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1 INTRODUCTION AND SPECIFICATION

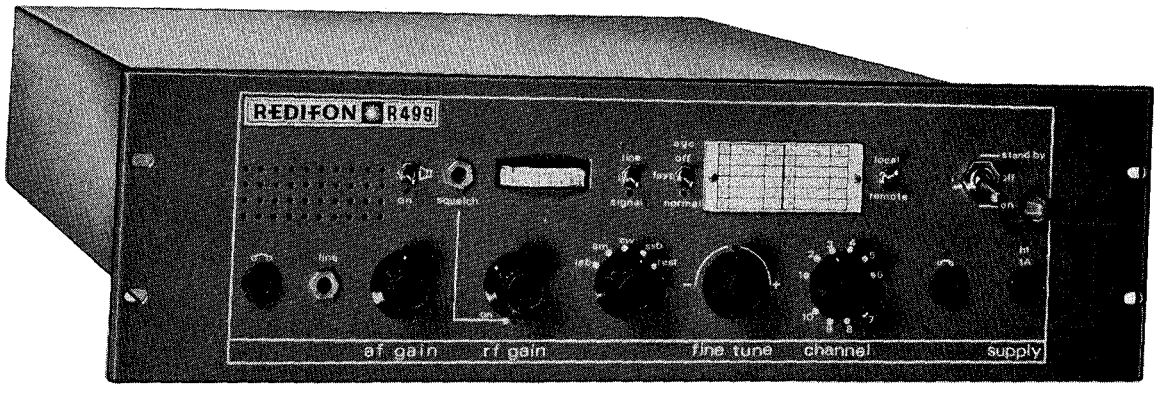

Fig. 1.1

R499A RECEIVER

887–1

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.

The R499A accepts sidetone, aerial muting and AGC desensitising inputs from an associated transmitter, with provision for 'listening through'.

A remote control system type RC116A is available for use with the R499A. Remote facilities include channel selection, service and on-off switching, fine tuning, AF monitoring (by loudspeaker or headset) and channel-in-use indication.

SPECIFICATION

R499A

Frequency range:	1.5 MHz to 30 MHz and 255 kHz to 525 kHz
Channels:	Maximum of 6 HF+4 MF with extra MF filters or 10 MF or 6 HF+4 HF within 1% of other 6
Modes of operation:	
standard version	A2j, A3j, A2a, A2h, A3a, A3h
optional	A1, A2, A3 A3b (using adaptor ARU10A)
Aerial impedance:	
above 1.5 MHz	50Ω
255 kHz to 525 kHz	10Ω in series with 200 pF to 700 pF
Aerial protection:	Withstands up to 30V e.m.f. from a 50Ω source
Frequency stability:	
short term	±0.5 part in 10^6 or ±4 Hz whichever is greater
long term	±1 part in 10^6 or ±6 Hz whichever is greater
Fine tuning:	Total frequency change approx. 100 Hz
Selectivity: (at 3 dB points)	2.7 kHz for SSB 6 kHz for AM 200 Hz for CW
Noise factor:	Typically 7 dB (not greater than 10 dB)
Image rejection:	90 dB to 50 dB (255 kHz to 30 MHz)
Climatic and durability standard:	DEF 133 Clause L1 −15°C to +55°C
AGC:	Output variation not greater than 1dB (for input range of 110dB)
AGC time constants:	0.1 sec and 1 sec for AM 2 msec and 10 sec for CW 2 msec and 10 sec for SSB
Cross modulation:	Cross modulation from a 1V unwanted signal is 30dB below a 1mV wanted signal
Intermodulation:	Better than 36dB below level of wanted signals of 1mV or less (CCIR ref. 332)
Blocking:	An unwanted 6V signal will not reduce the output produced by a 1mV A2 wanted signal by more than 3dB
Radiation:	Less than 40uV across 50 ohm at aerial input
AF Output:	(a) 1.5W into external 3 ohm load with 0.5W into internal 10 ohm loudspeaker or 1.25W into external 600 ohm load with 0.5W internal 10 ohm loudspeaker (b) +10dBm into 600 ohm load with separate Set Level control (c) 2 outputs, each 2mW into 600 ohm headphones or 1 output when BFO fitted
IF output:	100mV into 50 ohm at 1.4MHz
Power supply:	24V d.c. or 100—125V and 200-250V at 50-60Hz
Dimensions:	Height 5.25in (13.3cm) Width 19in (48.3cm) Depth 20.25in (51.5cm)
Weight:	22lb (10kg)
Optional (extra) facilities:	(1) DSB filter (2) CW filter and BFO (3) 6kHz bandwidth ISB filter (4) MF aerial filters for channels in 255kHz to 525kHz band (5) Type ARU10 ISB adaptor (6) runners for rack mounting

RC116A: Includes remote selection of Service and Channel, Fine Tuning, AF Gain control and On/Off switching at distances up to approximately 200 yards (180m)

Dimensions:	Height 1.75in (2.4cm) Width 19in (48.2cm) Depth 6in (15.3cm)
Weight:	
control unit	3lb 6 oz (1.5kg)
motor switching unit	4¼lb (1.9kg)

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. $\pm$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. $\pm$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	5	5	
6	6 600 ohm line output	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 passing 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.