the Service and Channel switches in the RC116A. While the R499A is controlled from the RC116A, the settings of the Channel and Service switches on the receiver do not necessarily correspond with the settings of the same switches on the RC116A. However, once the Local/Remote switch on the receiver is set to LOCAL, the switches automatically re-align.

(5) Set Squelch switch to down position, request a transmission and ensure that the green Channel-In-Use lamp lights. If the carrier of the transmitted signal is suppressed, adjust the Fine Tune control to clarify the transmitted speech.

R499/ISB+ARU10A OPERATING INSTRUCTIONS

On the R499/ISB set the controls as follows:—

(1) Loudspeaker switch to the down position.

(2) AF Gain control to red spot.

NOTE: The next instruction regarding the setting of the RF Gain control includes procedure which checks the operation of the double-pole switch, ganged to the control.

(3) RF Gain control fully clockwise. Ensure that the clicking sound denoting operation of the ganged switch is heard. Then turn the control counter-clockwise (again checking for the clicking of the switch) to the red spot.

(4) Line/Signal switch to SIGNAL.

(5) AGC switch to NORMAL.

(6) Fine Tune control to red spot.

(7) Channel switch to the channel required.

(8) Service switch to ISB.

(9) Set the Standby/Off/On Switch to ON. Noise output from the loudspeaker should be heard immediately.

(10) After a period of approximately 12 to 15 minutes (to allow the temperatures of the ovens to stabilize), adjust as necessary, the Fine Tune control to resolve any signal.

(11) Adjust the AF Gain control to obtain the desired audio level.

(12) Set Loudspeaker switch to the up position on the ARU10A and set the AF Gain to give audible noise. With the R499/ISB controls set as specified, the noise output is obtained from the R499/ISB loudspeaker. If more convenient, the noise can be monitored by a 600 ohm headset inserted in the front-panel socket of the ARU10A.

(13) On the R499/ISB, set the RF Gain control fully clockwise so that the receiver squelch system operates.

(14) On the ARU10A,

(a) Set the front-panel Squelch control fully counter-clockwise.

(b) With audio noise evident from the ARU10A, adjust the Squelch control slowly clockwise until the audio noise output drops sharply.

(15) On the R499/ISB, set the Channel switch to obtain a LSB signal (see front-panel frequency chart).

(16) On the ARU10A,

(a) Set the Line/Signal switch to LINE.

(b) Adjust preset Line control to obtain the required level of audio output as indicated by the front-panel meter (−10dBm to +10dBm).

(c) Set the Line/Signal switch to indicate LINE or SIGNAL level as required.

R499/ISB + RC116/ISB + ARU10A OPERATING INSTRUCTIONS

Preliminaries

(1) On the RC116/ISB, set:

(a) The Standby/On switch to STANDBY.

(b) The Squelch switch to OFF.

(c) The Audio switch to the up position.

(d) The AF Gain control fully counter-clockwise.

(e) The Service switch to ISB.

(f) Fine Tune to mid position.

(2) If fitted, set the external buzzer switch to off.

(3) On the R499/ISB, set:

(a) The Standby/Off/On switch to ON.

(b) The Line/Remote switch to REMOTE.

(c) The RF Gain control to maximum clockwise.

(d) The AF Gain control to the red spot.

(e) The Audio switch to the mid position.

(f) AGC switch to NORMAL.

(g) The preset Squelch control as described in (15) of R499A.

Operating Instructions

With the controls set as specified, ensure that the amber Supply lamp lights on the RC116/ISB.

(4) On the RC116/ISB:

(a) Set the Standby/On switch to ON and ensure that the red On lamp lights.

(b) The AF Gain clockwise and ensure that noise output is obtained from the loudspeaker.

NOTE: When the switch is set to ON, the service and channel motors are energised and the switches in the R499/ISB are turned to the positions determined by the settings of the Service and Channel switches in the RC116/ISB. While the R499/ISB is controlled from the RC116/ISB, the setting of the Channel and Service switches on the receiver do not necessarily correspond with the settings of the same switches on the RC116/ISB. However, once the Local Remote switch on the receiver is set to LOCAL, the switches automatically re-align.

(5) On the ARU10A, set the AF Gain to give audible noise. The noise can be monitored by a 600 ohm headset inserted in the front-panel socket of the ARU10A.

(6) On the RC116/ISB set the Squelch switch to the down position.

(7) On the ARU10A:

(a) Set the front-panel Squelch control fully counter-clockwise.

(b) With audio noise evident from the ARU10A, adjust the Squelch control slowly clockwise until the audio noise output drops sharply.

(8) On the RC116/ISB, set the Channel switch to obtain a LSB signal (see front-panel frequency chart).

(a) Ensure that the Channel-In-Use lamp lights.

(b) Resolve the transmitted speech with adjustment of the Fine Tune control.

(9) On the ARU10A:

(a) Set the Line/Signal switch to LINE.

(b) Adjust preset Line control to obtain the required level of audio output as indicated by the front-panel meter (−10dBm to +10dBm).

(c) Set the Line/Signal level as required.

(10) On the RC116/ISB, set the Channel switch to obtain a USB signal (see front-panel frequency chart).

(a) Ensure that the green Channel-In-Use lamp lights.

(b) Resolve the transmitted speech with adjustment of the Fine Tune control.

(11) If the R499/ISB is operated from an a.c. mains supply, and a d.c. supply is connected, request that the a.c. mains supply be temporarily disconnected and ensure that the red 24 V supply lamp lights.

6 CIRCUIT DESCRIPTION OF RECEIVER

6 CIRCUIT DESCRIPTION OF RECEIVER

RF AMPLIFICATION

Muting

The circuit of the RF amplifier board (P27475) is shown in Fig. 10.2. The signal from aerial socket SKA is applied to static leak resistor R1, which is returned to earth. From R1, the signal is applied to the input circuitry of the receiver via contacts on the aerial mute relay RLA.

The energising voltage for RLA is routed from the power supply, via external muting link LKC connected across pins 1 and 2 of PLA. When the muting of the receiver is to be controlled externally, the link is disconnected and external control lines are connected across the two pins of PLA. When the aerial mute relay RLA is energised, the RF signal voltage at R1 is switched to the wiper contact of switch wafer SA10 on Channel switch SA.

Channel Switching

NOTE: To facilitate the description of channel switching in the RF amplifier, the Channel switch is referred to by its relevant ganged RF wafers SA10, SA9, SA8, SA7, SA6.

The setting of the Channel switch determines the routeing of the RF signal through the RF amplifier. There are several switching combinations to which the Channel switch can be wired. This circuit description is based on the standard arrangement shown in Fig. 10.2, in which the first six settings of the switch, route HF signals and the remaining four settings route MF signals. Other combinations are possible as described in Chapter 3.

With RLA energised and SA10 set to any one of the first six positions, the RF signal is applied to the constant-k bandstop IF trap pretuned by L1, T1, and L2 to introduce at least 90dB of rejection of the nominal IF of 1.4 MHz.

If an MF channel is selected, the RF signals are not switched to the IF trap, but instead are routed through SA10 to MF filters shown in Fig. 6.1. The MF filter is an optional extra and comprises two separate bandpass filters mounted on the same board. Each filter consists of two constant-k bandpass sections terminated by a constant-k lowpass section. One complete filter covers a range of 255 kHz to 365 kHz, and the other filter covers a range of 365 kHz to 525 kHz. Two separate filters are necessary to prevent spurious responses to inputs at twice the wanted channel frequency.

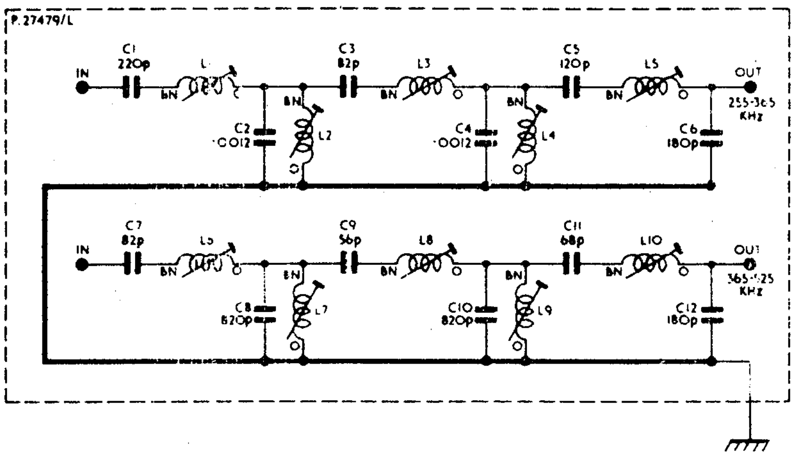


FIG. 6.1 MF FILTER

HF Filter Sets

The total HF coverage is 1.5 MHz to 30 MHz and this range is covered by seven different HF filter sets, colour coded for frequency reference as indicated in Table 6.1.

Table 6.1

Colour code	*Frequency coverage (MHz)*
Black	1.5 to 2.25
Brown	2.25 to 3.6
Orange	3.6 to 5.7
Yellow	5.7 to 9.2
Green	9.2 to 14.2
Blue	14.2 to 21.2
Violet	21.2 to 30

Reference to Fig 6.2 shows that each of the seven HF filter sets is of the same basic configuration, except for a series capacitor C2 used for four of the sets. Each filter unit contains three separate tuned circuits as follows:

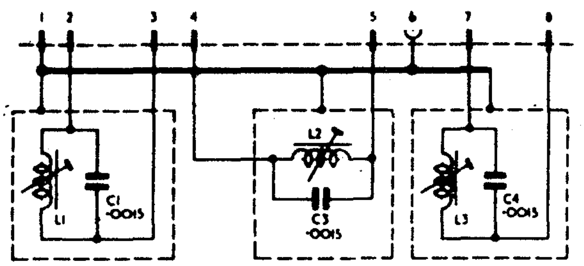
(a) A simple parallel tuned circuit L1 and C1. This is the 1st HF selectivity filter connected from the signal line and chassis, and between the aerial and signal attenuator X1. The circuit is tuned for peak response at the signal frequency.

(b) A parallel resonator L2 and C3 (and series capacitor C2 as required), in series with the output of the RF amplifier. The circuit acts as an image frequency trap. The effective series reactance at signal frequency is tuned out by a capacitor in series with the resonator. At the higher frequencies in the HF range, fractional separation between signal and image is small; accordingly, series resonance is critical and a trimmer capacitor is provided. At lower frequencies in the HF range, a fixed series capacitor suffices.

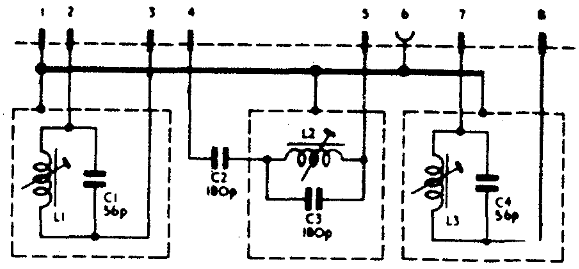
(c) A simple parallel tuned circuit, L3 and C4. This is the 2nd HF selectivity filter connected between signal line and chassis, and between the RF amplifier and the mixer. The circuit is tuned for peak response at the signal frequency.

Although nominally single-frequency, each filter has finite bandwidth. Over a band of $\pm 1\%$ of nominal frequency, there is no significant attenuation; one filter set can, in fact, serve for any number of channels provided the frequency separation is small.

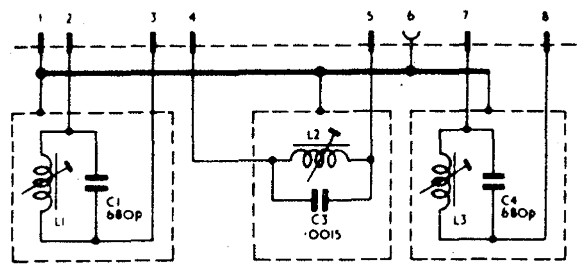
One complete channel set of filters is mounted on a small plug-in assembly which plugs into the RF amplifier printed circuit board. All of the seven possible filter sets are carried on identical boards. Any set will plug into any of the six locations provided on the parent board. Accordingly, at any instant, a maximum of six filter sets can be in position.



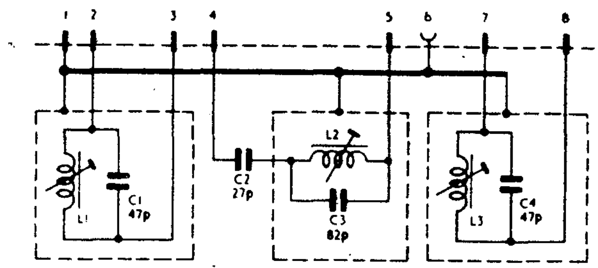
1.5–2.25 MHz BLACK



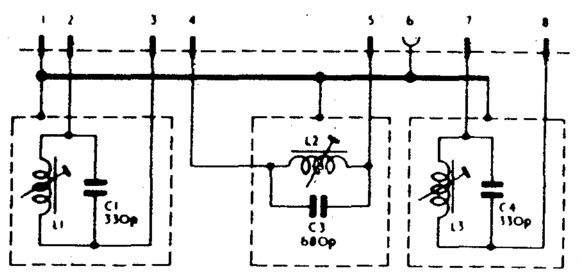
9.2–14.2 MHz GREEN



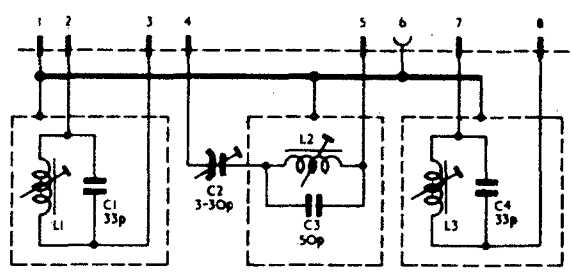
2.25–3.6 MHz BROWN



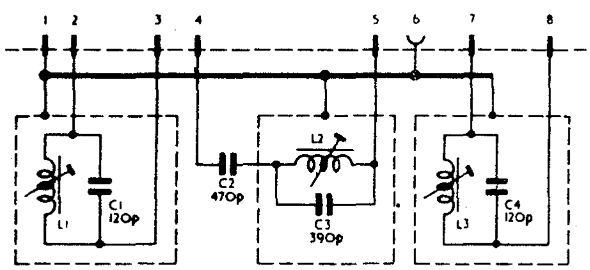
14.2–21.2 MHz BLUE



3.6–5.7 MHz ORANGE



21.2–30 MHz VIOLET



5.7–9.2 MHz YELLOW

NOTE:-
PIN NUMBERS 1, 3, 6, 8 ARE EARTHED WHEN PLUGGED IN.

HF FILTER SETS. Fig. 6.2

HF Filter Set Selection

Fig 6.3 shows how an HF filter set and its associated switching are connected in circuit. This diagram also includes the impedance at various points in the filter chain.

Each filter in an HF set is selected as required by wafers SA9, SA8, SA7 and SA6. The incoming signal is routed by SA10 to either one of the MF filters or the HF signal line which passes through the IF rejection trap and then to wafer SA9. For MF channels, SA9 connects the output of the selected MF filter to the attenuator input line of the RF amplifier. Although the HF signal line and the IF trap are still connected to the amplifier input line on MF channels, they have no adverse effect.

The output of the RF amplifier is switched by SA8 to the image trap circuit of an HF filter set, or directly to SA7 when an MF channel is in operation (this connection is not shown on Fig 6.3). SA7 accepts output either from an HF filter-set image-trap or directly from SA8 and switches it via impedance matching transformer T6 to SA6. The output of the RF amplifier when operating on an MF channel is not filtered. Note also that SA8 and SA7 select the two ends of each HF image trap, and have no true function on MF. On each MF position of SA6, a fixed capacitor C11 (not shown on Fig 6.3) is connected in parallel with the secondary of T6 and the primary of T7.

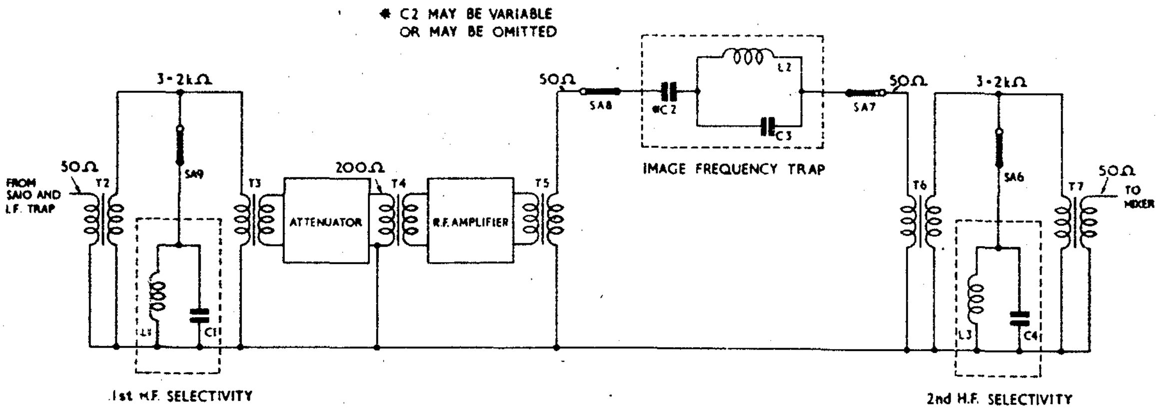


FIG. 6.3 HF FILTER SET SWITCHING

Protection of the RF Amplifier

The output of the 1st RF selectivity filter is transformed to approximately 200 ohm by wideband transformer T3 and fed via FS1 into attenuator X1. During large signal conditions, the RF amplifier is protected against overload voltage levels by the local 'front-end' AGC system. Should overload conditions become excessively severe, the signal frequency current drawn by attenuator X1 can become sufficient to rupture FS1 before either the attenuator or the RF amplifier are damaged.

RF Amplifier

The unbalanced output voltage of the attenuator has an impedance of 200 ohm and is transformed by wideband transformer T4 to a push-pull voltage at 12.5 ohm +12.5 ohm impedance balanced about +3V. This voltage is derived from the potential divider R3 and R4 to which the secondary centre tap of T4 is returned. The first stage of the RF amplifier contains transistors VT1 and VT2 operating in class A push-pull.

Local series and shunt negative feedback is applied to each transistor. For transistor VT1, series negative feedback is introduced by the un-bypassed emitter resistor R9; shunt negative feedback is introduced by R5 and d.c. blocked by C4. Feedback for transistor VT2 is introduced by an identical arrangement of R11, R7 and C5. Bias stabilising resistors R10 and R12 are decoupled by C7 and C8, respectively. At frequencies in the region of 30 MHz, gain is increased slightly by C6. The combined feedback arrangement maintains a constant input impedance over the RF signal range, defines the gain and linearises the transfer function.

The amplified push-pull output signal of the first stage is directly connected to the bases of transistors VT3 and VT4 which also operate under class A bias conditions in the second push-pull stage. Local series and shunt negative feedback is applied similarly to that in the first stage. Un-bypassed resistors R15 and R16 introduce series emitter feedback; shunt feedback from the collector circuits is introduced by R17, R18 and R19, R20. Bias stabilising resistors R13 and R14 are decoupled by C9 to the virtual earth which exists at this point in the class A push-pull stage. Overall feedback over the two push-pull stages is effected by returning the emitter of VT3 and the emitter of VT4 to the shunt feedback networks of VT1 and VT2, respectively.

The output from the second push-pull stage is matched by transformer T5 and switched by SA8 to the image frequency trap. The d.c. supply to the primary centre tap of T5 is applied via R21. If the RF amplifier is overdriven, R21 introduces symmetrical peak clipping and reduces the effect of overdrive at the mixer.

Local AGC

There is an independent front-end AGC loop operating around the RF amplifier only, which controls very large signals falling within the RF passband, but outside the IF passband and which therefore do not operate the main AGC system.

Such signals, if not controlled, would cause the RF amplifier or mixer to overload, and this in turn would result in loss of service of wanted signals. The RF attenuation also affects the wanted signal, so the front-end AGC loop is arranged to come into action not only for out-of-band signals, but for large wanted signals which otherwise would cause intermodulation, cross-modulation and blocking.

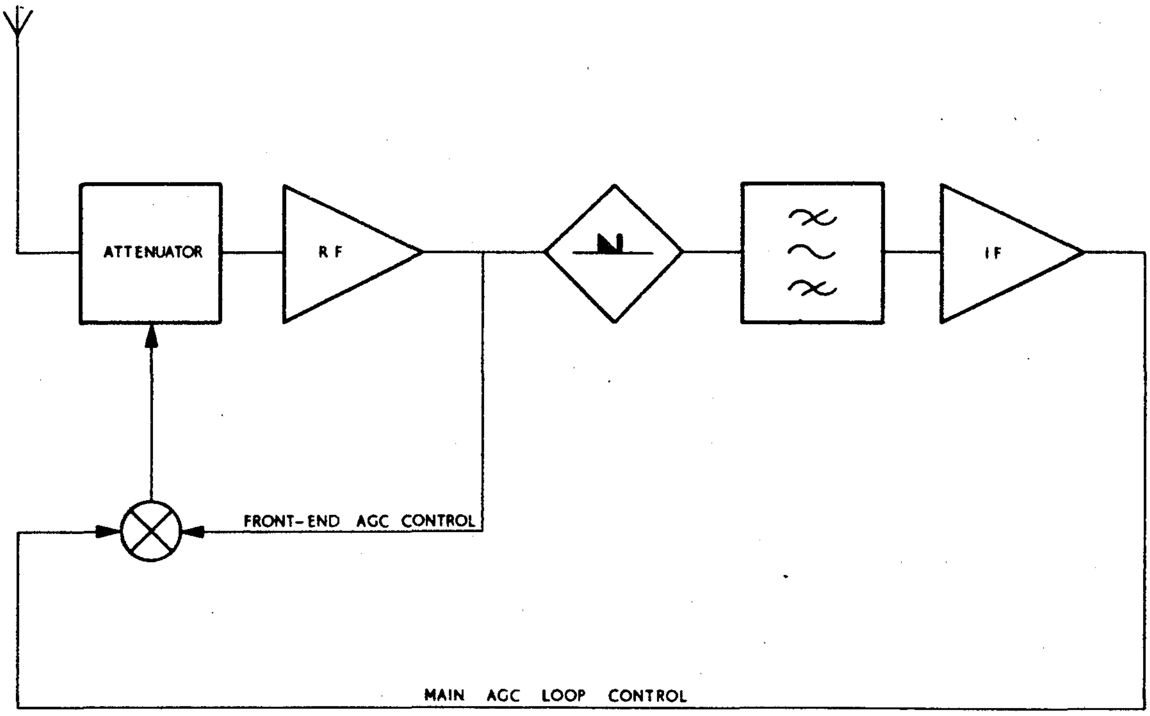


FIG. 6.4 AGC SYSTEM

Transistors VT5, 6, 7 and 8 form a d.c. coupled wideband AGC amplifier.

The amplified RF output signal at the secondary of T5 is applied to the base of a detector transistor VT8, via buffer resistor R37. The purpose of this resistor is to prevent peak clipping of the RF signal. The emitter is at a positive potential determined by R33 and R34. This bias arrangement determines the threshold level of operation of the local AGC.

During quiescent and low signal conditions, transistor VT8 is non-conducting, but as soon as the output level of the RF amplifier rises above the local AGC threshold voltage, VT8 conducts. The rectified output of VT8 consists of RF pulses (rectified signals) which are amplified by VT7 and smoothed by capacitor C13 in the collector circuit.

Immediately the local AGC becomes active, a d.c. signal from the collector of VT7 is fed back into the main AGC system to shorten the decay time-constant of the main AGC. In this way, the receiver is prevented from being subjected to considerable 'blanking off' periods as a result of transient high level signals.

The voltage developed across C13 and R29 is applied to the base of VT6 via R28 and MR3. Resistor R28 limits the current drawn from C13. The main AGC loop is also applied to the base of VT6 via isolating diode MR2. Diodes MR2 and MR3 isolate the main AGC from the local AGC to prevent interaction between the two systems. The potential divider R24, R25 provides AGC delay bias at VT6.

D.C. voltages at the collector of VT6 are applied directly to the base of VT5 which acts as a driver for attenuator X1. Emitter current is limited by R23, and drive current by R22. Diode MR1 prevents accumulation of reverse charge on C12 by rectification of very large input signals.

CHANNEL OSCILLATOR

Introduction

The circuitry of the channel oscillator is mounted on two printed circuit boards P27472 and P27472, as shown in Fig 10.2.

Basic Oscillator

The basic oscillator VT9, is a modified Colpitts circuit with base-emitter feedback, and is mounted on board P27472. This board and up to a maximum of 10 crystals are housed in a temperature controlled oven. Base bias stabilisation for VT9 is provided by R38 and R39. The base is returned to the R38/R39 junction via a stabilizing and limiting resistor R40. The output of the oscillator is fed through a buffer stage VT10, to a multiplier and amplifier.

The channel crystal is switched into the base circuit of VT9 by wafer SA4 of the front-panel Channel switch. The frequency is approximately 1.4 MHz higher than the signal. The exact frequency difference depends upon the service mode of the receiver and the IF filter fitted. Full details of the channel oscillator frequency and service modes are tabulated in Table 3.2 of Chapter 3. Connected in series with each crystal is a trimmer capacitor for precise trimming of the crystal frequency. At any switch position, unselected crystals are shorted directly to chassis by an earthing ring on the switch.

For the signal frequency range, 255 kHz to 30 MHz, the channel oscillator must cover a frequency range of 1.655 MHz to 31.4 MHz. However, the practical frequency limit for fundamental mode crystals is below 20 MHz. Accordingly, for oscillator frequencies of 16 MHz and above, a fundamental mode crystal of half the operating frequency is used and the output of the oscillator switched to a frequency doubler on board P27471.

Multiplier and Amplifier

The output from the buffer stage on board P27472 is fed to a full-wave doubler network comprising transformer T8, diodes MR4 and MR5 and choke L6. After doubling, the output from the network is applied to $2F_o$ which is one of three distribution terminals used for making wiring connections to contacts on wafer SA5 of the Channel switch. Of the two other distribution terminals, S_o is used as a parking pin for unused channel leads, and F_o, fed via buffer resister R44 direct from the oscillator, is used as a distribution point for fundamental crystal frequencies.

The connections to the wafer of SA5 thus determine whether the oscillator frequency is a direct fundamental crystal frequency or a doubled fundamental. The frequency selected by the wiper is capacitively coupled to the two-stage direct-coupled mixer-driver amplifier containing transistors VT11 and VT12. Overall negative feedback and bias for VT11 is provided by R50 and R46. The output of the amplifier is matched by T9 to the mixer.

MIXER AND IF FILTERS

Mixer

The circuitry of the mixer is enclosed in a screening can which is mounted on the chassis of the receiver. Two inputs are routed by coaxial lines to the mixer, one from the secondary of T9 on the channel oscillator board and one from the secondary of T7 on the RF amplifier board.

Frequency changing is effected by a modified ring modulator: oscillator drive is applied via T10, and the RF input via T11. The four diodes, MR6, MR7, MR8 and MR9 are matched and encapsulated so that balance adjustments are not necessary. The output from the modulator is connected to SKC mounted on the screening assembly.

IF Filters

The IF output from the mixer is connected via PLC to the bandpass filter FL2 and to the wiper of wafer SB8. This wafer in conjunction with wafer SB7, routes the IF output signal from the mixer through an IF filter. It is the characteristics of the filter switched into circuit which basically determine the selectivity of the IF amplifier. Full details of the different types of IF filter including their bandwidth and the channel oscillator and reinsertion oscillator frequencies at which they are used, are given in Table 3.2 in Chapter 3.

The switch has five positions, identified on the front-panel as:—

ISB, AM, CW, SSB, TEST.

In the TEST position, a signal from the reinsertion oscillator is used for testing the succeeding circuits of the receiver as explained later in this Chapter. Connections associated with the ISB function are determined by the application of the receiver. If the receiver is used with the ARU10A ISB Adaptor, the IF output from the mixer is applied to a hybrid splitter identified on Fig. 10.3 as X2. Of the two outputs derived from the splitter, one is fed through an upper sideband filter via SB7 to the IF amplifier and audio board, and the other output is routed via SKD—the ISB OUT socket on the rear of the receiver—to the ISB Adaptor.

NOTE: During frequency conversion at the mixer, sidebands are reversed. Thus for reception of USB signal frequencies, a filter which accepts the LSB of the IF signal is fitted.

If the receiver is the standard version, the hybrid splitter is not fitted.

The three remaining settings AM, CW, and SSB can be used to switch these filters into circuit. Of the three filter locations on the chassis, two locations accept any two of the five filters A, B, D, G, H detailed in Table 3.1 Chapter 3. The third location accepts a CW filter only.

IF AMPLIFIER BOARD

Introduction

The circuitry of the IF amplifier board (P27470) is shown in Fig 10.3 and a simplified block diagram showing signal flow and control loops is given in Fig. 10.4. On the block diagram, signal flow is emphasised in heavy lines, and control loops are distinguished by thin lines.

Brief Overall Description

The input to the IF amplifier is fed from the wiper of SB7, one of the wafers on the five-position front-panel Service switch. In positions 1 to 4 inclusive, the input is a received signal, but in position 5, TEST, a low level signal is applied from the insertion oscillator. This signal is used to test the IF stages of the receiver. When the receiver is working correctly, application of the test signal produces a d.c. level on the front-panel meter.

As shown in Fig. 10.4, the IF input signal passes through a four-stage wideband amplifier, VT13 to VT16 inclusive, to a tuned amplifier stage containing VT17. A double tuned circuit, driven by VT17, limits the noise bandwidth of the otherwise untuned IF section. In CW mode, crystal filter XL11 is switched into circuit to further reduce the noise bandwidth.

The gain of VT17 is set by the Service switch to the optimum value for the selected mode of operation. Amplifiers VT14, VT15 and VT16 are gain-controlled by AGC diode attenuator networks.

Output transistor VT18 drives three circuits.

(1) Buffer stage VT19 which feeds the rear panel connector IF OUT.

(2) Detector stages.

(3) Peak level AGC detector.

The IF output to the detectors is connected by the front-panel Service switch, to the detector appropriate to the mode of the signal. After detection, the demodulated signal is amplified by a two-stage audio pre-amplifier and then applied to two independent gain controls—the front-panel AF Gain control and a preset control which determines the output audio level at the front-panel loudspeaker and line sockets, respectively.

The peak level AGC detector is biased off to provide delayed AGC. The rectified output is applied to switch-selected attack and decay time-constant circuits which provide optimum AGC attack and decay times for the different service modes. Transistor VT27 is connected across the AGC time-constant circuitry and is controlled by an output from the font-end AGC system in the RF amplifier. The function of the transistor is to shorten the decay time of the main AGC system when the independent front-end system operates. The output from the front-end AGC is also applied to pin 19 of SKF (AGC to ISB) to operate a similar circuit in the ARU10A ISB Adaptor, if fitted.

An additional manual override on the AGC system is effected when two control settings are used simultaneously. These two controls and their settings are as follows:

(1) The front-panel AGC switch set to OFF.

(2) The front-panel RF Gain control set to any setting except maximum.

The override consists of a closed switch on the RF Gain control which shorts out the AGC time-constant circuit via the OFF contacts of the AGC switch.

The output from the AGC time-constant circuitry and the voltage corresponding to the setting of the RF Gain control, is applied to a compound emitter-follower stage (AGC buffer) which effects impedance matching between the AGC time-constant circuitry and the AGC attenuators. Whichever is the greater of the two applied voltages, assumes control, and the other voltage is ineffective. Outputs from the compound emitter-follower are fed as follows:

(1) A voltage which can be displayed on the front-panel S meter when the front-panel meter switch is set to SIGNAL.

(2) A control voltage to the front-end AGC system.

(3) The AGC voltage applied to the AGC attenuators which control transistors VT14, VT15 and VT16 in the IF amplifier.

(4) A voltage applied to the squelch system.

If the following circuit conditions exist in the squelch system, a voltage from the squelch circuit is applied to the audio pre-amplifier and reduces the output by approximately 30dB.

(1) The front-panel RF Gain control is at the maximum setting.

(2) The AGC voltage is below a level determined by a preset control in the squelch circuit.

(3) An earth is not applied to TSA22 from the remote control system (if fitted).

When the AGC voltage rises above the preset squelch level—and conditions (1) and (3) are not imposed —the mute is removed from the pre-amplifier.

Detailed Description

IF AMPLIFICATION

The filtered input signal obtained from the wiper of SB7 is capacitively coupled to the first stage of IF amplification containing VT13; this transistor is a low noise type. Shunt negative feedback is applied in the stage via C34, R54, and series feedback by the un-bypassed emitter resistor R58.

The output from the collector of VT13 is matched to VT14 by transformer T13. Damping resistor R61, across the secondary of T13 prevents ringing which may otherwise be caused by transient high-level signals. When VT14 is subjected to AGC, the base circuit is shunted by a diode attenuator network in the AGC system described in detail later.

From the collector of VT14, the amplified signal is directly coupled to the base of VT15.

The output of VT15 is applied via C42 and C44 to the base of VT16.

From VT16 the signal is directly connected to the base of transistor VT17. Automatic gain control is not applied to this transistor. In the emitter circuit of VT17, three resistors R79, R80 and R81 are connected in series. Switch wafer SB6 of the front-panel Service switch, in conjunction with C51, is used to decouple R81 or, R80 in series with R81, to earth. At any setting of the switch, the emitter resistors not decoupled, determine the amount of series emitter feedback and hence the gain of the transistor. This arrangement sets the overall IF gain to the optimum for the service selected.

The collector of VT17 is impedance matched by transformer T14 to a simple coupled-pair filter comprising the secondary of T14 tuned by C49 and auto-transformer T15 tuned by C53. For all service modes except CW, capacitor C52 is switched into circuit by wafer SB5a. With C52 in circuit, the two tuned circuits are slightly over-coupled. In the CW position of the switch, capacitor C52 is disconnected from circuit and a neutralizing trimmer capacitor C50, and crystal XL11 are switched in to provide the coupling. On all settings except CW, wafer SB5b is used to short-circuit XL11. At any setting of the Service switch, the network switched into circuit limits the noise bandwidth of the otherwise aperiodic IF amplifier, to a suitable value.

The output from T15 is capacitively coupled via C54, to the base of transistor VT18 in the output stage. The collector circuit of the transistor contains wideband transformer T16 whose primary winding is damped by resistor R88. Two bias chains are used in this stage. Resistors R85, R86, R83 and R84—decoupled at the junction of R86 and R83 by C55—provide bias levels for limiter diodes MR11 and MR12 connected in the collector circuit, to limit the collector output. The decoupled point in the chain is also used as the return for a threshold bias network in the peak level AGC detector circuit. The other chain, fed from the decoupled point of the first chain, comprises R82 and R87 which provide base bias for VT18. Emitter feedback in introduced by R89.

Three outputs are routed from the stage as follows:

(1) An output from the collector to the AGC system (described later).

(2) An output from the emitter to buffer amplifier VT19. An output from the emitter of VT19 is routed to SKE, the IF OUT socket on the rear of the receiver.

(3) An output from the secondary of wideband transformer T16 is applied to the wiper of wafer SB3a which connects the signal to whichever type of detector is required for the mode of reception.

DETECTION

Two types of detectors are used:

(a) Diode detector, MR13, loaded by R94.

(b) Product detector comprising diodes MR14, MR15 and resistors R96 and R97. The product detector is fed from the insertion oscillator on printed circuit board P27473.

The input and output levels of the detectors are adjusted by the Service switch to obtain substantially the same audio levels with different modes of modulation.

At each setting of the five-position Service switch, the IF signal connected to the wiper of SB3a is switched to a detector circuit as follows:

(1) ISB
The signal is switched to the product detector MR14, MR15, and the audio output is attenuated by R98 and R107.

(2) AM
The signal is switched to the diode detector MR13.

(3) CW
The signal is switched via resistor R95 to the product detector, and the audio output is attenuated by R98 and R107.

(4) SSB
The signal is switched to the product detector, and the audio output is attenuated by R98 and R107.

(5) TEST
The test signal is disconnected from the detector system. All demodulated outputs are routed through wafer SB3b to the audio pre-amplifier.

AUDIO PRE-AMPLIFIER

The audio input routed from the wiper of SB3b is applied to a low-pass filter for removal of RF, and then fed to a two-stage direct-coupled amplifier containing transistors VT20 and VT21. Provision is also made to connect and amplify external sidetone: the sidetone signal can be connected to pin 12 of SKF whence it is routed via an attenuator network, R102, R101 and R100, to the base input circuit of VT20.

Transistor VT21 operates as an emitter-follower. The emitter load consists of the front-panel AF Gain control R186 in series with R195, both of which are in parallel with preset gain control R185. The slider of each potentiometer is connected to different amplifiers. The emitter of VT21 is also connected to the squelch circuit. The operation of the squelch circuit and the function of R108 and C64 connected between emitter and base of VT21, are described later.

LINE AMPLIFIER

The voltage at the slider of R185 is capacitively coupled to the base of emitter-follower VT32. Transformer T19 in the emitter circuit is designed to feed the line output signal into a 600 ohm line: maximum line output power is 10mW. The line audio signal is monitored on the front-panel meter ME1 when the front-panel toggle switch is set to LINE. The meter has an almost logarithmic characteristic produced by a diode-resistor network connected between the secondary of T19 and ME1. The line audio is rectified to a near average value by MR29, R156 and C87. The resultant d.c. level is applied to the diode resistor network which functions as follows. At a standard low level of OdBm, MR30 does not conduct, R157 being adjusted for a meter indication of OdBm. At a standard high level of +10dBm, MR30 conducts and R158 is adjusted for a meter indication of +10dBm.

LOUDSPEAKER OUTPUT

The voltage at the slider of R186 is capacitively coupled to a conventional AF amplifier containing transistor VT22 which is transformer coupled to a push-pull output stage biased to operate in class AB. Transistors VT23 and VT24 in the output stage are matched to the load by transformer T18. This transformer has two secondary windings, one to match into a 3 ohm circuit, and the other into a 600 ohm circuit.

The output power of the 3 ohm winding is applied as follows:

(a) 10 mW to the front-panel headset socket JKA.

(b) 10 mW to the front-panel headset socket JKB (This socket is not fitted to the receiver when the BFO facility is incorporated).

(c) 0.5W to the front-panel loudspeaker.

(d) 1.5W to the external 3 ohm loudspeaker.

The front-panel loudspeaker switch controls the internal loudspeaker and, if necessary, can be arranged to control the external loudspeaker by removal of link LKA. When the ARU10A ISB Adaptor is used with the receiver, the front-panel switch can be wired as a change-over switch to monitor either sideband signal For this facility, link LKA is removed and the ISB audio is connected to pins 14 and 24 of SKF. In the ON position of the front-panel switch, the sideband audio from the receiver is connected to the internal and external loudspeakers. In the OFF position, sideband audio from the ISB adaptor is connected to the loudspeakers. In the centre position, the loudspeaker is disconnected (see table in Chapter 5)

The 600 ohm winding of T18 has an output power rating of 1.25W and is intended to drive external loads connected to the receiver via long lines.

AGC SYSTEM

The input to the AGC system is applied from the collector of VT18 to the peak level detector comprising the compound emitter-follower configuration of VT28 and VT29. The peak level detector does not operate until the AGC threshold voltage is exceeded; this threshold voltage is established by the bias network of R142 and R143 to which the emitter of VT28 is returned. The bias network is fed from the decoupled point of the bias chain in the IF stage containing VT18. Thus, because the base of VT29 is connected directly to the collector of VT18, the compound emitter-follower cannot conduct unless the output from the collector of VT18 exceeds the bias level.

Whenever the collector potential of VT18 exceeds the AGC threshold bias voltage, the peak level detector conducts and a charging current proportional to the signal level is fed to the time-constant circuits which determine the attack and decay times. Subsequent operation of the AGC system is such that the peak-envelope level of the signal is maintained constant.

AGC Time-Constant Circuits

Three capacitors are mainly associated with the time-constant circuits: C79, C80 and C81. Capacitor C79 is the AGC attack-time capacitor, whilst C80 and C81 are the decay-time capacitors.

The optimum time-constant values for the mode of operation in use are automatically selected by the Service switch. Also included in the time-constant circuits is an AGC switch which has three positions:

NORMAL	—for normal operating conditions
FAST	—for conditions of rapid fading
OFF	—switches the AGC off (assuming the RF Gain control is *not* at its maximum gain setting)

Further details of this switch are contained in the following circuit description.

On AM operation (assume the AGC switch is set to NORMAL), a short circuit is connected across R139 by SB4a contacts, and resistors R140 and R141 are switched into circuit by SB4b contacts. The charging current to the two time-constant capacitors (ignoring R138) flows via R140. Note that C81 is short circuited by the AGC switch. This circuit arrangement provides the relatively slow attack-time (R140 action) and fast decay-time (R141 action) necessary for AM operation. On all other modes of operation R140 is short-circuited to decrease the attack-time, whilst R141 is disconnected to increase the decay-time.

The receiver cannot be blocked by the action of isolated interference pulses charging the AGC capacitors. This is because random transients do not last long enough to charge C80, and although they will charge C79 this charge will decay rapidly.

The discharge of the AGC time-constant circuits is also controlled by transistor VT27, which is connected across resistor R135. If a signal is received of sufficient amplitude to operate the front-end AGC system, then a voltage is applied to VT27 base to cause it to conduct. This action effectively short circuits R135 and the decay-time is considerably decreased.

When the AGC switch is set to FAST, the short circuit is removed from C81 which is connected in series with C80 to reduce the total capacitance, and hence the decay-time. This facility is useful in conditions of rapid fading.

The AGC switch completes the earth circuit for SEa (switch ganged to the RF Gain control) when it is set to OFF. The AGC system is then switched off if:—

(a) The RF Gain control is *not* set to maximum.

(b) The Service switch is set to any mode of operation except AM.

Note that a second switch SEb, is ganged to the RF Gain control and operates the squelch system (described later).

Manual Control of AGC

The RF Gain control R179, is part of a resistor network fed from the 20V line. Thermistor TH1 in the network, provides a degree of thermal compensation. The voltage developed across R179 is tapped off by the slider and applied, via diode MR25, as bias, to the base of transistor VT26. The output from the AGC time-constant network is also applied to the base of VT26, via diode MR26. Of the two voltages, the one which has the highest amplitude, controls the transistor.

A connection is taken to TSA-30 for desensitising, and to SKF-20 for external r.f. gain control; these facilities are described in Chapter 7 and the handbook for the ARU10A respectively.

AGC Attenuators

Transistors VT26 and VT25 form a compound emitter-follower which provides an impedance match between the AGC time-constant circuitry and the AGC attenuators. Output circuits are fed from the compound emitter-follower as described below.

The AGC voltage is applied progressively to the attenuators in the following order:

(i) 4th IF stage attenuator

(ii) front end attenuator

(iii) 2nd IF stage attenuator

(iv) 3rd IF stage attenuator

This sequence of AGC application ensures optimum signal-to-noise ratio at all times.

From the emitter of VT25 the AGC voltage is applied via two delay diodes MR24a and MR24b, and a lowpass filter comprising L5 and C75, to the attenatuor in the 4th IF stage. A delay voltage, determined by the R125/R128 potential divider, is applied to the attenuator diodes MR20, MR21. When the AGC voltage rises to a sufficient level, these diodes will conduct to shunt the signal at VT16 base. The maximum voltage across the attenuator diodes is limited by diodes MR23ab.

As the AGC voltage rises further it is applied to the front-end attenuator via line B (see section headed LOCAL AGC).

A further increase in AGC voltage overcomes the delay introduced by MR22 and causes attenuator diodes MR16 and MR17 to conduct via R123, and consequently shunt VT14 base circuit. Delay bias for these two diodes is applied at the R122/R121 junction.

Finally MR18ab and 19ab conduct to shunt the signal at VT15 base. Note that the delay bias on these diodes is the same as on MR16/17, but because there are four in series a higher AGC voltage is required to cause them to conduct.

Resistors R120 and R124 ensure a smooth AGC action over the full dynamic range.

AGC Out

AGC output if required, is available at pin 10 of SKF.

Signal Level Indication

AGC output is routed from the junction of R131 and C77 via the front-panel Line/Signal switch to the front-panel meter ME1. With the switch set to SIGNAL, the deflection of the meter represents the level of the AGC voltage, and hence the signal strength.

SQUELCH SYSTEM

The squelch circuits control relay RLB/2, which when energised causes the audio output of the receiver to be demuted by approximately 30 dB.

AGC voltage at the emitter of VT25 is applied to VT30 base to control this transistor. The squelch circuit comes into operation before the AGC system because it is not subjected to the delay imposed by diodes MR24ab.

Transistor VT30 will not conduct until the potential at its base is higher than the potential at the emitter, this being set by the Squelch control R184.

When VT30 is not conducting (receiver squelched) a positive potential is applied to VT31 base and this transistor is also cut off. Note that SEb contracts are open during squelch operation (RF Gain maximum clockwise); the reason for incorporating these contacts is explained later. In the collector circuit of VT31 is the squelch control relay RLB/2; diode MR27 is a back—e.m.f. protection diode. When VT31 is non-conducting RLB/2 is not energised and contacts RLB1 are consequently open to allow a positive potential to be fed, via MR28, to VT21 emitter to cut off the transistor. Capacitor C64 and resistor R108 form a by-pass circuit for VT21 so that even when the transistor is cut off a small signal is passed on to the a.f. output stage to give a very low audio output when the receiver is squelched. Note that a second pair of relay contacts, RLB2, are employed; their function will be explained later.

When the signal level, and consequently the AGC level, rises sufficiently to overcome the delay imposed by the Squelch control setting, VT30 will conduct, and so will VT31 to energise RLB/2. Contacts RLB1 close to remove the bias from VT21, and full audio output is obtained. Diode MR28 prevents the emitter of VT21 from being shorted to the negative line when RLB1 contacts close.

As mentioned previously the RF Gain must be set to maximum for squelch operation. Contacts SEa and b, which really form the Squelch On/Off switch, open under this condition. The purposes of these contacts is as follows:—

SEa—These contacts open to override the AGC switch. Thus if the AGC switch is set to OFF, thereby short-circuiting the AGC line, the opening of these contacts ensures that AGC voltage is available for un-squelching purposes.

SEb—These contacts ensure that the receiver is automatically un-squelched when the RF Gain control is rotated from its maximum position. They also ensure that a wanted signal is not lost if the RF Gain is inadvertantly rotated when the receiver is squelched and the AGC switch is set to OFF. When SEb closes, a bias voltage is applied to VT31 causing it to conduct. When this happens RLB/2 is energised and the receiver is un-squelched. These contacts also control a similar circuit in the ARU10A, via pin 21 of SKF.

When a remote control system is fitted, relay contacts RLB2 complete the circuit for the Channel-in-Use indicator on the control unit via TSA-27. This line is also extended to pin 3 of SKF so that advantage can be taken of this facility even if a remote control unit is not employed.

A connection is taken from the remote control unit to TSA-22; a Squelch On/Off switch in the control unit effectively earths this point to un-squelch the receiver if required (see Chapter 7).

RE-INSERTION OSCILLATOR BOARD AND BFO

Introduction

The circuit of the reinsertion oscillator board P27473 is shown in Fig. 10.3. Two crystal frequencies are provided so that USB and LSB can be obtained from any one SSB filter.

Facilities

Assume that the R499A is fitted with the standard USB filter A. The response of the filter is shown in Fig. 6.5 and it will be noted that the response is symmetrical. If reception of an USB RF input signal of 10 MHz nominal frequency, modulated by audio frequencies within the range 250 Hz to 3000 Hz, is required. the frequency of the local oscillator crystal must be chosen so that the wanted sideband of the signal falls within the response of the filter.

The local oscillator is always set to operate at a frequency above the RF signal, and therefore the local oscillator (LO) and IF are related. for this example, as follows:—

LO – 10 MHz = IF

LO – (10 MHz + 250 Hz) = IF-250 Hz

LO – (10 MHz + 3000 Hz) = IF-3000 Hz

For filter A to conform with this result and for the accepted sideband to be *below* the nominal IF, a local oscillator crystal which produces an IF of 1.4 MHz must be used. To demodulate the 1.4 MHz IF, the reinsertion oscillator must be fitted with a 1.4 MHz crystal.

Thus, the foregoing example establishes the circuit frequencies for reception of an USB signal at a nominal frequency of 10 MHz. Now suppose that reception of a LSB input signal of 10 MHz nominal frequency modulated by the same audio frequencies is required: the position of the sidebands relative to the nominal IF are derived similarly as follows:—

LO – (10 MHz—250 Hz) = IF + 250 Hz.

LO – (10 MHz—3000 Hz) = IF + 3000 Hz.

For filter A to conform with this result and for the accepted sidebands to be *above* the nominal IF, a local oscillator crystal which produces an IF of 1.396750 MHz must be used. The reinsertion oscillator must be fitted with a 1.396750 MHz crystal. Thus by use of suitable local oscillator crystals, the same SSB filter can be used for reception of either the USB or LSB of the signal.

There are other conditions in which different IF and reinsertion oscillator frequencies will give more than one service from a filter. These are shown in Table 3.2 Chapter 3. In general, selection of the required crystal frequencies is based on the same principle:

(1) Select the local oscillator frequency to convert the RF signal so that it 'sits' in the passband of an IF filter.

(2) Select the reinsertion oscillator frequency so that the signal can be demodulated.

It is also possible to arrange the switching of the receiver so that either the upper or lower sideband of the same nominal radio frequency can be selected. This is effected by allocating two separate channel positions for one signal frequency, and fitting the required local oscillator and reinsertion oscillator crystals. Alternatively, a second SSB filter which is a mirror image of the first, can be fitted. With this method, either sideband can be selected but only one local oscillator and one reinsertion oscillator crystal are needed.

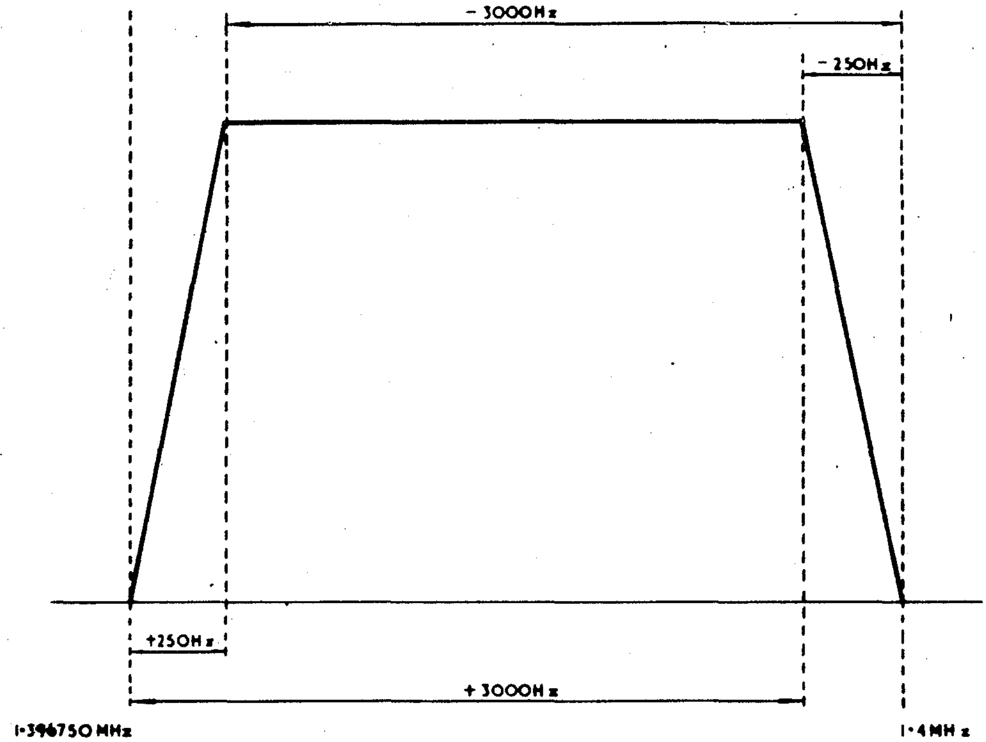


Fig. 6.5 response (idealised) of SSB filter A

Circuit Details

REINSERTION OSCILLATOR

The reinsertion oscillator comprises a modified Colpitts oscillator VT33, and buffer amplifier VT34. The frequency of the oscillator is determined primarily by one of two crystals XL12 or XL13, switched into circuit by wafers SA2 and SA3. Both wafers are part of the Channel switch and are pre-wired to select XL12 or XL13 (or neither) as required by the selected channel.

Both XL12 and XL13 are housed in a thermostatically controlled oven, the heater element of which is energised from 24V a.c. or d.c. as described later in this Chapter. The output of each crystal is connected to two sets of terminals 1 to 10. One set of terminals is associated with the 10 stator contacts of SA2, and the other set with the 10 stator contacts of SA3. The crystal switched into circuit at any position of the Channel switch is determined by wiring links soldered from the stator contacts to the respective terminals.

Fine tuning of the oscillator is effected by a voltage applied to varactor diodes MR31 and MR32. This voltage is derived from either the front-panel Fine Tune control R163, or a voltage applied externally to TSA18 from the remote control system, if installed. If the remote control voltage is to be used, switch SHb (one pole of the front-panel Local/Remote switch), is set to REMOTE and link LKB removed. When the remote control system is not installed, the Local/Remote switch is not fitted and R163 is connected permanently in circuit via LKB. MR38 ensures linear operation of R163.

The output of the reinsertion oscillator is routed from the centre-tapped secondary of T20, balanced about chassis, to the product detector on the IF amplifier board.

BFO

The BFO is mounted on printed circuit board P27474, and its circuit is a conventional Colpitts oscillator, as shown in Fig. 6.6. Tuning is effected by C1, the motor shaft of which is connected to a control knob fitted in place of the right-hand headset socket on the front-panel of the receiver.

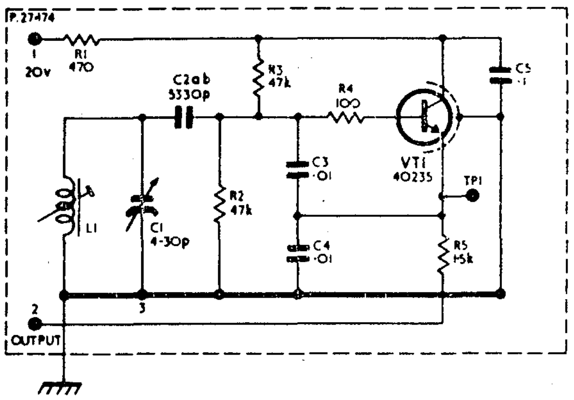


Fig. 6.6 BFO circuit

POWER SUPPLY AND STABILIZATION

Introduction

Most of the circuitry of the power supply is mounted on the chassis of the receiver. Stabilization, however, is effected by circuitry mounted on the stabilizer printed circuit board P27469: circuit details are shown in Fig. 10.2.

Input Supplies

The a.c. supply is connected to PLA on the rear of the receiver. The live and neutral sides of the mains are protected by fuses FS2 and FS3 respectively, mounted on the rear of the receiver. From the fuses, the mains input is applied to SGa and b, the three-position, four-pole Standby/Off/On front-panel switch. In either ON or STANDBY, the mains are connected to the primary windings of transformer T21. The two separate primary windings can be connected in series or parallel for 100-125V or 200-250V.

The positive side of the 24V d.c. supply if used, is connected to pin 6 of the 25-way plug which mates with SKF. The negative side of the supply is connected to pin 16.

Rectification and Circuit Routeing

The secondary winding of T21 is applied to a full-wave bridge rectifier MR33, and hence to relay RLC, the contacts of which perform the following functions when the relay is energised.

RELAY FUNCTIONS

RLC1 and RLC2:—

Connect the secondary voltage of T21 across the following three circuits:—

(a) Red supply lamp ILP1 on front panel and series resistor R187.

(b) Thermostatically controlled heater of oven 1 in which the channel oscillator crystal is housed.

(c) Thermostatically controlled heater of oven 2 in which the reinsertion oscillator crystals are housed.

RLC3:—

Disconnects the positive side of the d.c. supply, protected by fuse FS4, from the wiper of SGc. If the mains supply fails, or is disconnected, the d.c. supply is automatically switched into circuit, and with SGc set to either ON or STANDBY, the d.c. voltage is applied to two circuits as follows:—

(a) To TSA19. Via this terminal strip and external wiring, the d.c. voltage is routed to the RC116A, where it energises a front-panel lamp Emergency Supply.

(b) To MR37 which functions as a reverse polarity protection diode. From MR37, the d.c. supply is fed to:—

(i) Link LKC and then to RLA, the aerial muting relay on the RF amplifier board. If external muting facilities are required, LKC is removed. Pin 1 and 2 wiring connections are then extended via the 25-way plug which mates with SKF to a suitable rack wiring terminal strip. The external aerial mute lines are then connected to this rack terminal strip.

(ii) The front-panel lamp ILP1 and ovens 1 and 2 via RLC1 contacts (RLC de-energised).

(iii) The wiper of SGd.

Rectifier MR34 blocks the battery d.c. from relay RLC. The unstabilized voltage across C95 is applied to separate circuit paths as follows:—

(1) To the aerial mute relay circuit LKC as already explained.

(2) Via switch SGd and link LKD if fitted, to the stabilizer board.

With SGd in the ON position, the unstabilized voltage is applied to SHa, the front-panel Local/Remote switch. When the remote control facility is used with the receiver, link LKD is removed. In this condition, the unstabilized voltage is routed to the stabilizer board when SHa is set to LOCAL. In the REMOTE position of the switch, the unstabilized voltage is routed to the remote control system, via TSA17. When the Standby/On switch on the control unit is set to ON, an external circuit (relay contacts on the motor switching unit) is completed to TSA16 on the receiver. The unstabilized voltage is then applied, via FS5, to the stabilizer.

With link LKD in position, the routeing of the unstabilized voltage to the stabilizer board is not a function of SHa, and the unstabilized voltage is fed via the fuse FS5, to the stabilizer. The fuse holder for FS5 is mounted on the front-panel and identified as HT 1A.

Stabilization

The circuit of the stabilizer is conventional and is mounted on board P27469. A series regulator VT37 is used. The level of the stabilized output voltage is determined by the setting of preset potentiometer R192 which in turn, determines the base voltage of error-sensing amplifier VT36. Zener diode MR35c is the reference source and maintains the emitter of VT36 at a fixed potential.

After amplification, the error voltage is applied to the base of VT35 which in turn controls the base current and hence the amplification of VT37, thus stabilizing the output.

7 CIRCUIT DESCRIPTION OF REMOTE CONTROL SYSTEM RC.116A

7 CIRCUIT DESCRIPTION OF REMOTE CONTROL SYSTEM RC.116A

BRIEF DESCRIPTION

Introduction

The remote control system comprises a motor switching unit bolted to the receiver and a control unit intended for either free standing or fitting in a 19in rack. The receiver and motor switching unit are interconnected by terminal block wiring. The motor switching unit and the control unit are interconnected by an 18-way cable.

Motor Switching Unit

The motor switching unit contains circuitry and switch drive motors with associated power supply components which operate the Channel and Service switches in the receiver. The unit also serves as an intermediate termination point for interconnecting wiring from the receiver to the control unit.

The motors are Ledex units energized by conduction of thyristors. These thyristors receive control signals (gate voltages) from the Service and Channel switches on either the control unit or the receiver. When the receiver is used with the remote control system, the control knobs on the receiver are physically disconnected from the main switch shafts, but they remain connected to auxiliary wafers which route control signals to the motor switching unit. The motor switching unit also contains a relay RLA, the operation of which is controlled by the Standby/On switch at the control unit and the R499 Local/Remote switch. This relay switches various supply and function lines as explained in the Detailed Description that follows the Brief Description.

Control Unit

The control unit performs two sets of functions—control and monitoring—which are determined by the settings of controls on the receiver. When the receiver is set to REMOTE by means of an additional Local/Remote switch, the control functions are as follows:—

(1) ON-STANDBY

The Standby/Off/On switch on the receiver must be set to ON. At this setting, the receiver is always at STANDBY or ON as determined by the setting of the Standby/On switch on the control unit. At these switch settings, the receiver can never be switched completely off from the control unit. When the control unit is set to ON, the switch energizes the relay in the motor switching unit and connects the power supply to all parts of the receiver.

(2) CHANNEL and SERVICE selection

This is achieved by switching the control signals to the thyristors in the motor switching unit.

(3) FINE TUNE

This is achieved by a variable direct voltage routed to varactor diodes in the receiver via a contact on RLA in the motor switching unit.

(4) SQUELCH ON/OFF

This is achieved by grounding a line which is routed back to the squelch system in the receiver.

When the receiver is set to LOCAL, all control functions are disconnected from the control unit.

The monitoring functions are; audio monitoring via a headset socket and loudspeaker terminals, and operating conditions as indicated by panel lamps.

Modifications to the Standard R499A

When used in conjunction with the remote control system, the standard R499A is modified as follows:—

(1) The universal coupling mechanisms which couple the front-panel Channel and Service control knobs to the switch wafers are disconnected.

(2) The motor switching unit is bolted to the back plate of the R499A.

(3) The universal coupling mechanisms are reconnected so that they couple the motor drive shafts to the back end of the shafts on the two switches. Except for one auxiliary wafer on each switch, no direct mechanical drive then exists between the control knobs and the switch wafers. The only way in which the settings of the switches can be controlled from the front-panel knobs is by energizing the switching motors via the remaining wafer still mechanically connected.

(4) The front-panel chart is repositioned (alternative fixing centres are provided) to expose the panel cut-out for the double-pole, double-throw Local/Remote switch. The switch is fitted and wired to stand-off terminals adjacent to the switch. Shorting links LKB and LKD are removed. This ensures that selection of remote or local Fine Tune controls and stabilized h.t. ON/OFF is determined solely by the setting of the Local/Remote switch fitted to the receiver.

DETAILED DESCRIPTION

Introduction

All channel frequencies and service modes are selected by operation of the switching motors. These motors are operated by a control signal during either local or remote control conditions. Before the routeing of the control signal is considered, the circuitry of the motors should be first understood. Circuit details are shown in Fig. 10.5.

Motor Supply

A separate d.c. supply for the switching motors is produced by full wave rectifier MR1. The a.c. supply for the rectifier is routed via TSA-20 and 21 from transformer T21 in the R499A. The d.c. output of MR1 is partially smoothed by C1 and then applied to the motor circuits. Ledex motor M1 drives the R499 Channel switch, and Ledex motor M2 drives the R499 Service switch. Each motor is stepped by a thyristor pulsing circuit. Both motors are identical, and only M1 is described.

The positive side of the d.c. supply to M1 is applied to the series circuit comprising the motor windings, a motor switch contact and thyristor VT1 and thence to chassis, which is the negative return of the supply. Resistor R3 is a non-linear surge-limiting resistor which shunts the motor windings, and C2 and R5 function as an arc suppression network across the motor switch contact.

The switch contact is coupled to the armature of the motor and is closed when the motor is at rest and opened when the motor steps. With the d.c. applied, the motor and the switch contact constitute a self commutating system which, subject to the impedance of VT1, steps continuously until the supply is disconnected. However, before the motor supply can be effective, a d.c. control voltage must be applied to the gate of the thyristor.

Without a d.c. control voltage applied to its gate terminal, the thyristor presents a very high impedance between anode and cathode, and the motor circuit is virtually open circuit. When a d.c. control voltage is applied to the gate terminal, the thyristor becomes a low impedance path and remains so irrespective of the gate voltage. This low impedance condition exists until the anode current is interrupted, whereupon the thyristor reverts to a high impedance condition.

Thus, when a positive d.c. voltage is applied to the gate terminal, the thyristor becomes low impedance, the current path for the motor is completed, and the motor operates. At each stroke, the motor switch contact opens and interrupts the current through M1. The thyristor then becomes high impedance, but assuming the gate voltage remains connected, the thyristor reverts to a low impedance immediately the supply circuit to its anode is completed by closure of the motor switching contact. The overall result is that as soon as a gate signal is applied to VT1, M1 steps and continues to do so until the gate signal is disconnected.

The gate signal to VT1 is routed from either the control unit or the receiver. The route is determined by whether the receiver is set for LOCAL or REMOTE control.

Motor Blanking Pulses

When the motors operate, they cause RF transients which could cause audio noise in the receiver. This is prevented as follows. Whenever either thyristor gate circuit is energised i.e. when either motor is running, a pulse of approximately +24V amplitude is transmitted through one or both isolating diodes MR3 and MR4 to the attenuator comprising R9 and R7. The pulse at the junction of R9 and R7 is routed via MR2 and TSA30 to the IF derived AGC system in the receiver and desensitises the receiver during motor switching operations.

Local Control

When the Local/Remote switch on the receiver is set to LOCAL, 24V unstabilized d.c. is routed, via TSA16, to the motor switching unit. Relay RLA is de-energized (contacts RLA4 and RLA5 are closed) and 24V d.c. is returned to the wiper contact of the Channel switch and the Service switch via TSA29 and TSA28, respectively.

From the Channel and Service switch wiper contacts, the 24V is routed back to the motor switching unit. The connecting leads and TSA terminal through which the 24V is routed, is determined by the setting of the two switches. As shown on Fig. 10.5, terminals 1 to 10 inclusive, are associated with the 10 settings of the Channel switch, and terminals 11 to 15 inclusive, are associated with the 5 settings of the Service switch.

With the setting of SB2 (on the motor switching unit) as shown in Fig. 10.5, assume that the wiper of the R499 Channel switch SA1, is set to position 10. The 24V is applied via the switch wiper ring to the gate circuit of thyristor VT1. If should be noted that there is a gap in the wiper ring of the switch. Current pulses are produced and motor M1 steps until the gap in the switch wiper ring is opposite stator contact 10. The motor then rests until the receiver Channel switch is set to a different channel. Diode MR5 blocks the +24V d.c. from wafer SB1B which is part of the switch system for remote selection of the receiver channel frequency.

Similarly, the 24V applied to the wiper of R499 switch SB1, is switched as a gate voltage to the local service selection circuit containing M2 and VT2. This gate voltage is blocked from the remote service selection switching system by MR6.

Remote Control

When the Local/Remote switch on the receiver is set to REMOTE, 24V unstabilized d.c. is routed, via TSA17, to the motor switching unit and out, via pin 9 of SKA and over the remote control line, to the control unit. On the control unit, the 24V lights the amber Standby lamp ILP2. If the Standby/On switch is set to ON, the following functions are also effected:—

(1) The red Receiver lamp ILP3 lights

(2) 24V is applied to:—

   (a) Switch wafer SC1B which, with SC1F, forms the Channel switch.

   (b) Switch wafer SD1B which, with SD1F, forms the Service switch.

(c) Pin 4 of PLA. From pin 4, the 24V is routed back to the motor switching unit where it energises RLA. With RLA energized, the switching functions of the relay contacts are as under.

NOTE: In the following description of the switching functions of the relays, repetitous reference to the terminal-to-terminal routeing of lines has been avoided wherever possible. Full details of the routeing will be seen from Fig. 10.5.

(i) RLA1: Closes and connects the unstabilized 24V to terminal 16 of TSA. This completes the input line to the stabilizer in the receiver.

(ii) RLA2: Closes and completes the circuit for audio from the ARU10A ISB adaptor (if fitted). This audio is fed to the receiver and then out via TSA26 to one side of the Audio switch SB on the control unit.

(iii) RLA3: Closes and completes the circuit for the 600 ohm audio fed from the receiver on TSA23 to the other side of the Audio switch SB on the control unit.

(iv) RLA4: Opens and disconnects the unstabilized 24V d.c. (which would otherwise be applied via closed contact RLA1) from the local channel frequency switching arrangement.

(v) RLA5: Opens and disconnects the unstabilized 24V d.c. (which would otherwise be applied via the closed contact RLA1) from the local service mode switching arrangement.

(vi) RLA6: Closes and partly completes an earth return for the squelch system in the receiver and the ARU10A (if fitted). The earth return is completed when the Squelch switch on the control unit is closed.

The unstabilized 24V d.c. switched by the Standby/On switch on the control unit is also applied to the following circuits which are described under the respective headings.

(1) Channel-In-Use indicator lamp ILP4.

(2) Buzzer circuit.

(3) Fine Tune circuit.

Channel-In-Use Lamps

NOTE: For completeness of circuit information, two channel lamps are shown in Fig. 10.5. The one enclosed in the broken outline rectangle is only fitted to the RC116/ISB model and is the Channel-In-Use lamp for the ARU10A.

The 24V applied via R5 to ILP4 is routed via pin 5 of PLA to TSA27 on the R499. When the squelch relay on the receiver operates, one of the contacts closes and completes the earth return for ILP4 which then lights. The energized condition of the lamp indicates that the audio of the receiver is not attenuated, i.e. that the receiver has a signal which is large enough to operate the squelch system.

Buzzer Circuit

The buzzer and the associated switch are not provided, only provision for the connections is made. The connections are made to terminal strip TSA on the rear panel of the control unit. The buzzer is connected to terminals 2 and 3, and the switch to 1 and 3. When the Standby/On switch is set to ON, 24V d.c. is applied to terminal 1. If the buzzer switch is closed, the 24V is applied to the buzzer, but the buzzer does not operate unless the earth return for the Channel-In-Use lamp is completed. The earth return is applied through diode MR1. This diode and MR2 (for ARU10A functions only) prevent interaction of receiver and ISB Adaptor Channel-In-Use indicator lamp circuits, but allow the buzzer to operate when either the receiver or ARU10A earth return is completed.

Fine Tune

The 24V unstabilized d.c. is applied to the Fine Tune potentiometer R9, via series resistor R11. Zener diode MR3 stabilizes the voltage across R9. The slider voltage is routed through pin 2 of PLA to TSA-18 on the receiver and then to the reinsertion oscillator.

Remote Selection of Frequency and Mode

Switch wafers SC1F and SC1B are set by the control unit Channel switch and wafers SD1B and SD1F by the control unit Service switch. The switching method employed for remote selection of channel frequency and service mode is different from that used for local selection. The remote system is more complex because only four of the remote lines are used to perform the 10 Channel switch functions, and four of the lines for the 5 Service switch functions. Operation of both the Channel and Service switches are identical; only the Channel switch is described.

The 24V applied to the switches in the control unit is brought in on pin 9 of PLA and switched by the Standby/On switch. When the Local/Remote switch on the receiver is set to LOCAL, the supply is disconnected and the control unit loses control.

When a given channel position is selected at the control unit, remote lines 15, 16, 17 and 18 are each set either to +24V or 0 volt in a combination which is unique to the selected channel position and is determined by the setting of SC1B and SC1F. Each combination represents a commanded final setting of the switch.

Although 16 different combinations of the four lines are possible, only 10 combinations are used as shown in Table 7.1.

Table 7.1 Voltage-line combinations for Channel selection

Channel	Line			
	15	16	17	18
1	+24V	+24V	OV	OV
2	+24V	+24V	+24V	OV
3	OV	+24V	+24V	+24V
4	+24V	OV	+24V	+24V
5	+24V	+24V	OV	+24V
6	OV	+24V	+24V	OV
7	OV	OV	+24V	+24V
8	+24V	OV	OV	+24V
9	OV	+24V	OV	OV
10	OV	OV	+24V	OV

These four lines are each connected to stator contacts on the Channel switch wafers in the motor switching unit. The two switch rotors are reverse images of each other. i.e. wherever one rotor has a contact section, the other has a gap. The wiper contact of SB1B connects through isolating diode MR5 (as explained) to the motor switching circuit. Shunt capacitor C4 filters out noise and transients which might otherwise cause malfunction.

When lines 15 to 18 are energized, +24V d.c. passes through SB1B to the gate of VT1 and causes M1 to operate. As the motor operates, SB1B is driven round until a position is reached such that SB1B rotor does not connect with +24V applied to any of the lines. As a result the gate signal is removed and the motor stops.

Switch SB1F does not have a wiper contact but introduces a bridging function which ensures that during rotation of the motor (and hence the switch wafers) 24V remains applied to the motor until the commanded position is reached. For example, assume that the selected channel position sets lines 15 and 16 to +24V, and lines 17 and 18 to 0 volt. Examination of the circuit shows that there are three positions of SB1B at which a d.c. output is not obtained from the wiper. Thus during rotation of this one wafer, 'false' positions occur which would disconnect the control voltage from the motor circuit. However, if the two energized lines sit in a 'gap' on SB1B then they must sit on a rotor section on SB1F. Detailed examination shows that every 'false' position of SB1B, results in one of the 24V lines bridging across to one of the 0 volt lines, either on SB1F or by transfer back to the control unit which contains a similar twin-wafer system.

The Service functions are commanded by a similar system of 16 combinations of which only 4 are used. These combinations are shown in Table 7.2.

Table 7.2 Voltage-line combinations for Service selection

Service	Line			
	10	11	12	13
ISB	+24V	+24V	OV	OV
AM	+24V	+24V	+24V	OV
CW	OV	+24V	+24V	+24V
SSB	+24V	OV	+24V	+24V

Audio

The audio inputs to the control unit are applied to Audio switch SB. Operation of the switch applies the audio to the AF Gain control potentiometer R6, which is connected with fixed resistor R7 to earth. The audio voltage at the slider of R6 is applied to T1. The secondary winding of T1 feeds JKA, the front-panel headset socket, and terminals 5 and 6 of the rear-panel terminal strip TSA. If required, a 10 ohm external loudspeaker may be connected across these two terminals. It should be noted that the control has little or no effect on the audio output connected directly to the receiver.

NOTE: If an external loudspeaker is fitted, insertion of a jack plug into the headset socket on the front-panel of the control unit disconnects the loudspeaker.

Squelch Switch

The squelch condition is established by the receiver controls and the function of the Squelch switch on the remote control unit is confined to un-squelching the receiver, should conditions render this desirable.

Emergency Supply

If a 24V d.c. supply and an a.c. mains supply are connected to the receiver the Emergency Supply lamp ILP1 becomes energized from the 24V d.c. supply in the event of a mains failure. The d.c. supply is switched by relay contact RLC3 in the R499 to TSA-19 on the receiver. This in turn is connected to pin 3 of PLA on the control unit.

8 FAULT FINDING

8 FAULT FINDING

INTRODUCTION

The procedure recommended in fault finding, is divided into 5 stages.

(1) Verify that the 20V stabilized supply is available.

(2) Check the static d.c. voltages on the transistors.

(3) Check the receiver operationally, starting with the audio amplifier.

(4) Check the IF amplifier board.

(5) Check the oscillators.

The positions of the main assemblies in the receiver are shown in Fig. 8.1.

The following items of test equipment will be required.

Multi-range meter	e.g. Avometer model 8
600 ohm headset	
AF signal generator	e.g. Advance J2
AF output power meter	e.g. Marconi TF893A
RF signal generator	e.g. Marconi TF144H
Valve voltmeter	e.g. Airmec 301

STABILIZED VOLTAGE SUPPLY

The voltage should be 20±0.5V. Measure the voltage between pin 17 of SKF and chassis. If necessary adjust the voltage on R192 on the stabilizer board.

If the stabilized voltage is above 22V, check the circuit on the stabilizer board.

If the stabilized voltage is below 19V, measure the unstabilized voltage between pin 2 of SKF and chassis. It should be between 22 and 30V.

TRANSISTOR VOLTAGES

Check the d.c. voltages on the transistors under the conditions indicated in Table 8.1.

Table 8.1 Typical Transistor Voltages

Assembly	*Condition*	*Transistor*	*Emitter*	*Base*	*Collector*
RF Amplifier	No signal input	VT1	1.68	2.4	7.2
		VT2	1.68	2.4	6.9
		VT3	6.6	7.2	16.5
		VT4	6.2	7.0	16.5
		VT5	20	20	—
		VT6	0.9	—	20
		VT7	20	20	—
		VT8	0.4	—	20
Channel Oscillator		VT9	4.5	5.0	12.6
		VT10	3.9	4.5	12.6
		VT11	12.0	12.5	19.5
		VT12	11.2	11.8	19.5
IF Amplifier	No signal input Squelch off	VT13	2.8	3.6	7.8
		VT14	9.0	9.6	15
		VT15	15.7	15	7.8
		VT16	1.9	2.5	8.85
		VT17	8.4	8.85	19.3
		VT18	9.7	10.3	15.5
		VT19	9.0	9.7	12.6
		VT20	3.1	3.65	6.1
		VT21	5.6	6.2	15.7
		VT22	9.8	10.4	15.6
		VT23	19.5	19.3	—
		VT24	19.5	19.3	—
		VT25	—	0.14	20
		VT26	0.14	0.5	20
		VT27	—	—	—
		VT28	15.2	14.2	—
		VT29	14.4	15.6	—
	Squelch on	VT30	1.36	—	19.4
	Squelch off	VT31	19	18.2	19
		VT32	8.6	9.3	15.4
Reinsertion Oscillator		VT33	6.15	6.7	14.2
		VT34	2.4	13.0	19.2
BFO		VT1	8	7.9	18.7

AUDIO SYSTEM

(1) Disconnect the aerial and set the receiver controls as under:—

(a) RF Gain to maximum clockwise setting, but without operating the ganged switch: the receiver is not squelched for this check.

(b) Service and Channel switches to an operational combination of settings.

(c) AF Gain to maximum clockwise setting.

(2) Check for noise from the loudspeaker. If noise is heard, verify that the level varies with the setting of the AF Gain control.

FURTHER CHECKS

(1) If noise is absent or very faint:
Connect the headset to pins 5 and 7 of SKF.
Set the front-panel preset Line control to maximum: noise should be heard in the headset.

(2) If noise is faint, but varies with the setting of the AF Gain control, there may be a fault in the squelch system, causing the receiver to be permanently squelched (see notes below on squelch system).

(3) If noise is completely absent or manifests itself only as hum, there may be a fault in the IF, detector or AF stages.

NOTE: For correct operation an AF signal generator input of 0.5 to 1V injected at pin 12 of SKF should produce an output at one of the headset sockets of 1 milliwatt.

Squelch System

(1) With the aerial disconnected, set the receiver controls as under:

(a) Service and Channel switches to an operational combination of settings.

(b) AF Gain to maximum clockwise setting.

(c) RF Gain to maximum clockwise setting, but without operating the ganged switch.

Whilst listening to the noise from the loudspeaker, move the RF Gain control further clockwise to operate the ganged switch. As the switch operates, the noise level should drop perceptibly.

FURTHER TEST

(1) Connect the Avometer, switched to a resistance range, to pin 3 of SKP and chassis.

(2) Set the RF Gain control to maximum clockwise and operate the ganged switch.

(3) Connect the RF signal generator and inject 1mV into the aerial socket: the Avometer should indicate a short circuit. Switch off the signal generator, and the Avometer should indicate an open circuit.

IF AMPLIFIER

With the aerial disconnected, set the AF Gain to maximum and the RF Gain to maximum without operating the ganged switch.

(1) Set Service switch to AM and vary the RF Gain: if the noise varies, the IF stages are functioning correctly. Absence of noise indicates a fault in the IF amplifier or AM detector.

(2) Set Service switch to SSB and repeat the test. Absence of noise indicates a fault in the product detector, reinsertion oscillator or BFO.

(3) Set Service switch to TEST, the AGC switch to NORMAL or FAST, and the Line/Signal switch to SIGNAL: the meter ME1 should deflect to the centre red mark (0dBm). If the meter deflects, but noise is absent, the product detector is faulty.

Main AGC System

(1) Disconnect the aerial and set RF gain to maximum without operating the ganged switch and Line/Signal switch to SIGNAL: the meter should read zero.

(2) Turn RF gain counter-clockwise and observe that meter indication increases as the noise decreases.

(3) Turn the RF gain fully clockwise to operate the ganged switch and observe that meter falls to zero.

(4) With RF gain at maximum and switch operated, inject a signal into the aerial socket. Increase the signal and note that the meter deflection increases, whilst the audio ouput remains constant.

(5) Reduce the signal rapidly to zero and note that the meter deflection drops to zero very slowly.

RF Amplifier and Front-end AGC

(1) Connect the Avometer, switched to the 10V d.c. range, to pin 18 of SKF and chassis, and set the receiver controls as follows:

(a) Service to SSB (irrespective of whether the receiver is equipped for SSB operation).

(b) Channel switch to an operational position.

(c) RF Gain to maximum, without operating the ganged switch.

(d) AGC to OFF.

(2) Inject a signal into the aerial socket and increase the RF signal generator output from zero to 500mV: the Avometer reading should increase from zero to at least 4V.

(3) Rapidly remove the signal and observe that the Avometer reading decreases slowly to zero.

(4) Disconnect the Avometer and set the receiver controls as follows:

(a) Service and Channel switches to an operational combination.

(b) RF Gain to maximum without operating the ganged switch.

(c) AF Gain to maximum: note there is noise from the loudspeaker.

(d) Switch Channel switch to a non-operational frequency: note that noise level drops perceptibly. If noise level does not drop, there is a fault in the RF amplifier, channel oscillator or mixer.

OSCILLATORS

(1) Connect the valve voltmeter to TP6 on the channel oscillator amplifier-multiplier board P27471 and obtain a reading greater than 2 volts.

(2) Connect the valve voltmeter to TP17 on the reinsertion oscillator board P27473 and obtain a reading not less than 4V, when the receiver is set to CW or SSB.

RECEIVER GAIN CHECKS

Table 8.2 gives the inputs that should be applied at points in the circuit to produce 1 watt at the audio output, for the various service modes.

(1) Set the RF Gain to maximum, without operating the switch.

(2) Connect the AF output power meter to pins 8 and 9 of SKF and set the Loudspeaker switch to OFF. Note that link LKC must be in position to complete the audio circuit to the power meter.

(3) Proceed to check the receiver gains.

Note that signal levels are specified as p.d. or e.m.f. Where e.m.f. levels are specified, the impedance of the source must be 50 ohm.

Table 8.2 Signal injection points

		Signal level		
Injection point	*Signal frequency*	*AM*	*CW*	*SSB/ISB*
VT22 base	1 kHz	400–600mV p.d.		
SB3b wiper	1 kHz	6–10mV p.d.		
SB3a wiper	1.4 MHz 30% mod. 1.401 MHz	90–180mV e.m.f.	200–400mV e.m.f.	30–60mV e.m.f.
VT18 base	1.4 MHz 30% mod. 1.401 MHz	35–70mV e.m.f.	200–400mV e.m.f.	20–40mV e.m.f.
VT17 base	1.4 MHz 30% mod. 1.401 MHz	250–500mV e.m.f.	35–70mV e.m.f.	150–300mV e.m.f.
VT16 base	1.4 MHz 30% mod. 1.401 MHz	5–10mV e.m.f.	0.8–1.6mV e.m.f.	2.5–5mV e.m.f.
VT15 base	1.4 MHz 30% mod. 1.401 MHz	450–900uV	70–140uV e.m.f.	225–450uV e.m.f.
VT14 base	1.4 MHz 30% mod. 1.401 MHz	100–200uV e.m.f.	12–24uV e.m.f.	45–90uV e.m.f.
SB7 wiper	1.4 MHz 30% mod. 1.401 MHz	5–10uV e.m.f.	0.8–1.6uV e.m.f.	2.5–5uV e.m.f.
SB8 wiper	1.4 MHz 30% mod. as required	6–12uV e.m.f.	1.5–3uV e.m.f.	3–6uV e.m.f.
SA8 wiper	as required (30% mod.) as required	50–150uV e.m.f.	5–15uV e.m.f.	18–55uV e.m.f.
Aerial socket SKA	as required (30% mod.) as required	2–8uV e.m.f.	0.2–0.8uV e.m.f.	0.6–2.5uV e.m.f.

(4) Set the receiver controls as follows:

AGC switch to OFF

Service switch to SSB or ISB

Connect the Avometer to TP2 on the RF amplifier board P27475.

Apply an e.m.f. (50 ohm) of 300-800mV at a frequency and mode to suit one of the operating channels of the receiver. The Avometer should read +1 volt.

FAULT FINDING IN REMOTE CONTROL SYSTEM

Failure of Motors to Function

The Service and Channel motor circuits are identical. The following procedure applies to motor M1.

(1) Confirm that 24V d.c. is present across the secondary winding of transformer T21 in the receiver.

(2) Check that 30V d.c. is present across the motor and chassis. If not, check MR1.

(3) Measure the gate voltage of VT1: this should be approximately 1.5V on all but one channel, when it should be zero.

(4) Should the gate voltage be zero on all channels, check the voltage at the anode of MR3: this should be 30V on all but one channel. If this voltage is not present, check MR5 and the switch wiring.

(5) If the gate voltage is correct, measure the voltages at the anode of VT1 and at the junction of R3/R5: they should be equal.

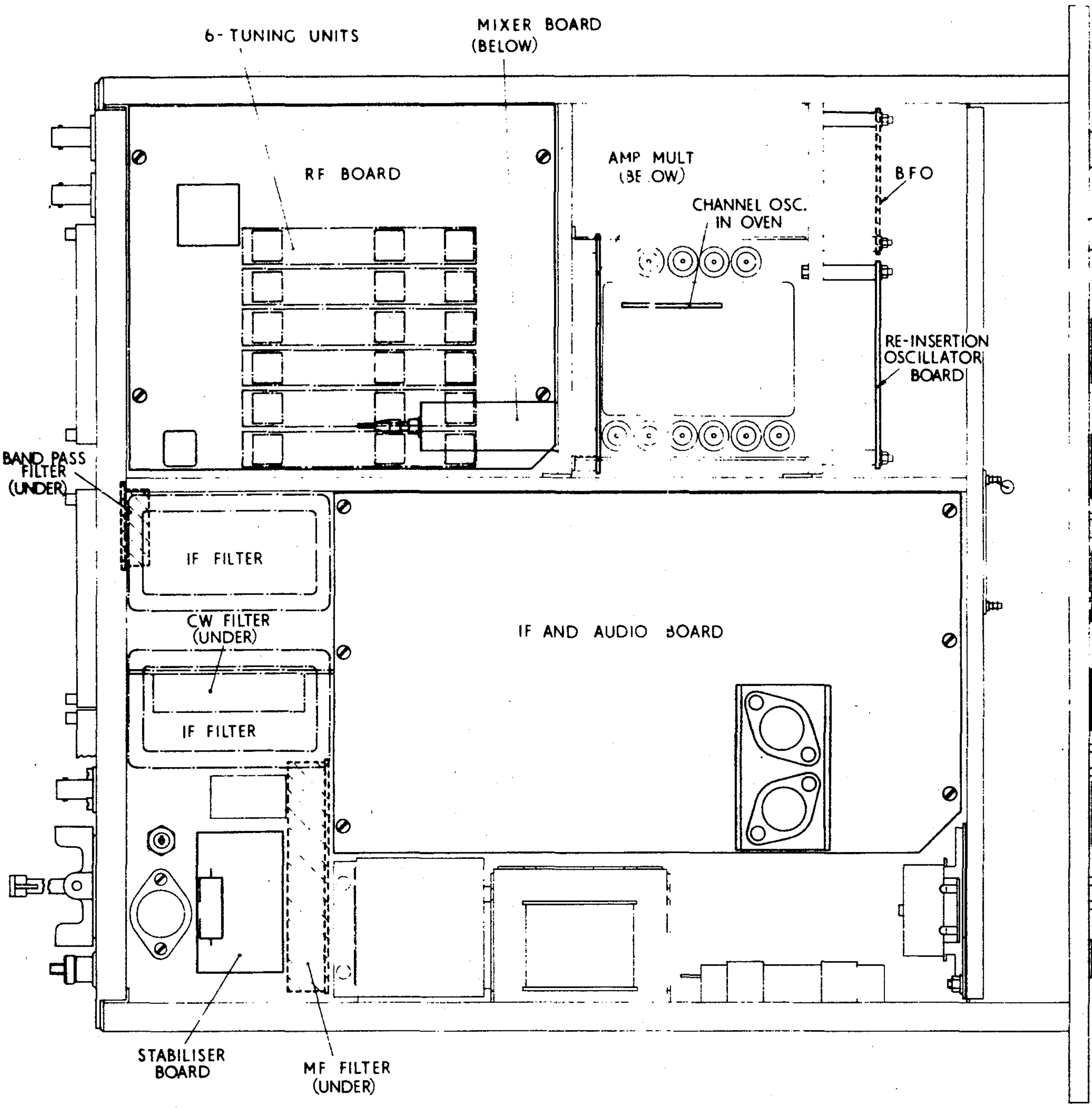
If they are not equal, the motor contacts are failing to make, indicating dirty contacts or mechanical failure in the motor unit.

If voltages are equal and approximately 30V, VT1 is open circuit.

If voltages are equal but much less than 30V, the motor winding is open circuit.

(6) If the fuse blows frequently, check the motor windings and the positive supply for short circuit to earth.

(7) If service or channel motors cannot be stopped during local or remote operation, check for faulty switch wiring or short circuit in VT1 or VT2.



 LOCATION OF MAIN ASSEMBLIES IN RECEIVER R499 FIG. 8.1

9 REALIGNMENT

9 REALIGNMENT

INTRODUCTION

Realignment may be necessary as a result of having to replace a frequency sensitive component. It should be undertaken only by skilled personnel in suitably equipped workshops.

The procedures detailed in this chapter apply to both the R499A and R499/ISB receivers. The procedures may be followed in part or whole according to circumstances.

It is recommended that the results of measurement be recorded to form a maintenance log for future reference

TEST EQUIPMENT REQUIRED

MF and HF signal generator, e.g. Marconi TF144H.
General purpose valve voltmeter, e.g. Advance 77.
Frequency counter, e.g. Hewlett Packard 5245L.
33k ohm resistor.
3200 ohm resistor.
50 ohm resistor.
10 ohm resistor.
375 pF capacitor.

IF TUNED CIRCUITS FOR SSB

Preliminaries

(a) Isolate the wiper of switch SB7 from the crystal filter.
(b) Set Service switch to SSB.
(c) Set AGC switch to OFF.
(d) Set RF Gain to maximum clockwise setting.
(e) Connect the valve voltmeter to the IF OUT socket.
(f) Switch the receiver ON.

(1) Adjust the frequency of the signal generator to 1400 kHz ±50 Hz and apply signal to the wiper of SB7.

(2) Adjust the output of the signal generator to obtain an indication of 80 mV on the valve voltmeter, but do not allow the indication to exceed 100 mV during subsequent adjustments.

(3) Adjust the cores of the coil assemblies T14 and T15 alternately to obtain maximum indication on the valve voltmeter. Continue adjustment until no further increase in the indication of the valve voltmeter results. For an indication of 100 mV on the valve voltmeter, the output from the signal generator should not be greater than 5uV e.m.f.

(4) Unless the following tests on the IF tuned circuits are to be implemented, reconnect the crystal filter to appropriate contact of switch SB7.

IF TUNED CIRCUITS FOR CW

It is assumed that T14 and T15 are aligned according to the preceding instructions given under IF TUNED CIRCUITS FOR SSB.

(1) With the signal generator connected to SB7 wiper (isolated from the crystal filter) and the valve voltmeter connected to the IF OUT socket, on the receiver,
    (a) Set Service switch to CW
    (b) Set AGC switch to OFF
    (c) Set trimmer capacitor C50 to near minimum capacity.

During the following test it is necessary to check the signal generator frequency with the frequency counter connected to the IF OUT socket of receiver. If the counter is connected elsewhere, unwanted signals may be fed into the circuit.

(2) Set the frequency of the signal generator to 1400 kHz ±20 Hz.

(3) Adjust C50 for maximum indication on the valve voltmeter.

(4) Set the frequency of the signal generator alternately 1 kHz above and 1 kHz below 1400 kHz. Note the indication of the valve voltmeter at these two frequencies. Continue re-adjusting C50 and 'swinging' the frequency of the generator until the levels at 1400 kHz ±1 kHz differ by less than 2 dB. Typical 6 dB bandwidth is 1 kHz.

(5) Reconnect the crystal filter to the appropriate contact of switch SB7.

CW FILTER

For this test, the filter must be isolated from the receiver.

(1) Load the output of the filter (secondary of T2) with the 50 ohm test resistor, and connect the valve voltmeter across the resistor.

(2) Connect the signal generator to the input of the filter (primary of T1), and set the level of the signal generator to approximately 500 mV e.m.f. at a frequency of 1400 kHz ±10 Hz.

(3) Tune the filter as follows,
    (a) Set C2 and C3 to minimum capacity
    (b) Tune T1 and T2 for maximum indication on the valve voltmeter
    (c) Set the frequency of the signal generator to 1400 kHz−3.5 kHz
    (d) Adjust C2 for minimum indication on the valve voltmeter

(e) Set the frequency of the signal generator to 1400 kHz + 3.5 kHz

(f) Adjust C3 for minimum indication on the valve voltmeter.

(4) Repeat the tuning procedure until re-adjustments do not have any appreciable effect. The bandwidth at the following points should be as follows:
approx. 200 Hz at 3 dB points
approx. 800 Hz at 10 dB points
approx. 1600 Hz at 30 dB points

MF FILTER

Separate test procedures are given for the two frequency sections of the filter. The filter must be isolated from the receiver for both tests.

Section 1 (255 kHz to 365 kHz)

(1) On the filter,

(a) Disconnect C3 from L3

(b) Short circuit C2

(c) Connect the 33k ohm test resistor in series with the 375 pF test capacitor and connect the capacitor to the input of the filter.

(d) Connect the valve voltmeter from earth to the junction of the 33k ohm resistor and the 375 pF capacitor.

(2) Set the level of the signal generator to 2V e.m.f. at a frequency of 305 kHz ±0.5 kHz and apply the signal to the 33k ohm test resistor and earth.

(3) Tune L1 for minimum indication on the valve voltmeter.

(4) Remove the shorting link from C2.

(5) Tune L2 for maximum indication on the valve voltmeter.

(6) Reconnect C3 to L3

(7) Short circuit C4.

(8) Tune L3 for minimum indication on the valve voltmeter.

(9) Disconnect C5 from L5.

(10) Remove the short across C4.

(11) Tune L4 for maximum indication on the valve voltmeter.

(12) Reconnect C5 to L5.

(13) Short circuit C6.

(14) Tune L5 for minimum indication on the valve voltmeter.

(15) Remove the short across C6.

(16) Disconnect the signal generator, the 33k ohm test resistor and the valve voltmeter, but leave the 375 pF test capacitor connected.

(17) To check the passband.

(a) Shunt the signal generator with the 10 ohm test resistor.

(b) Connect the signal generator to the 375 pF test capacitor.

(c) Connect the 3200 ohm test resistor across C6 and the valve voltmeter across the test resistor.

(d) 'Swing' the frequency of the signal generator from 255 kHz to 365 kHz and ensure that the attenuation within the passband is within 3 dB

(18) Disconnect the test resistors and capacitor.

Section 2 (365 kHz to 525 kHz)

(1) On the filter

(a) Disconnect C9 from L8

(b) Short circuit C8

(c) Connect the 33k ohm test resistor in series with the 375 pF test capacitor and connect the capacitor to the input of the filter.

(d) Connect the valve voltmeter from earth to the junction of the 33k ohm resistor and 375 pF capacitor.

(2) Set the level of the signal generator to 2V e.m.f. at a frequency of 438 kHz ±0.5 kHz, and apply the signal to the 33k ohm test resistor.

(3) Tune L6 for minimum indication on the valve voltmeter.

(4) Remove the short across C8.

(5) Tune L7 for maximum indication on the valve voltmeter.

(6) Reconnect C9 to L8.

(7) Short circuit C10.

(8) Tune L8 for minimum indication on the valve voltmeter.

(9) Disconnect C11 from L10.

(10) Remove the short across C10.

(11) Tune L9 for maximum indication on the valve voltmeter.

(12) Reconnect C11 to L10.

(13) Short circuit C12.

(14) Tune L10 for minimum indication on the valve voltmeter.

(15) Remove the short across C12.

(16) Disconnect the signal generator, the 33k ohm test resistor, the valve voltmeter, but leave the 375 pF test capacitor connected.

(17) To check the passband,

(a) Shunt the signal generator with the 10 ohm test resistor.

(b) Connect the signal generator to the 375 pF test capacitor.

(c) Connect the 3200 ohm test resistor across C12 and connect the valve voltmeter across the test resistor.

(d) 'Swing' the frequency of the signal generator from 365 kHz to 525 kHz and ensure that the attenuation within the passband is within 3 dB.

(18) Disconnect the test resistors and capacitor.

IF TRAP

(1) On the receiver,

(a) Set the Service switch to AM.

NOTE: If an AM filter is not provided, set the switch to SSB. The frequency of the signal generator may have to be altered during the ensuring tests.

(b) Set the AGC switch to OFF.

(c) Set the RF Gain control to the maximum clockwise setting.

(d) Connect a shorting link between the wiper of SA7 and the wiper of SA8.

(e) Connect the valve voltmeter to the IF OUT socket.

(2) Set the level of the signal generator to 2V e.m.f. at a frequency of 1400 kHz $\pm$ 100 Hz.

(3) Connect the signal generator to the AE socket of the receiver, but if the indication of the valve voltmeter is greater than 100 mV reduce the input level from the signal generator.

(4) Tune L1, L2, T1 for minimum indication on the valve voltmeter.

NOTE: The signal input level may have to be re-adjusted while tuning.

CHANNEL OSCILLATOR

Before adjusting the frequency of the channel oscillator, ensure that the channel oscillator oven is given time to reach its stable working temperature. For this purpose the receiver may be left on STANDBY for at least 20 minutes.

There are positions in the oven for ten crystals, associated with the ten channels available in the equipment. Situated around the oven are ten trimmer capacitors, C16 to C25. These adjust the channel oscillator frequency on channels 1 to 10 respectively.

To adjust the frequency, first select the appropriate channel on the Channel switch; then adjust the relevant trimmer with a suitable non-metallic adjusting tool. The frequency is monitored by a frequency counter connected to test point TP6 on the amplifier/multiplier board. If, during this adjustment, it is found that the trimmer is required to be unscrewed excessively, the associated 22 pF capacitor which is connected in parallel with the trimmer may be removed, and the adjustment repeated.

HF FILTER SETS (1.5 MHz to 21.2 MHz)

The test procedure is as follows:

(1) Select the filter sets to suit the desired channel frequencies and place them in their respective positions.

(2) On the receiver,

(a) Unscrew the core of L2 so that is just flush with the screening can.

(b) Set the AGC switch to OFF.

(c) Set the RF Gain control to the maximum clockwise setting.

(d) Set the Service switch to AM on SSB.

(e) Connect the valve voltmeter to the IF OUT socket.

(f) Connect the signal generator to the AE socket.

(3) Set the level of the signal generator to approximately 100 mV at a frequency corresponding to the channel frequency selected by the Channel switch.

(4) Slowly 'swing' the frequency of the signal generator to obtain maximum indication on the valve voltmeter.

(5) Adjust the level of the signal generator so that the indication of the valve voltmeter is approximately 80 mV.

(6) Tune L1 and L3 for maximum indication on the valve voltmeter. Do not allow the indication of the valve voltmeter to exceed 100 mV; reduce signal level when necessary.

(7) Set the level of the signal generator to approximately 1V at a frequency corresponding to the image frequency of the selected channel frequency.

(8) 'Swing' the frequency of the signal generator for maximum indication on the valve voltmeter.

(9) Adjust the input level so that the indication of the valve voltmeter is approximately 80 mV.

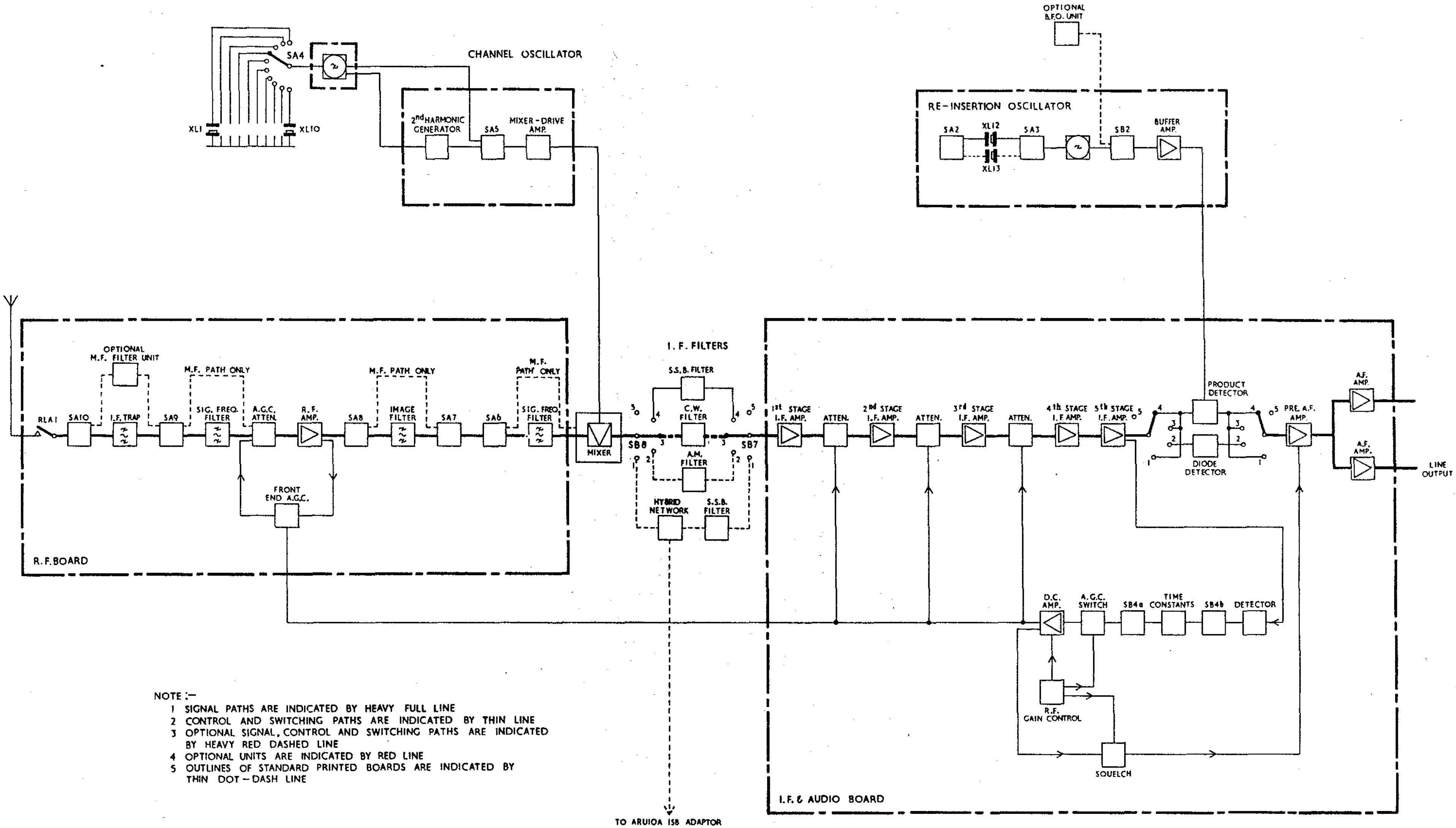
(10) Tune L2 for minimum indication on the valve voltmeter (signal level may have to be re-adjusted while tuning).

(11) Repeat the complete procedure until the re-adjustments of L1, L3 and L2 do not have any appreciable effect.

HF FILTER SETS (21.2 MHz to 30 MHz)

The test procedure is the same as that given for HF FILTER SETS (1.5 MHz to 21.2 MHz) but C2 has to be adjusted in conjunction with L1 and L3 for maximum indication at the signal frequency, on the valve voltmeter.

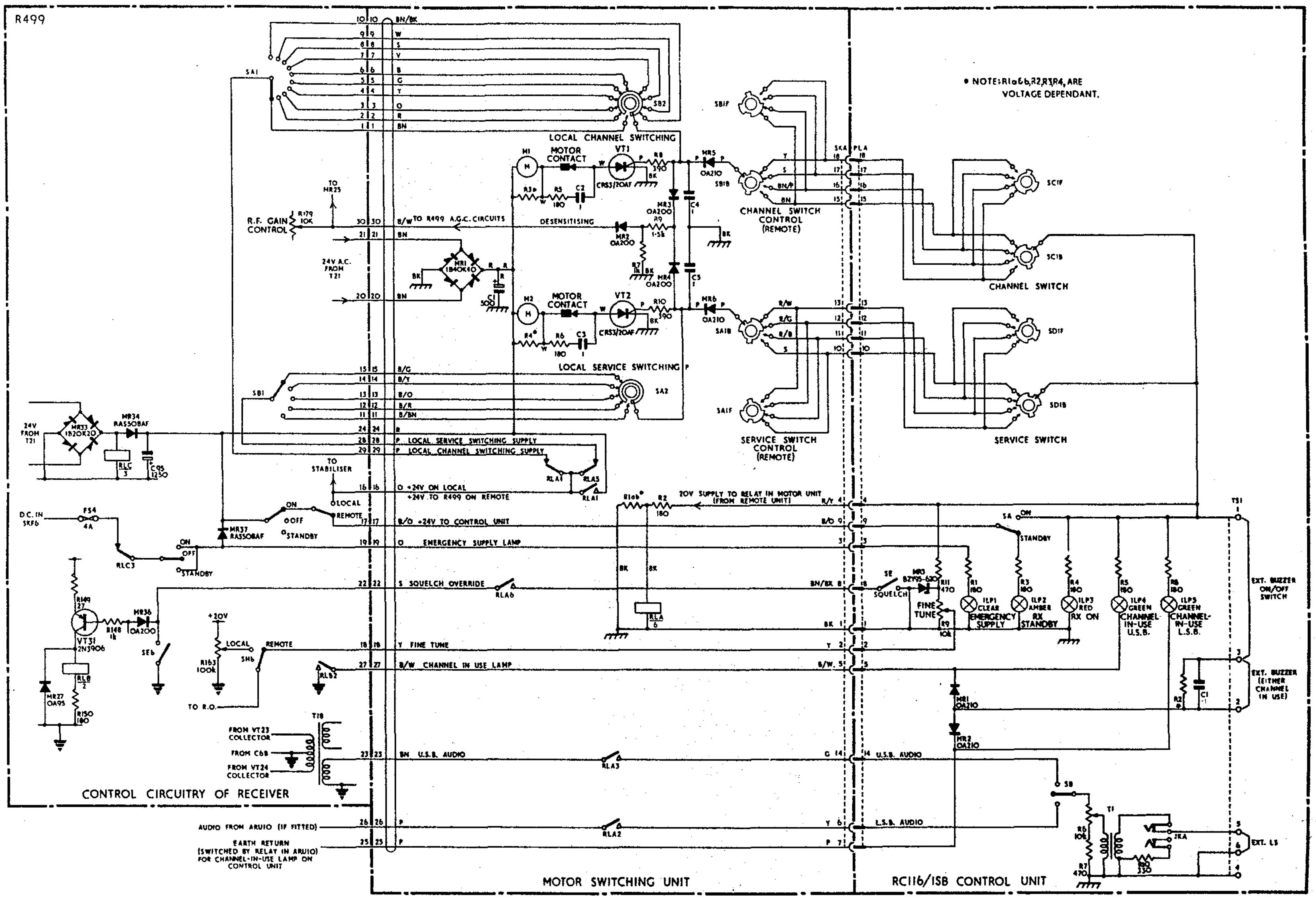
10 ILLUSTRATIONS



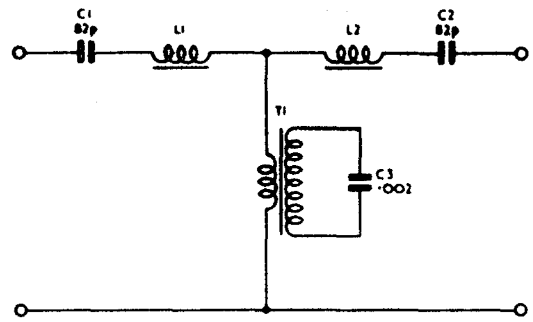
NOTE :—
1. SIGNAL PATHS ARE INDICATED BY HEAVY FULL LINE
2. CONTROL AND SWITCHING PATHS ARE INDICATED BY THIN LINE
3. OPTIONAL SIGNAL, CONTROL AND SWITCHING PATHS ARE INDICATED BY HEAVY RED DASHED LINE
4. OPTIONAL UNITS ARE INDICATED BY RED LINE
5. OUTLINES OF STANDARD PRINTED BOARDS ARE INDICATED BY THIN DOT–DASH LINE

R499A BLOCK DIAGRAM

FIG. 10·1

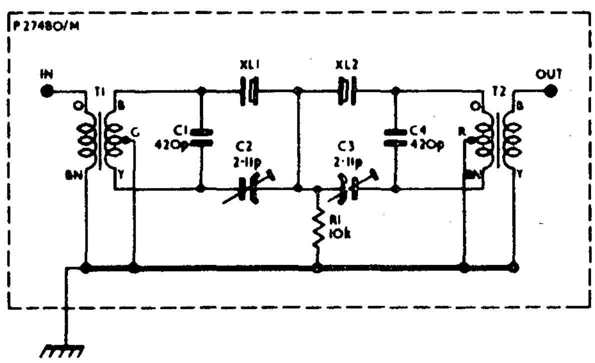


REMOTE CONROL SYSTEM FIG.10·5



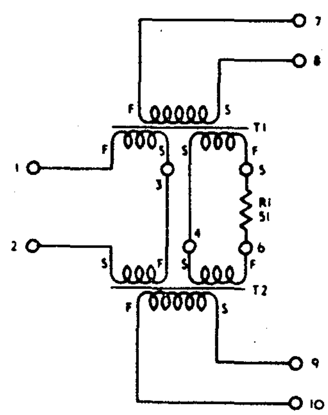
1.4 MHz BANDPASS FILTER FL2

FIG.10·6



IF FILTER CW

FIG.10·7



HYBRID NETWORK X2

Fig. 10.8

11 COMPONENT LISTS

RECEIVER R499A

REMOTE CONTROL UNIT RC116A

MOTOR SWITCHING UNIT (REMOTE CONTROL SYSTEM RC116A)

11 COMPONENT LIST

RECEIVER R499A (CLA 5642-1)

CAPACITORS

C1	300 pF±2% 125V GEC PF
C2	1200 pF±2% 125V GEC PF
C3	300 pF±2% 125V GEC PF
C4	0.1 uF±20% 100V STC PMAO. 1 M100
C5	0.1 uF±20% 100V STC PMAO.1 M100
C6	330 pF±2% 125V GEC PF
C7	0.1 uF±20% 100V STC PMAO.1 M100
C8	0.1 uF±20% 100V STC PMAO.1 M100
C9	0.22 uF±20% 100V STC PMAO.22 M100
C10	0.1 uF±20% 100V STC PMAO.1 M100
C11	330 pF±2% 125V GEC PF
C12	10 uF+50% −20% 35V Wima PRINTILYT
C13	250 uF+50% −20% 25V Mullard C437AR/F250
C14	0.1 uF±20% 100V STC PMAO.1 M100
C15	0.1 uF±20% 100V STC PMAO.1 M100
C16	3–30 pF Mullard E7876
C17	3–30 pF Mullard E7876
C18	3–30 pF Mullard E7876
C19	3–30 pF Mullard E7876
C20	3–30 pF Mullard E7876
C21	3–30 pF Mullard E7876
C22	3–30 pF Mullard E7876
C23	3–30 pF Mullard E7876
C24	3–30 pF Mullard E7876
C25	3–30 pF Mullard E7876
C26	100 pF±2% 350V Lemco MS611/1/R/100PG/350
C27	100 pF±2% 350V Lemco MS611/1/R/100PG/350
C28	0.1 uF±20% 100V STC PMAO.1 M100
C29	5 uF+50% −20% 35V Wima PRINTILYT
C30	0.1 uF±20% 100V STC PMAO.1 M100
C31	0.1 uF±20% 100V STC PMAO.1 M100
C32	0.1 uF±20% 100V STC PMAO.1 M100
C33	0.1 uF±20% 100V STC PMAO.1 M100
C34	0.1 uF±20% 100V STC PMAO.1 M100
C35	0.1 uF±20% 100V STC PMAO.1 M100
C36	0.1 uF±20% 100V STC PMAO.1 M100
C37	0.1 uF±20% 100V STC PMAO.1 M100
C38	0.1 uF±20% 100V STC PMAO.1 M100
C39	0.1 uF±20% 100V STC PMAO.1 M100
C40	0.1 uF±20% 100V STC PMAO.1 M100
C41	0.1 uF±20% 100V STC PMAO.1 M100
C42	0.1 uF±20% 100V STC PMAO.1 M100
C43	0.1 uF±20% 100V STC PAMO.1 M100
C44	0.1 uF±20% 100V STC PMAO.1 M100
C45	0.1 uF±20% 100V STC PMAO.1 M100
C46	0.1 uF±20% 100V STC PMAO.1 M100
C47	5 uF+50% −20% 35V Wima PRINTILYT
C48	0.1 uF±20% 100V STC PMAO.1 M100
C49	410 pF±2% 125V GEC PF
C50	3-30 pF Mullard E7890
C51	0.1 uF±20% 100V STC PMAO.1 M100
C52	10 pF±2 pF 125V GEC PF
C53	200 pF±2% 125V GEC PF
C54	0.1 uF±20% 100V STC PMAO.1 M100
C55	10 uF+50% −20% 35V Wima PRINTILYT
C56	0.1 uF±20% 100V STC PMAO.1 M100
C57	0.1 uF±20% 100V STC PMAO.1 M100
C58	0.1 uF±20% 100V STC PMAO.1 M100
C59	0.002 uF±2% 125V GEC PF
C60	0.002 uF±2% 125V GEC PF
C61	10 uF+50% −20% 35V Wima PRINTILYT
C62	640 uF+50%−10% 25V Mullard C437AR/F640
C63	47 uF±20% 20V Union Carbide K47J20
C64	0.22 uF±20% 100V STC PMAO.22 M100
C65	50 uF+50%−20% 35V Wima PRINTILYT
C66	50 uF+50%−20% 35V Wima PRINTILYT
C67	10 uF+50%−20% 35V Wima PRINTILYT
C68	500 uF+50%−10% 40V Mullard C431BR/G500
C69	0.1 uF±20% 100V STC PMAO.1 M100
C70	0.1 uF±20% 100V STC PMAO.1 M100
C71	0.1 uF±20% 100V STC PMAO.1 M100
C72	0.1 uF±20% 100V STC PMAO.1 M100
C73	50 uF+50%−20% 35V Wima PRINTILYT
C74	0.1 uF±20% 100V STC PMAO.1 M100
C75	0.1 uF±20% 100V STC PMAO.1 M100
C76	0.1 uF±20% 100V STC PMAO.1 M100
C77	0.1 uF±20% 100V STC PMAO.1 M100
C78	0.1 uF±20% 100V STC PMAO.1 M100
C79	4.7 uF±20% 20V Union Carbide K4R7J20
C80	33 uF±20% 20V Union Carbide K33J20
C81	10 uF±20% 20V Union Carbide K10J20
C82	0.1 uF±20% 100V STC PMAO.1 M100
C83	10 uF+50%−20% 35V Wima PRINTILYT
C84	100 uF+50%−20% 35V Wima PRINTILYT
C85	50 uF+50%−20% 35V Wima PRINTILYT
C86	100 uF+50%−20% 35V Wima PRINTILYT
C87	50 uF+50%−20% 35V Wima PRINTILYT
C88	0.1 uF±20% 100V STC PMAO.1 M100
C89	470 pF±2% 350V Lemco MS611/1/R/470PG/350
C90	330 pF±2% 350V Lemco MS611/1/R/330PG/350
C91	0.1 uF±20% 100V STC PMAO.1 M100
C92	0.1 uF±30% 100V STC PMAO.1 M100
C93	0.1 uF±20% 100V STC PMAO.1 M100
C94	0.1 uF±20% 100V STC PMAO.1 M100
C95	1250 uF+50%−10% 40V Mullard C431BR/G1250
C96	500 uF+50%−10% 40V Mullard C431BR/G500
C97	100 uF+50%−20% 35V Wima PRINTILYT
C98	12 pF±2 pF 125V GEC PF
C99	12 pF±2 pF 125V GEC PF
C100	12 pF±2 pF 125V GEC PF

C101 12 pF±2 pF 125V GEC PF
C102 12 pF±2 pF 125V GEC PF
C103 12 pF±2 pF 125V GEC PF
C104 12 pF±2 pF 125V GEC PF
C105 12 pF±2 pF 125V GEC PF

C106 12 pF±2 pF 125V GEC PF
C107 12 pF±2 pF 125V GEC PF
C108 102 pF±2% 350V Lemco MS611/1/R/120PG/350
C109 0.1 uF±20% 100V STC PMAO.1 M100
C110 0.1 uF±20% 100V STC PMAO.1 M100

RESISTORS

R1 47 kΩ±2% ½W Electrosil TR5
R2a 56Ω±2% ½W Electrosil TR5
R2b 56Ω±2% ½W Electrosil TR5
R3 6.8kΩ±2% ½W Electrosil TR5
R4 1.2kΩ±2% ½W Electrosil TR5

R5 820Ω±2% ½W Electrosil TR5
R6 820Ω±2% ½W Electrosil TR5
R7 820Ω%2± ½W Electrosil TR5
R8 820Ω±2% ½W Electrosil TR5
R9 10Ω±2% ½W Electrosil TR5

R10 150Ω±2% ½W Electrosil TR5
R11 10Ω±2% ½W Electrosil TR5
R12 150Ω±2% ½W Electrosil TR5
R13 120Ω±2% ½W Electrosil TR5
R14 120Ω±2% ½W Electrosil TR5

R15 47Ω±2% ½W Electrosil TR5
R16 47Ω±2% ½W Electrosil TR5
R17 2.2kΩ±2% ½W Electrosil TR5
R18 1.8kΩ±2% ½W Electrosil TR5
R19 2.2kΩ±2% ½W Electrosil TR5

R20 1.8kΩ±2% ½W Electrosil TR5
R21 47Ω±2% ½W Electrosil TR5
R22 100Ω±10% 2.5W Welwyn W21
R23 33Ω±2% ½W Electrosil TR5
R24 10kΩ±2% ½W Electrosil TR5

R25 470Ω±2% ½W Electrosil TR5
R26 470Ω±2% ½W Electrosil TR5
R27 1kΩ±2% ½W Electrosil TR5
R28 2.7kΩ±2% ½W Electrosil TR5
R29 47kΩ±2% ½W Electrosil TR5

R30 22Ω±2% ½W Electrosil TR5
R31 150kΩ±2% ½W Electrosil TR5
R32 560Ω±2% ½W Electrosil TR5
R33 68kΩ±2% ½W Electrosil TR5
R34 1.5kΩ±2% ½W Electrosil TR5

R35 1.5kΩ±2% ½W Electrosil TR5
R36 5.6kΩ±2% ½W Electrosil TR5
R37 560Ω±2% ½W Electrosil TR5
R38 33kΩ±2% ½W Electrosil TR5
R39 33kΩ±2% ½W Electrosil TR5

R40 100Ω±2% ½W Electrosil TR5
R41 100Ω±2% ½W Electrosil TR5
R42 1kΩ±2% ½W Electrosil TR5
R43 330Ω±2% ½W Electrosil TR5
R44 1kΩ±2% ½W Electrosil TR5

R46 10kΩ±2% ½W Electrosil TR5
R47 470Ω±2% ½W Electrosil TR5
R48 1.2kΩ±2% ½W Electrosil TR5
R49 22Ω±2% ½W Electrosil TR5
R50 5.6kΩ±2% ½W Electrosil TR5

R51 10Ω±2% ½W Electrosil TR5
R52 330Ω±2% ½W Electrosil TR5
R53 82Ω±2% ½W Electrosil TR5
R54 150Ω±2% ½W Electrosil TR5
R55 3.3kΩ±2% ½W Electrosil TR5

R56 3.3kΩ±2% ½W Electrosil TR5
R57 150Ω±2% ½W Electrosil TR5
R58 27Ω±2% ½W Electrosil TR5
R59 220Ω±2% ½W Electrosil TR5
R60 560Ω±2% ½W Electrosil TR5

R61 4.7kΩ±2% ½W Electrosil TR5
R62 1.8kΩ±2% ½W Electrosil TR5
R63 100Ω±2% ½W Electrosil TR5
R64 1.8kΩ±2% ½W Electrosil TR5
R65 120Ω±2% ½W Electrosil TR5

R66 680Ω±2% ½W Electrosil TR5
R67 15kΩ±2% ½W Electrosil TR5
R68 1kΩ±2% ½W Electrosil TR5
R69 56Ω±2% ½W Electrosil TR5
R70 2.2kΩ±2% ½W Electrosil TR5

R71 4.7kΩ±2% ½W Electrosil TR5
R72 27kΩ±2% ½W Electrosil TR5
R73 1kΩ±2% ½W Electrosil TR5
R74 4.7kΩ±2% ½W Electrosil TR5
R75 56Ω±2% ½W Electrosil TR5

R76 1kΩ±2% ½W Electrosil TR5
R77 15kΩ±2% ½W Electrosil TR5
R78 270Ω±2% ½W Electrosil TR5
R79 680Ω±2% ½W Electrosil TR5
R80 1.8kΩ±2% ½W Electrosil TR5

R81 820Ω±2% ½W Electrosil TR5
R82 4.7kΩ±2% ½W Electrosil TR5
R83 120Ω±2% ½W Electrosil TR5
R84 1.2kΩ±2% ½W Electrosil TR5
R85 120Ω±2% ½W Electrosil TR5

R86 68Ω±2% ½W Electrosil TR5
R87 10kΩ±2% ½W Electrosil TR5
R88 1kΩ±2% ½W Electrosil TR5
R89 82Ω±2% ½W Electrosil TR5
R90 1.2kΩ±2% ½W Electrosil TR5

R91 [illegible]kΩ±2% ½W Electrosil TR5
R92 2.[illegible]kΩ±2% ½W Electrosil TR5
R93 1.8kΩ±2% ½W Electrosil TR5
R94 2.2kΩ±2% ½W Electrosil TR5
R95 5.6kΩ±2% ½W Electrosil TR5

R96 470Ω±2% ½W Electrosil TR5
R97 470Ω±2% ½W Electrosil TR5
R98 1.5kΩ±2% ½W Electrosil TR5
R99 1kΩ±2% ½W Electrosil TR5
R100 6.8kΩ±2% ½W Electrosil TR5

R101 82Ω±2% ½W Electrosil TR5
R102 560Ω±2% ½W Electrosil TR5
R103 47kΩ±2% ½W Electrosil TR5
R104 68Ω±2% ½W Electrosil TR5
R105 820Ω±2% ½W Electrosil TR5

R106 6.8kΩ±2% ½W Electrosil TR5
R107 1.5kΩ±2% ½W Electrosil TR5
R108 15kΩ±2% ½W Electrosil TR5
R109 5.6Ω±2% ½W Electrosil TR5
R110 12kΩ±2% ½W Electrosil TR5

R111 47Ω±2% ½W Electrosil TR5
R112 1kΩ±2% ½W Electrosil TR5
R113 270Ω±2% ½W Electrosil TR5
R114 10Ω±2% ½W Electrosil TR5
R115 1kΩ±2% ½W Electrosil TR5

R116 1.5kΩ±2% ½W Electrosil TR5
R117 3.3Ω±10% 2.5W Welwyn W21
R118 3.3Ω±10% 2.5W Welwyn W21
R119 10Ω±2% ½W Electrosil TR5
R120 4.7kΩ±2% ½W Electrosil TR5

R121 330Ω±2% ½W Electrosil TR5
R122 2.2kΩ±2% ½W Electrosil TR5
R123 820Ω±2% ½W Electrosil TR5
R124 10kΩ±2% ½W Electrosil TR5
R125 39kΩ±2% ½W Electrosil TR5

R126 10kΩ±2% ½W Electrosil TR5
R127 39Ω±2% ½W Electrosil TR5
R128 1kΩ±2% ½W Electrosil TR5
R129 390Ω±2% ½W Electrosil TR5
R130 3.3kΩ±2% ½W Electrosil TR5

R131 68kΩ±2% ½W Electrosil TR5
R132 330Ω±2% ½W Electrosil TR5
R133 27kΩ±2% ½W Electrosil TR5
R134 27kΩ±2% ½W Electrosil TR5
R135 470kΩ±2% ½W Electrosil TR5

R136 2.2kΩ±2% ½W Electrosil TR5
R137 100kΩ±2% ½W Electrosil TR5
R138 100Ω±2% ½W Electrosil TR5
R139 2.2kΩ±2% ½W Electrosil TR5
R140 5.6kΩ±2% ½W Electrosil TR5

R141 68kΩ±2% ½W Electrosil TR5
R142 3.9kΩ±2% ½W Electrosil TR5
R143 68Ω±2% ½W Electrosil TR5
R144 220Ω±2% ½W Electrosil TR5
R145 1kΩ±2% ½W Electrosil TR5

R146 27kΩ±2% ½W Electrosil TR5
R148 1kΩ±2% ½W Electrosil TR5
R149 27Ω±2% ½W Electrosil TR5
R150 180Ω±2% ½W Electrosil TR5
R151 3.9kΩ±2% ½W Electrosil TR5

R152 180Ω±2% ½W Electrosil TR5
R153 15kΩ±2% ½W Electrosil TR5
R154 8.2kΩ±2% ½W Electrosil TR5
R155 330Ω±2% ½W Electrosil TR5
R156 1kΩ±2% ½W Electrosil TR5

R157 4.7kΩ LIN Plessey MP Dealer
R158 4.7kΩ LIN Plessey MP Dealer
R159 1kΩ±2% ½W Electrosil TR5
R160 2.2kΩ±2% ½W Electrosil TR5
R161 680Ω±2% ½W Electrosil TR5

R162 680Ω±2% ½W Electrosil TR5
R163 100kΩ LIN To Redifon 1/OP5707/S
R164 100kΩ±2% ½W Electrosil TR5
R165 1MΩ±2% ½W Electrosil TR5
R166 33kΩ±2% ½W Electrosil TR5

R167 33kΩ±2% ½W Electrosil TR5
R168 100Ω±2% ½W Electrosil TR5
R169 1.2kΩ±2% ½W Electrosil TR5
R170 4.7kΩ±2% ½W Electrosil TR5
R171 4.7kΩ±2% ½W Electrosil TR5

R172 12kΩ±2% ½W Electrosil TR5
R173 150Ω±2% ½W Electrosil TR5
R174 27kΩ±2% ½W Electrosil TR5
R175 10Ω±2% ½W Electrosil TR5
R176 2.2kΩ±2% ½W Electrosil TR5

R177 47kΩ±2% ½W Electrosil TR5
R178 100Ω±2% ½W Electrosil TR5
R179 10kΩ LIN To Redifon 1/OP5708/S
R180 470Ω±2% ½W Electrosil TR5
R181 820Ω±2% ½W Electrosil TR5

R182 12kΩ±2% ½W Electrosil TR5
R183 680Ω±2% ½W Electrosil TR5
R184 50Ω LIN Colvern CLR1106/9S
R185 5kΩ LOG To Redifon 1/OP5731/S
R186 5kΩ LOG To Redifon 2/OP5707/S

R187 330Ω±10% 2.5W Welwyn W21
R188 470Ω±2% ½W Electrosil TR5
R189 47Ω±2% ½W Electrosil TR5
R190 3.3Ω±10% 2.5W Welwyn W21
R191 820Ω±2% ½W Electrosil TR5

R192 470Ω LIN Plessey MP Dealer
R193 2.2kΩ±2% ½W Electrosil TR5
R194 470Ω±2% ½W Electrosil TR5
R195 270Ω±2% ½W Electrosil TR5

THERMISTORS

TH1 Mullard VA1011

RELAYS

RLA ERG style ED10873
RLB ERG style ED10850
RLC Varley VP4/5A/C/A/B/34

TRANSISTORS

VT1 RCA 2N3866
VT2 RCA 2N3866
VT3 RCA 2N3866
VT4 RCA 2N3866
VT5 Fairchild V410

VT6 Motorola 2N3904
VT7 Motorola 2N3906
VT8 Fairchild 2N3663
VT9 RCA 40235
VT10 Motorola 2N3904

VT11 Motorola 2N3904
VT12 RCA 2N3866
VT13 RCA 40235
VT14 Motorola 2N3904
VT15 Motorola 2N3906

VT16 Motorola 2N3904
VT17 Motorola 2N3904
VT18 Motorola 2N3904
VT19 Motorola 2N3904
VT20 Motorola 2N3904

VT21 Motorola 2N3904
VT22 Motorola 2N3904
VT23 Mullard OC28
VT24 Mullard OC28
VT25 Motorola 2N3904

VT26 Motorola 2N3904
VT27 Motorola 2N3904
VT28 Motorola 2N3906
VT29 Motorola 2N3906
VT30 Motorola 2N3904

VT31 Motorola 2N3906
VT32 Motorola 2N3904
VT33 RCA 40235
VT34 Motorola 2N3904
VT35 Motorola 2N3904

VT36 Motorola 2N3904
VT37 Mullard BDY20

DIODES

MR1 Hughes HG5007
MR2 Mullard OA200
MR3 Mullard OA200
MR4 Hughes HG5007
MR5 Hughes HG5007

MR6 Hughes HBX31
MR7 Hughes HBX31
MR8 Hughes HBX31
MR9 Hughes HBX31
MR11 Mullard OA95
MR12 Mullard OA95
MR13 Hughes HG5007
MR14 Hughes HG5007
MR15 Hughes HG5007
MR16 Mullard OA200

MR17 Mullard OA200
MR18a Mullard OA200
MR18b Mullard OA200
MR19a Mullard OA200
MR19b Mullard OA200

MR20 Hughes HG5007
MR21 Hughes HG5007
MR22 Mullard OA200
MR23a Mullard OA200
MR23b Mullard OA200

MR24a Mullard OA200
MR24b Hughes HG5007
MR25 Mullard OA200
MR26 Mullard OA200
MR27 Mullard OA95

MR28 Mullard OA95
MR29 Hughes HG5007
MR30 Mullard OA200
MR31 Hughes HC7002
MR32 Hughes HC7002

MR33 Texas 1B20K20
MR34 STC RAS508AF
MR35a Mullard OA200
MR35b Mullard OA200
MR35c Mullard BZY95C12

MR36 Mullard OA200
MR37 STC RAS508AF
MR38 Hughes HG5007

SWITCHES

SA1 To Redifon Spec. OP5709/S
SA2 To Redifon Spec. OP5709/S
SA3 To Redifon Spec. OP5709/S
SA4 To Redifon Spec. OP5710/S
SA5 To Redifon Spec. OP5709/S

SA6 To Redifon Spec. OP5709/S
SA7 To Redifon Spec. OP5709/S
SA8 To Redifon Spec. OP5709/S
SA9 To Redifon Spec. OP5709/S
SA10 To Redifon Spec. OP5709/S

SB1 To Redifon Spec. OP5711/S
SB2 To Redifon Spec. OP5711/S
SB3 To Redifon Spec. OP5713/S
SB4 To Redifon Spec. OP5713/S
SB5 To Redifon Spec. OP5712/S

SB6	To Redifon Spec. OP5711/S
SB7	To Redifon Spec. OP5711/S
SB8	To Redifon Spec. OP5711/S
SC	Arrow TC6
SD	Arrow TS6
SE	Part of R179
SF	Arrow TC3
SG	NSF 7693/K2

TRANSFORMERS

T1	To Redifon Spec. P.27581/S
T2	To Redifon Spec. P.27582/S
T3	To Redifon Spec. P.27583/S
T4	To Redifon Spec. P.27584/S
T5	To Redifon Spec. P.27585/S
T6	To Redifon Spec. P.27586/S
T7	To Redifon Spec. P.27587/S
T8	To Redifon Spec. P.27588/S
T9	To Redifon Spec. P.27589/S
T10	To Redifon Spec. P.27590/S
T11	To Redifon Spec. P.27591/S
T12	To Redifon Spec. P.27592/S
T13	To Redifon Spec. P.27593/S
T14	To Redifon Spec. P.27594/S
T15	To Redifon Spec. P.27595/S
T16	To Redifon Spec. P.27596/S
T17	To Redifon Spec. SRT2652
T18	To Redifon Spec. SRT2705
T19	To Redifon Spec. SRT2698
T20	To Redifon Spec. P.27597/S
T21	To Redifon Spec. SRT2700

COILS

L1	To Redifon Spec. P.27598/S
L2	To Redifon Spec. P.27599/S
L3	2.7mH Cambion 3635–42
L4	100uH Cambion 3635–25
L5	2.7mH Cambion 3635–42
L6	1uH Painton 58–10–0005–10

METERS

ME1	0–100uA To Redifon Spec. OP5778/S

FUSES

FS1	100mA Belling Lee L562
FS2	0.5A (200-250V) 1A (100-125V) Beswick TDC134
FS3	0.5A (200-250V) 1A (100-125V) Beswick TDC134
FS4	4A Belling Lee L562
FS5	1A Belling Lee L562

LAMPS

ILP1	LES 14V 0.75W 5mm E5/8Cap

PLUGS

PLA	3 pin Bulgin P429
PLB	Part of PCB to Redifon Spec. P27478/L
PLC	Coaxial To Redifon Spec. OP5720/S

SOCKETS

SKA	Coaxial Greenpar GE35085H
SKB	Part of P.C.B. to Redifon Spec. P27475/L
SKC	Coaxial Belling Lee L1403/PCS/Au
SKD	Coaxial Greenpar GE35085H
SKE	Coaxial Greenpar GE35085H
SKF	25 Way Belling Lee L1328/S
SKG	Coaxial Greenpar GE35085H
SKH	Coaxial Greenpar GE35085H

JACKS

JKA	Igranic P73
JKB	Igranic P73

CRYSTAL OVENS

Oven 1	24V 75°C Snelgrove SO–15–12
Oven 2	12/24V 75°C to Redifon Spec. 2/OP9293/S

ATTENUATORS

X1	Attenuator to Redifon Spec. PL5643 Edn.A

HYBRID TRANSFORMERS

X2	Hybrid Network to Redifon Spec. PL5656 Edn.A

CRYSTALS

XL1	To Redifon Spec. OP9197/S
XL2	To Redifon Spec. OP9197/S
XL3	To Redifon Spec. OP9197/S
XL4	To Redifon Spec. OP9197/S
XL5	To Redifon Spec. OP9197/S
XL6	To Redifon Spec. OP9197/S
XL7	To Redifon Spec. OP9197/S
XL8	To Redifon Spec. OP9197/S
XL9	To Redifon Spec. OP9197/S
XL10	To Redifon Spec. OP9197/S
XL11	To Redifon Spec. OP9141/S
XL12	To Redifon Spec. OP9186/S
XL13	To Redifon Spec. OP9186/S

IF FILTERS

FL1	To Redifon Spec. PL5649 Edn.A
FL2	To Redifon Spec. PL5662 Edn.A
FL3	+250Hz to 3kHz to Redifon Spec. PL5645 Edn.A −250Hz to 3kHz to Redifon Spec. PL5645 Edn.B
FL4	To Redifon Spec. PL5647 Edn.A
FL5	To Redifon Spec. PL5648 Edn.A
FL6	+250Hz to 6kHz to Redifon Spec. PL5646 Edn.A −250Hz to 6kHz to Redifon Spec. PL5646 Edn.B

LOUDSPEAKER

LS1	10Ω Richard Allen 370S or Fane 3227

COMPONENT LIST
REMOTE CONTROL UNIT RC116A (CLA 5652-1)

CAPACITORS

C1 0.1uF ±20% 100V STC PMA0.1 M100

RESISTORS

R1 180Ω ±5% 2.5W Welwyn W21
R2 Voltage dependant Mullard E299DD/P228
R3 180Ω ±5% 2.5W Welwyn W21
R4 180Ω ±5% 2.5W Welwyn W21
R5 180Ω ±5% 2.5W Welwyn W21

R6 10kΩ Log Redifon to Drg. 3/OP5707/S
R7 470Ω ±2% 1/2W Electrosil TR5
R8 180Ω ±5% 2.5W Welwyn W21
R9 10kΩ ± Lin Redifon to Drg. 4/OP5707/S
R10 330Ω ±2% 1/2W Electrosil TR5
R11 470Ω ±5% 2.5W Welwyn W21

DIODES

MR1 Mullard OA210
MR2 Mullard OA210
MR3 Mullard BZY95–620

TRANSFORMERS

T1 Redifon to Drg. SRT/2705

SWITCHES

SA Arrow TS3
SB Arrow TC3
SC Redifon to Drg. OP.9248/M
SD Redifon to Drg. OP.9249/M
SE Arrow TS3

PLUGS

PLA 18-way Belling Lee L656/P

JACK SOCKETS

JKA Igranic P73

LAMPS

ILP1 0.75W LES 14V 5mm E5/8 CAP
ILP2 0.75W LES 14V 5mm E5/8 CAP
ILP3 0.75W LES 14V 5mm E5/8 CAP
ILP4 0.75W LES 14V 5mm E5/8 CAP
ILP5 0.75W LES 14V 5mm E5/8 CAP

COMPONENT LIST
MOTOR SWITCHING UNIT (REMOTE CONTROL SYSTEM RC116) (CLA 5653-1)

CAPACITORS

C1 500uF ±20% 50V Plessey CE1294
C2 1uF ±10% 160V Waycom WIMA TROPYFOL 'M'
C3 1uF ±10% 160V Waycom WIMA TROPYFOL 'M'
C4 1uF ±20% 100V STC PMA 1.0 M100
C5 1uF ±20% 100V STC PMA 1.0 M100

RESISTORS

R1a Voltage Dependant Mullard E299DD/P220
R1b Voltage Dependant Mullard E299DD/P220
R2 180Ω ±10% Welwyn W21
R3 Voltage Dependant Mullard E299DD/P228
R4 Voltage Dependant Mullard E299DD/P228

R5 180Ω ±2% 0.5W Electrosil TR5
R6 180Ω ±2% 0.5W Electrosil TR5
R7 1kΩ ±2% 0.5W Electrosil TP5
R8 390Ω ±10% 2.5W Welwyn W21
R9 1.5kΩ ±2% 0.5W Electrosil TR5
R10 390Ω ±10% 2.5W Welwyn W21

BRIDGE RECTIFIERS

MR1 Texas 1B40K40

DIODES

MR2 Mullard OA200
MR3 Mullard OA200
MR4 Mullard OA200
MR5 Mullard OA210
MR6 Mullard OA210

THYRISTORS

VT1 STC CRS3/20AF
VT2 STC CRS3/20AF

SWITCH SELECTORS

SA1 Redifon To Spec. OP.5775/S
SA2 Redifon To Spec. OP.5776/S
SB1 Redifon to Spec. OP.5775/S
SB2 Redifon to Spec. OP.5776/S

LEDEX MOTORS

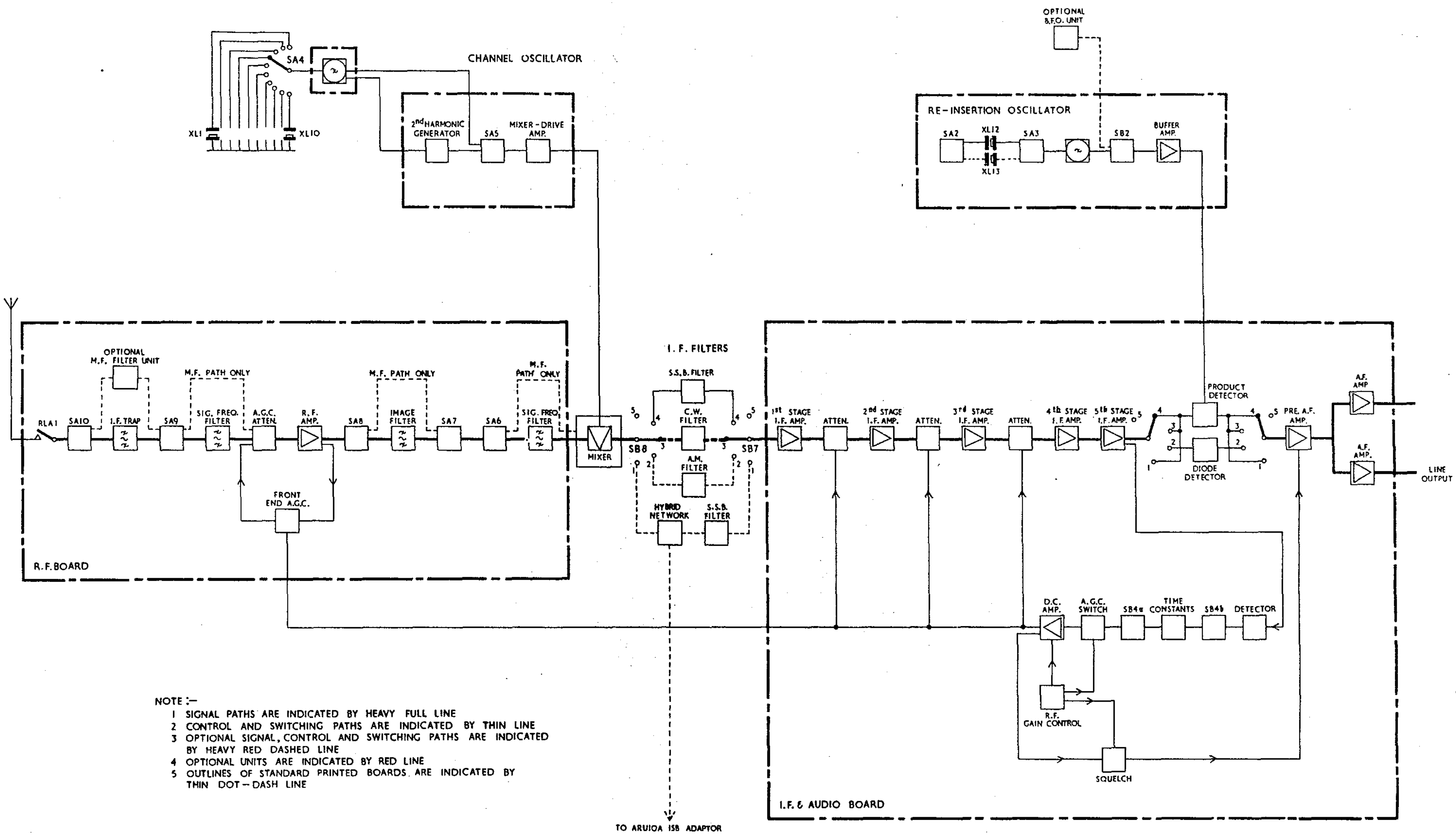
M1 Redifon to Spec. OP.9201/M
M2 Redifon to Spec. OP.9209/M

RELAYS

RLA Varley VP6/–/MB/B/B/21

SOCKETS

SKA Belling Lee L656/S



NOTE :—
1 SIGNAL PATHS ARE INDICATED BY HEAVY FULL LINE
2 CONTROL AND SWITCHING PATHS ARE INDICATED BY THIN LINE
3 OPTIONAL SIGNAL, CONTROL AND SWITCHING PATHS ARE INDICATED BY HEAVY RED DASHED LINE
4 OPTIONAL UNITS ARE INDICATED BY RED LINE
5 OUTLINES OF STANDARD PRINTED BOARDS ARE INDICATED BY THIN DOT-DASH LINE

R499A BLOCK DIAGRAM

FIG. 10·1

CIVIL AVIATION DIVISION

MINISTRY OF TRANSPORT

TEST SHEET. RECEIVER, REDIFON R.499A. Serial No. 319...

RECEIVED FROM: JOB NO. ..K9....

REPORTED FAULT:

WORK DONE PRIOR TO FINAL TEST:

COPY

CHANNEL	LABELLED FREQUENCY		MODE
1.	3990.000	kHz	SSB
2.	~~~~	~~kHz~~	
3.		kHz	
4.		~~kHz~~	
5.		kHz	
6.		~~kHz~~	

SIGNATURE. [signature] .....DATE. 31-3-77

FINAL LABORATORY TEST DATA.

MODIFICATIONS: STI 170, STI 214

POWER SUPPLY VOLTAGE (20V. ±0.5V.) ✓

CLARIFIER FREQUENCY RANGE: + 38 Hz to - 92 Hz

BFO FREQUENCY NA

BFO KNOB ALIGNMENT NA

REMOTE CONTROLS

CLARIFIER	✓	CHAN. CHANGE	NA	RF GAIN	✓
BFO RANGE	NA	MOD CHANGE	NA	SQUELCH ON/OFF	✓
BFO ON/OFF	NA	CHAN. INDICATION	✓		

Channel details on continuation sheets.

Continuation sheet No.........

TEST RESULTS. RECEIVER, REDIFON R.499A No.319..

CHANNEL NUMBER	LABELLED FREQUENCY	MODE	OSC. FREQ.(measured)
1	3990.000 kHz	SSB	5390.001 kHz

		A.M.	S.S.B.	C.W.
A.F. OUTPUT	DBM		+13 dB	
SIGNAL/NOISE	DB		21.5 dB	
A.V.C.	DB		2.6 dB	
SQUELCH	uV		2.3 µV - 20 µV	
HUM & NOISE	DB		32 dB	
BANDWIDTH - 10db	kHz		0.117 to 3.163	
- 60db	kHz		-0.336 to 3.365	
IMAGE REJECTION	DB		83 dB	
I.F. REJECTION	DB		95 dB	

REMARKS

CHANNEL NUMBER	LABELLED FREQUENCY kHz	MODE	OSC. FREQ.(measured) kHz

		A.M.	S.S.B.	C.W.
A.F. OUTPUT	DBM			
SIGNAL/NOISE	DB			
A.V.C.	DB			
SQUELCH	uV			
IMAGE REJECTION	DB			
I.F. REJECTION	DB			

REMARKS

SIGNATURE.................. DATE 31-3-77