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BR 9005

HF RECEIVER AND MONITOR PANEL

NSN 5820-99-732-7231 (R 500 N)
NSN 5820-99-256-6719 (MP 505 N)
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MINISTRY OF DEFENCE
SEA SYSTEMS CONTROLLERATE
(DGSW(N))

D/SSC/DGSW/28/339/9005/89

NOTES TO READERS

1 GENERAL

This is a Commercial handbook, therefore the following should be noted:

- (1) All manufacturer's reference numbers should be disregarded. See para 3 below.
- (2) All references to Repair Manuals should be disregarded as these are not issued to the Royal Navy.
- (3) All references to 'Rediffusion' should read 'Redifon MEL'.
- (4) Instructions for 'Return for Repair' procedure are to be disregarded; normal Naval Stores procedure is to be followed.
- (5) All references to Repair to Component Level should be disregarded.
- (6) Typeface and format may vary throughout the publication.

2 INSTALLATION

The installation information contained in the equipment handbooks [listed on page (vi) overleaf] should be disregarded. Installation details for the ICS6 System, including equipments fitted, are contained in BR 8851(4A).

3 NATO CODIFICATION

NATO codification information for the ICS6 System Outfits is contained in BR 8851(7). Codification information for the equipments within the Outfits is contained either in the Outfit System Handbook Category 7, or on a separate fly sheet at the front of the handbook.

4 MAINTENANCE SCHEDULES

Maintenance schedules applicable to the ICS6 System are listed in the Design Authority Maintenance Schedules (DAMS) in BR 8851(6).

5 TEST EQUIPMENT

Items of test equipment for setting to work, maintenance and servicing on the ICS6 System are listed in BR 8851(5). Lists contained in the equipment handbooks should be disregarded.

6 OPERATING INSTRUCTIONS

Operating instructions for both the System and the individual equipments are contained in BR 8851(2). These instructions supersede all those contained in the individual handbooks.

7 CHANNEL FOR COMMENT

Service users are to send their comments on this publication to their Administrative Authority using form S2022. Non-service users are to send their comments to the sponsoring Director General named on the Title page, quoting the file reference on that page.

ASSOCIATED PUBLICATIONS

<u>BR Number</u>	<u>Title</u>
BR 2526	AERIAL TUNING OUTFIT ETB
BR 8297	OUTFIT AVK ANTENNA
BR 8482	OUTFIT KMY(1) DISTRIBUTION CONTROL
BR 8851	MF/HF INTEGRATED COMMUNICATIONS SYSTEM (ICS6)
BRF 8851(4A)	MF/HF INTEGRATED COMMUNICATIONS SYSTEM (ICS6) INSTALLATION SPECIFICATION
BR 8872	OUTFIT 648(7), 250 W MF/500 W HF TRANSMITTER including ACU PSU NSN 5820-99-733-7526 and FILTER UNITS AND CONTROL UNIT (CU2002N)
BR 8873 including	OUTFIT 648(5) & 648(6), 500 W & 1 kW HF TRANSMITTER ACU PSU NSN 5820-99-733-7526 and FILTER UNITS AND CONTROL UNIT (CU2003N)
BR 8874	OUTFIT CJG(6), HF RECEIVER
BR 8875	OUTFIT EJA(1), COMMON AERIAL WORKING SYSTEM
BR 8876	OUTFIT ETK(1)/(2), AERIAL COUPLING UNIT
BR 8878	OUTFIT IND(1), CONTROL ANCILLARIES
BR 9005 Parts 1 & 2	HF RECEIVER AND MONITOR PANEL NSN 5820-99-732-7231 (R500N) NSN 5820-99-256-6719 (MP505N)
BR 9006 Parts 1 & 2	HF RECEIVER AND MONITOR PANEL NSN 5820-99-255-1918 (R505N) NSN 5820-99-256-6719 (MP505N)
BR 9007 Parts 1 & 2	TRANSMITTER POWER AMPLIFIERS NSN 5820-99-704-2531 (HFA250N) NSN 5820-99-470-6126 (MFA250N)
BR 9008 Parts 1 & 2	TRANSMITTER DRIVE UNITS NSN 5820-99-730-5523 (DU505N) NSN 5820-99-853-2978 (DU530N)
BR 9009 Iss. 2	MULTICOUPLER UNITS NSN 5945-99-733-5729 (MCU100N) NSN 5820-99-255-5927 (MCU100P) NSN 5985-99-282-6812 (MCU200A) NSN 5820-99-740-2532 (AERIAL PATCH PANEL)
BR 9010 Parts 1, 2 & 3	REMOTE CONTROL UNITS NSN 5820-99-282-0670 (RC153N) NSN 5820-99-741-8368 (RC154N) NSN 5820-99-361-6985 (RC160N)

HF SSB Receiver/Monitor Panel
NATO Codification - Issue 1
DMC/Jly 1990

HF SSB RECEIVER AND MONITOR PANEL
NATO STOCK NUMBERS

NATO Stock Numbers have been allocated to the HF SSB Receiver R500N, and to certain modular parts replaceable as second line spares. These Stock Numbers are listed below, together with the relevant Redifon Drawing Numbers. The Monitor Panel MP505N has also been codified; this is only replaceable as a complete unit, and has no replaceable parts.

NSN	DESCRIPTION	DRG.
5820-99-732-7231	<u>R500N HF SSB Receiver</u>	001/12071/N
5820-99-730-5522	PEC (Processor [Basic]) *	010/12103N/1
5820-99-730-5524	Front Panel Assembly	001/13554N/1
5820-99-730-5526	Tuner Unit Assembly *	001/12080N/1
5820-99-731-4943	PEC (BFO/CIO/AF)	001/12098A/1
5820-99-733-0591	PEC (IF Amplifier)	001/12097N/1
5820-99-741-7199	PEC (Keyboard/Display)	001/90002A/1
5820-99-796-9079	PEC (Mixer Amplifier) *	001/12210A/2
5820-99-794-9083	PEC (Motor Drive) *	001/12087A/1
5820-99-794-9084	PEC (HF Synthesiser) *	001/12093A/1
6110-99-762-4555	Power Supply Assembly *	001/13637A/1
5820-99-794-9086	PEC (PSU Input/Output) *	012/12094A/1
5820-99-794-9087	1 MHz Frequency Reference Assembly *	001/12234A/2
	* Also used on R505N	

NSN	DESCRIPTION	DRG.
5820-99-256-6719	<u>MP505N Monitor Panel</u>	001/13840N/1
-	No replaceable parts	

LIST OF ABBREVIATIONS

AGC	Automatic Gain Control
AUX	Auxillary
BAL MOD	Balanced Modulator
BCD	Binary Coded Decimal
B/W	Bandwidth
CHN	Channel
CIO	Carrier Insertion Oscillator
CLR	Clear
EAROM	Electrically Alterable Programmable Read-only Memory
EPROM	Erasable Programmable Read-only Memory
EXT	External
FREQ	Frequency
FS	Fuse
HF	High Frequency
HI	High
IC	Integrated Circuit
IF	Intermediate Frequency
INT	Interrogate
LCD	Liquid Crystal Display
LK	Link
LO	Low
LSB	Lower Side Band
MEM	Memorise
MON	Monitor
OSCR	Oscillator
O/P	Output
PEC	Panel Electronic Circuit
PP	Probe Position
RAM	Random Access Memory
REF OSC	Reference Oscillator
R/R	Replace or Repair
RX	Receiver
SER	Service
ST/BY	Standby
SYNTH	Synthesiser
T/C	Time Constant
TP	Test Pin
TS	Terminal Strip
TST	Test
USB	Upper Sideband
VCO	Voltage Controlled Oscillator

SAFETY LEAFLET FOR SSB RECEIVER NSN 5820-99-732-7231

The following information on SSB Receiver NSN 5820-99-732-7231 (R500N) is intended to facilitate safe handling of the equipment.

1. Weight

The equipment is suitable for rack, cabinet or console mounting, and weighs 17.2 kg (38 lb).

2. Supplies

The supply requirements of the equipment are single phase 45 - 65 Hz ac at 200 - 250 V, 0.5 A, or 100 - 125 V, 1 A.

The supply must be fed via an isolator.

3. AC Isolator

A recommended single phase, double pole switched, single pole fused mains isolator is Crabtree type 2847QG, with 5 A cartridge fuse to BS 1362.

4. Supply Input Cables

Recommended supply cable rating is 400 V, 5 A max.

5. Earthing

The earth connection at the mains supply isolator must be in accordance with current IEE Regulations, or the equivalent local regulations. The equipment earth terminal on the rear panel must be connected to the earth plane (eg earth spike/mat as applicable) by a copper strip or braid of at least 19 mm x 3.2 mm (0.75 x 0.125 in).

6. Heat Emission

Under normal operating conditions the heat sink at the rear of the equipment may be up to 20 °C above ambient temperature; this may rise to approx. 100 °C under fault conditions. Module 12 contains an oven; beneath the outer cover a temperature of approx. 60 °C is accessible.

Do not obstruct the slots in the equipment top and bottom covers, and ensure that the minimum vertical separation between equipments is maintained.

7. Access

When the top and bottom covers are removed from the equipment, only authorised and trained personnel should carry out servicing which requires the mains supply to be reconnected, since dangerous voltages may be encountered.

During repair, modules or components must not be removed or replaced with the supply switched on since damage may be caused to the equipment, as well as being potentially hazardous to the operator.

8. Hazards

Dangerous voltages (over 150 Vac) exist between the Mains Input Filter and the Voltage Selector Panel on the Power Supply Unit (module 6). These are protected by a gaiter and a metal enclosure with a suitable warning notice.

9. Handbook Warnings

The handbook should be consulted before carrying out any work on the equipment, with particular reference to the following:-

Safety warnings on page 2-W (chapter 2), and paras. 2.4.2 to 2.4.4.

10. Flammability

No components or materials capable of supporting combustion are used in the equipment.

WARNING

BEFORE COMMENCING INSTALLATION OF RECEIVER
NSN 5820-99-732-7231 IT IS IMPORTANT TO
NOTE THAT THERE IS NOT A MAINS SWITCH:
THE STANDBY/ON PUSH-PUSH SWITCH DOES NOT
DISCONNECT THE MAINS SUPPLY FROM THE UNIT.

DO NOT CONNECT THE MAINS SUPPLY UNTIL
THE VOLTAGE SELECTOR HAS BEEN CORRECTLY
ADJUSTED FOR THE AVAILABLE MAINS VOLTAGE,
AND THE FUSES SELECTED ACCORDINGLY.

CONNECTION AND DISCONNECTION OF THE MAINS
MAY BE EITHER AT THE ISOLATOR SWITCH OR
BY MEANS OF THE PLUG ON THE REAR PANEL OF
THE UNIT.

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- 1 GENERAL DESCRIPTION & SPECIFICATION
- 2 INSTALLATION
- 3 OPERATING INSTRUCTIONS
- 4 FUNCTIONAL DESCRIPTIONS
- 5 FAULTFINDING TO MODULE LEVEL
- 6 MODULE REMOVAL & REPLACEMENT
- 7 PERIODICAL CHECKS & ADJUSTMENTS

APPENDIX 1 SIMPLEX/DUPLEX MONITOR MP500

1 GENERAL DESCRIPTION & SPECIFICATION

PLATE 1.1 RECEIVER TYPE 500N

1.1 GENERAL DESCRIPTION

1.1.1 Introduction

1.1.2 Keypad Operation & Display

1.1.3 Use of Prefix & Command Keys

1.1.4 AGC

1.1.5 Protection against Excessive Input

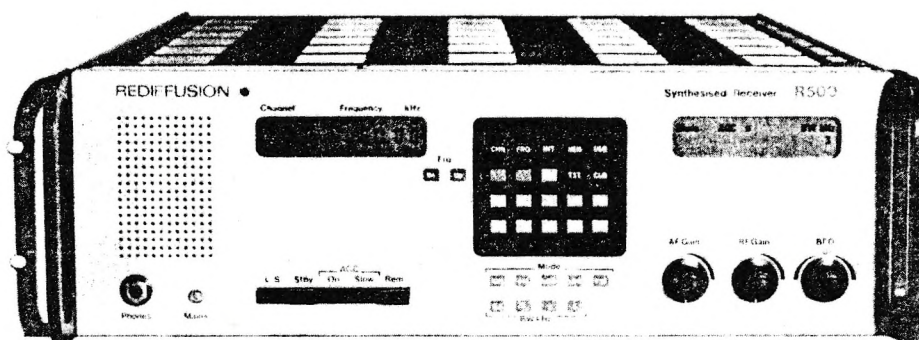
1.1.6 Audio Outputs & Sidetone

1.1.7 Remote Control

1.1.8 Optional Variants

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1.2 SPECIFICATION



RECEIVER TYPE R500N

1 GENERAL DESCRIPTION & SPECIFICATION

1.1 GENERAL DESCRIPTION

1.1.1 Introduction

The R500N receiver is a high grade professional synthesised communications receiver covering the frequency range 60kHz to 30MHz. The receiver is a single conversion superhet with an intermediate frequency which is nominally 1.4MHz (carrier): this is shifted for certain bandwidths and particularly for SSB lower SB, so that separate upper and lower sideband filters are not required. At the input there is an automatically tuned preselector.

The equipment is the N variant of the R500 receiver. The rear panel carries a type label with the identification R500N, a serial number label and a label detailing the options fitted.

The synthesiser is based on a single phase lock loop system controlling a Voltage Controlled Oscillator. Two special programmed divider ICs are used and phase comparison is combined with reference frequency division in another special IC. There is a crystal controlled reference oscillator.

Reception is provided on SSB and DSB telephony services, or DSB and CW telegraphy services. A choice of bandwidth is available on all services. A BFO is fitted with a manual adjustment of $\pm 3\text{kHz}$: there is an F1B option.

The received frequency is selected to the nearest 10Hz by operation of a keypad and shown on a numeric display. Control of the synthesiser and other functions, to be described, are carried out electrically by a microprocessor and memory system. Thus digital circuit techniques are used and therefore a high degree of reliability is assured. The receiver can be used with a comprehensive remote control system with reverive indications.

Circuits are built on a number of separate circuit panels which are interconnected via plugs and sockets. This results in a high service availability.

The processor system controls the tuning of the preselector making use of digital signals which exist for frequency selection.

1.1.2 Keypad Operation and Displays

Keys can be used to select one of a number of preset channels out of 63 whereby Frequency, Service and Bandwidth are set automatically and displayed, the necessary data having been stored in a memory. Also any individual Frequency, Service and Bandwidth can be selected from the keypad, without affecting the channels, using "Prefix" and "Command" keys, as described later. "Up" and "down" keys provide a fine tuning facility.

The frequency changes in 10Hz steps initially, increasing to a fixed rate of 425Hz/S over approximately 4S. Channels are preset or changed from the keyboard using appropriate "Prefix" and "Command" keys: also the status of any channel can be displayed without affecting the receiver itself. There are two displays, of the liquid crystal type, backlit by electroluminescent panels, which show a black image on a light background and these are:

- (a) Channel and Frequency (numeric display)
- (b) Service (Mode and Bandwidth.)

On display (a) there are two digits for Channel No. and seven digits for Frequency: INTERrogate, MEMorise and USE legends appear on this display. On display (b) Service (Mode & Bandwidth), AGC (Fast/Slow) and a MUTED legend appear.

1.1.3 Use of Prefix and Command Keys

The Frequency, Service and Bandwidth are actually changed in the receiver only when the command key USE is pressed: the functions of all the command and prefix keys are now described. Prefix keys are pressed before any numeric keys and they are Channel (CHN), Frequency (FRQ) and Service (SER). The command keys are pressed last and the resulting action is as follows:

P = prefix key N = numeric key

Command

Procedure and Effect

USE

- (a) If Channel (P) -Channel No. (N) and USE are pressed the receiver is operational on the Frequency, Service and Bandwidth memorised for the channel selected.
- (b) If Frequency (P) -Frequency digits (N) -Service (P) - Service No. (N) and USE are pressed the receiver is operational as selected.

In each case the display shows the actual receiver status and the legend USE, but for (b) Channel No. 0 is displayed.

INTERROGATE (INT)
To check the existing status of a channel

Press:
Channel (P) - Channel No (N) and INT.
This display shows:

Channel No. -Frequency -Service and Bandwidth already allocated to the channel selected. No change occurs to the receiver itself.

MEMORISE (MEM)
To preset or change* the status of a channel service No. (N)

Press:
Channel (P) - Channel No. (N) - Frequency (P) - Frequency digits (N) - Service (P). Bandwidth No. (N) and MEM.
Existing data for this channel is erased from memory and data for new condition entered. The display shows the new status. No change occurs to the receiver itself.

*There is a facility for "protecting" all channels or channels 1-10 so that they cannot be changed except by using internal links. See para. 3.2. In between commands the display shows the status of the receiver itself and the legend USE: if an Interrogate or Memorise command has been given the display changes temporarily, reverting to receiver status after approximately 40 seconds. During this time the legend INT or MEM is shown instead of USE.

1.1.4 AGC

A comprehensive AGC system is incorporated which in conjunction with a variable RF gain control gives a very large dynamic range of reception with good linearity and minimum intermodulation products. The AGC is switchable and can be set to SLOW for normal reception, FAST for conditions of rapid fading (decay time reduced) or it can be switched OFF when intense interference is present. The AGC status, (ON/OFF, FAST/SLOW) can be entered into channel memory.

1.1.5 Protection against Excessive Input

The receiver input stages will withstand without damage Aerial signals up to 50V emf. At approximately 20V emf a protection circuit operates the muting relay which cuts off the incoming signal at the input to the Preselector. Muting for this reason only occurs for the duration of the excessive signal but the same relay operates while the Preselector is tuning and can also be operated by a Transmit/Receive contact in an associated Transmitter. When the mute relay is cutting off the input for any of the reasons above, the word MUTED appears on the service/bandwidth display. Further protection is provided by an RF fuse and a spark gap which deals with short duration voltage surges.

1.1.6 Audio Outputs and Sidetone

These are provided, at appropriate levels, as follows:

Internal loudspeaker

Headphone jack on the front panel.

External loudspeaker.

External monitor

Line output (600 Ω balanced).

There is a sidetone input for use with an associated Transmitter: the signal is amplified and applied to all the audio outputs with preset level adjustment.

1.1.7 Remote Control

When the front panel remote pushbutton is depressed the front panel controls are rendered inoperative and control is effected via differential lines from a remote control device. The data lines are connected to a line driver and line receiver and thence via a UART to the receiver microprocessor. The remote controls permit channel selection, channel interrogation and presetting of new channel frequency, service mode and Auxiliary number.

1.1.8 Optional Variants

OPTION 01 F1B Module

F1B AF input 1700Hz $\pm$ 85Hz

Mark frequency 1615Hz

Output 6-0-6V EIA RS232 interface

Mark level $\cdot$ -5V Space level $\cdot$ +5V

Keying speed 100 bauds max.

OPTION 03 6.4MHz Frequency Reference

1.1.9 Power Supply

A single phase 45-63Hz AC mains supply is required in the range 100-125V (selectable in 5V steps) or 200-250V (selectable in 10V steps). Voltage variations within $\pm 10\%$ will not degrade the receiver performance. There is protection against current overloads and voltage surges.

1.2 SPECIFICATION

Frequency Range

60kHz to 1MHz and 1.6MHz to 30MHz in 10Hz steps. Will operate between 1MHz and 1.6MHz with performance limitations.

Frequency Readout Presentation

Readout is by seven figures each being approximately 8mm high LCD types. The least significant digit is 10Hz. Leading zeros are not displayed. A decimal point is displayed to denote whole kHz digits.

RF Tuning

Front end tuning is covered in six bands. 60kHz - 1MHz employs a low pass filter. The other five bands, 1-2MHz, 2-4MHz, 8-16MHz and 16-30MHz are each continuously tuned. Rejection is at least 30dB at $\pm 5\%$ off tune above 2MHz.

The tuning is automatically set by a combined microprocessor and motor drive system. The receiver input is cut off while tuning is in progress, during which the MUTED legend is displayed.

Preset Channels

The channels facility provides 63 channels. These are displayed by two figures at the left end, and of the same form, as the frequency presentation. Channel 'O' is dedicated to storing the last condition in use. Stored channels can be protected by an internal plug in link.

Antenna Impedance

The receiver is designed for a nominal antenna impedance of 50 ohms. For the LF/MF band, operation from a 10 ohm 250pF antenna source can be internally selected by link adjustment.

Antenna Radiation

The level of any discrete frequency component measured into 50 Ω at the antenna does not exceed 10 μ V from 0-100MHz.

Maximum Signal Input

No damage is caused by input signals of up to 50V emf from a 50 Ω source at any frequency between 60kHz and 30MHz.

Sensitivity

Frequency Range	Service Mode	Bandwidth	SND/N (dB)	Max. level of input signal dB μ V emf
60-100kHz	A1A	narrow 300Hz	20	+20
100-160kHz	A1A	narrow 300Hz	20	+15
	A2A	intermediate 1kHz	20	+30
160-535kHz	A1A	narrow 300Hz	20	+10
	A2A	intermediate 1kHz	20	+30
535-1000kHz	A1A	narrow 300Hz	20	+13
	A2A	intermediate 1kHz	20	+28
	J3E	intermediate 3kHz	20	+23
	A3E	wide 6kHz	20	+36
1.6-30MHz	SSB	3kHz	10	0

2 μ V emf will give full audio outputs and is the threshold of AGC operation.

Reciprocal Noise

-85dB.

Noise Figure

16dB 1.6-30MHz measured on SSB, 3kHz bandwidth.

Blocking

On any service with a 3kHz nominal bandwidth, a wanted signal up to 1mV emf does not have its output reduced by more than 3dB in the presence of an unwanted signal 20kHz removed and at a level of 500mV.

Cross Modulation

A 30% modulated unwanted A2A signal separated at least 20kHz from a wanted signal of 1mV emf can have a level up to 300mV emf before 3% cross modulation occurs.

Intermodulation Products

(a) Out of Band

Between 1.6 and 30MHz, for two separate 80dB μ V emf signals, removed from the wanted signal by not less than 20kHz, IP's are at least 80dB below either of the unwanted signals.

Between 60kHz and 1MHz the unwanted signal should be 30kHz removed from the wanted signal for the same performance.

(b) In band

On SSB, two in band unwanted signals of up to 50mV produce IP's at least 40dB below either of the unwanted signals.

Spurious Signal Rejection

At frequencies more than $\pm 20\text{kHz}$ from the tuned frequency, the spurious signal rejection is at least 80dB.

Intermediate and Image Frequency Rejection

The intermediate frequency at 1.4MHz and image frequency (signal frequency $+2.8\text{MHz}$) are rejected by at least:

Frequency	IF Rejection	Image Rejection
20 - 30MHz	100dB	60dB
2 - 20MHz	100dB	80dB
60kHz - 1MHz	70dB	70dB

Selectivity

USB 3kHz	+300Hz to +3kHz -500Hz to +3.8kHz	-6dB -60dB
LSB 3kHz	-300Hz to -3kHz +500Hz to -3.8kHz	-6dB -60dB
AM 6kHz	6kHz bandwidth at 20kHz bandwidth at 3kHz bandwidth at	-3dB -60dB -6dB
AM 3kHz	3kHz bandwidth at 4.3kHz bandwidth at	-6dB -60dB
CW 1kHz	1kHz bandwidth at 3.5kHz bandwidth at	-3dB -60dB
CW and F1B 300Hz	300Hz bandwidth at 2.4kHz bandwidth at	-6dB -60dB

Automatic Gain Control

An increase of 100dB from AGC threshold produces a change of output of typically less than 6dB.

AGC time constants:-

	SSB	CW	AM
Attack	<10mS*	<10mS*	<100mS
Fast decay	50-100mS**	50-100mS**	60mS
Slow decay	1-4 secs	1-4 secs	<120mS

*These figures relate to 6kHz bandwidth.

**These figures relate to 3 or 6kHz bandwidth

An increase of 20dB in level of an input signal giving 20dB signal to noise ratio will give an improvement of at least 15dB to the signal to noise ratio.

IF/RF Gain Control

A range of at least 100dB is provided; acting with the AGC voltage to establish a variable threshold.

Reception Modes

A1A, A2A, A3E, R2A, J2A, H2A, R3E, H3E, J3E (LSB and USB). F1B option with 6-0-6V output, 1700Hz $\pm$ 85Hz, 100 Bauds max.

Bandwidths

300Hz, 1kHz, 3kHz, 6kHz, SSB passband 300 - 3000Hz.

BFO

For A1A reception the BFO gives a $\pm$ 3kHz variation. For F1B (radio-telex service) the carrier insertion oscillator is used to provide an AF output centred on 1700Hz.

AF Outputs

Internal loudspeaker 15 Ω Total 500mW
External loudspeaker 8 Ω

Headphone jack on front panel 600 Ω , 3mW. Insertion of phone plug disconnects the internal loudspeaker. Line output 600 Ω balanced +8dBm. Monitor facility 600 Ω 1mW.

Audio Distortion

For an A2A (1000Hz) signal at 100mW emf and 80% depth of modulation (6kHz IF bandwidth).

AF distortion for loudspeaker and phones <5%.

AF distortion for line output <5%.

Audio Input (Sidetone)

0dBm input produces at least 10dBm line output with the line gain control at maximum and 500mW in the loudspeakers with the AF gain control at maximum.

Mute and Desense

An external normally open contact is closed to give receiver demute. The mute relay has an operate/release time of 1mS. There is 50dB of mute at 30MHz and 90dB of mute at 1MHz.

Desensing requires an external +12V supply. Typically 126dB desensitising is available.

Frequency Stability

(a) Internal Standard

$\times 10^{-8}$ At ambient temperatures from -15°C to +55°C, the frequency will be within 5 of the selected frequency, except that LSB will be within 15Hz of allocation (Crystal Reinsertion oscillator).

- (b) External Standard

A BNC coaxial connector and an Internal/External switch provides a facility for an external frequency standard input of 1MHz, 0dBm into 50Ω.

Power Supplies

- (a) AC Mains -100 to 125V in 5V steps or 200 to 250V rms in 10V steps, adjustable by mains setting panel using a plug in selector. Frequency 47 to 63Hz. Variations of supply from -10% to +10% will not degrade the equipment performance. No damage will result from voltage surges of 100% of up to 1ms duration.

Power consumption: typically less than 60W.

- (b) DC Supply - An external adaptor unit will be employed which will accept 24V DC nominal.

Controls and Connectors

- (a) Front panel
Keyboard (20 keys).

Numeric (0-9), Prefix, Commands.

Selects Frequency, Channel, Service, Bandwidth, Use, Interrogate, Memorise.

10Hz step up or step down: continuous frequency change while pressed.

7 digit frequency display

2 digit channel display

Service AGC & bandwidth display

AGC switch on/off

AGC switch - slow/fast

Loudspeaker switch - on/off

Standby/On switch

Local/Remote control switch

RF gain control

AF gain control

BFO control

Headphone jack.

- (b) Rear Panel

Earth stud 6mm dia. 25mm protrusion

RF input socket. BNC

External reference frequency: input/output BNC socket

External reference frequency: int/Ext switch

2-37 way D type connectors

2 - Mains fuses (one linked out for supplies which have a neutral)

Mains input plug with built-in RF filter

Mains voltage selector (under PSU)

1 - DIN connector for remote control

Weights and Dimensions

Weight 18.8kg (41.5lb)

Depth 445mm (17 1/2in)

Height 133mm (5 1/4in)

Width of chassis - 419mm (16 1/2in)

Width of front panel with "ears" 482mm (19in)

Suitable for 482mm (19in) rack mounting where the rack cabinet depth allows 533mm (21in) from the front face of the rack/cabinet to its rear

Runners, telescopic, available as an option.

Environmental

Meets the following clauses of DEF STAN 07-55:

B1: +70°C storage

B1: +45°C operational

B4: -40°C storage

B4: -10°C operational

B7: +45°C operational at 90-95% relative humidity

Shock

A3:3 shocks at 10g, 25ms in 3 planes, functional

Vibration

A1: Clause 3, method B and C, severity to fig 4, curve C, 10 hours duration, functional

Remote Control Facilities

A front panel Local/Remote switch and interconnection socket for remote control is a standard fitting.

Remote signalling will be in a serial format via a forward line (twisted pair) and revertive signalling via a return line (twisted pair). For distances greater than 3100m (10,000ft) tone signalling is necessary and external modems are required.

The controlled functions will be Channel, Frequency, Service and Bandwidth.

2 INSTALLATION

2.1 UNPACKING

2.2 SITING

2.3 EXTERNAL CONNECTIONS

Fig. 2.1 R500N Receiver - back view

Table 2.1 Connector PL1 details

Table 2.2 Connector SK2 details

Table 2.3 Connector SK5 details

2.4 CONNECTION DETAILS

2.4.1 External Cables - General

2.4.2 Mains Input

2.4.3 Mains Voltage Adjustment and Fuses

Fig. 2.2 Mains Voltage Selector

2.4.4 Main Receiver Earth

2.4.5 Aerial Input

2.4.6 Aerial Demuting

2.4.7 Desensitising

2.4.8 External RF Gain Control

2.4.9 Receiver Ready Input

2.4.10 AGC Output

2.4.11 AF Outputs

2.4.12 AF Sidetone Input

2.4.13 External Master Reference Frequency

2.4.14 F1 B Mode

2.5 REMOTE CONTROL

2.6 OPERATIONAL SWITCH SETTINGS

2.6.1 Auto Interrogate Time Setting

Table 2.4 Link LK4 Settings

2.6.2 Baud Rate Setting

Table 2.5 Switch S1 Setting

2.7 INSTALLATION TESTING

FIG. 2.3 MECHANICAL DETAILS

FIG. 2.4 TELESCOPIC RUNNER DETAILS

FIG. 2.5 PROCESSOR PEC ASSEMBLY

APPENDIX 1 CONNECTOR DETAILS

WARNING

BEFORE COMMENCING INSTALLATION OF THE R500N IT IS IMPORTANT TO NOTE THAT THERE IS NOT A MAINS SWITCH: THE STANDBY-ON PUSH-PUSH SWITCH DOES NOT DISCONNECT THE MAINS SUPPLY FROM THE UNIT.

DO NOT CONNECT THE MAINS SUPPLY UNTIL THE VOLTAGE SELECTOR HAS BEEN CORRECTLY ADJUSTED FOR THE AVAILABLE MAINS VOLTAGE AND THE FUSES SELECTED ACCORDINGLY.

CONNECTION AND DISCONNECTION OF MAINS MAY BE EITHER AT THE ISOLATOR SWITCH OR BY MEANS OF THE PLUG ON THE REAR PANEL OF THE UNIT.

2 INSTALLATION

2.1 UNPACKING

Immediately on receipt of the equipment, examine the packing case(s) for signs of damage, and inspect the contents for damage and/or shortages. In the event of damage or shortages being apparent, the Carriers and the local Rediffusion depot/agent must be notified within 3 days of receipt.

After inspection, partially re-pack the equipment and store in a clean dry area until required for installation. Avoid storage areas subject to condensation or high temperature.

2.2 SITING

If satisfactory duplex working is to be obtained, the siting of the receiver and the care with which it is installed are of vital importance. This applies particularly to marine installations. The receiver should be located as far away as practicable from the associated transmitter(s), and the transmitter aerial output leads and aerial switches. Particular attention must be paid to the routing of the external cables, aerial feeder(s) and earthing arrangements.

The receiver is suitable for bench top mounting but there is an option for 482mm (19in) rack/cabinet mounting. When rack mounted, the receiver occupies 133mm (5 1/4in) of rack height. NOTE. The receiver must NEVER be mounted such that the weight of the unit is taken by the front panel - it MUST be supported on angle brackets or telescopic runners.

Fig. 2.3 gives mechanical and fixing details. Fig. 2.4 gives details of runners.

Locate the unit(s) so that distracting reflections from the display surfaces are avoided.

When positioning the unit(s), do not overlook space requirements for the entry of external cables. In addition, sufficient space must be allowed for the free circulation of air for ventilation.* Finally, it must be possible to withdraw the receiver from its installed position for servicing, and adequate lighting and AC mains supply outlets for test equipment should be available for this purpose.

* Minimum 51mm (2in) at the back: 45mm (1 3/4in) above & below.

2.3 EXTERNAL CONNECTIONS

All external connections are made at the back of the receiver using the following connectors:

PL6 Mains - 3 Pin - Live, Neutral & Earth.

SK3 Aerial - Coaxial.

SK4 External reference frequency (1MHz) - Coaxial.

SK5 7 pin DIN - for Remote control only. For connections see Table 2.3.

PL1 37 way D type. Details in tables 2.1 and 2.2.

SK2 For locations see Fig. 2.1.

Details of the connector assemblies are provided in Appendix 1 to chapter 2.

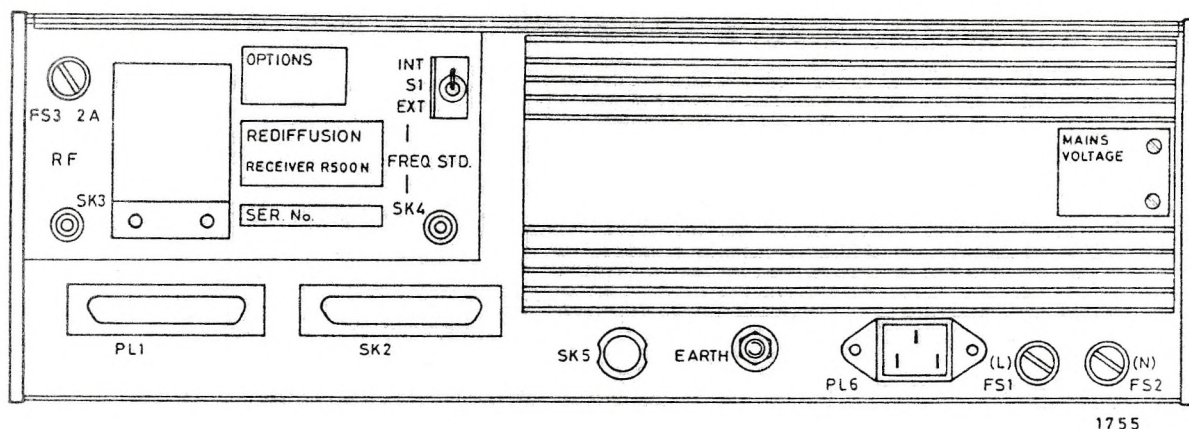


Fig. 2.1 R500N Receiver - Back View

TABLE 2.1 'D' Connector PL1 Details

PL1 pin no.	Function	Description Reference
1	0 - Screen for F1.	
2	+5V	
3	0V Earth for (2,6)	
4	F1B 6-0-6 VDC, Optional.	2.4.14
5	-	
6	Rx Ready	2.4.9
7	-	
8	-	
9	-	
10	-	
11	0V Earth for (12)	
12	AF Monitor Output.	2.4.11
13	0V Earth for (14)	
14	Remote AF Monitor	2.4.11
15	0V Earth for (16)	
16	Sidetone Input	2.4.12
17	0V Earth for (18)	
18	Aerial Mute	2.4.6
19	0V, Earth for (35, 37)	
20	32	
21	16	
22	8 BCD Coded Aerial Selection.	
23	4 Remote Control Only.	
24	2	
25	1	
26	-	
27	-	
28	Common for Aerial Selection.	
29	Screen for AF line - Pair.	
30	AF Line output	
31	AF Line output Pair	2.4.11
32	Loudspeaker output	
33	Loudspeaker output(E) Pair	2.4.11
34	-	
35	RF Gain - external control	2.4.8
36	-	
37	Desense input	2.4.7

TABLE 2.2 'D' Connector SK2 Details

This connector is used for test purposes only except if the AGC voltage or Frequency Reference "in lock" are required operationally.

SK2 pin No.	Function
1	0V
2	+5V (sw)*
3	0V
4	+10V
5	0V
6	+12V (sw)*
7	0V
8	+20V (sw)*
9	0V
10	+20V
11	0V
12	-12V
13	0V
14	-30V (sw)*
15	0V, Spare
16	Tuner monitor output (DC)
17	0V, Spare
18	AGC voltage Output
19	Sidetone input
20	AF line output
21	AF line output
22	Loudspeaker output
23	Loudspeaker output
24	Frequency Reference "in lock"
25	-
26	0V
27	F1B output (6-0-6V)
28	-
29	0V
30	-
31	-
32	-
33	-
34	-
35	-
36	-
37	-

* In standby these supplies are off: the other supplies remain on.

Table 2.3 Connector SK5 Details

SK5 Pin No.	Function R500N
1	(+) Return Data
2	(-) Return Data
3	Not Used
4	Earth
5	Not Used
6	(-) Forward Data
7	(+) Forward Data

2.4 CONNECTION DETAILS

2.4.1 External Cables - General

Connections to 37-pin 'D' connector PL1 are made via the mating free socket SK1 supplied (RRS Nos body C12899, hood and locking lever 153-003). Connections are listed in table 2.1 and in paras 2.4.6 - 2.4.14. The conductor size used with this socket should not exceed 16/0.2mm (16/0.008in) Use miniature overall screened cable as appropriate, according to the number of connections used.

It is recommended that connections to PL1 via SK1 are taken out to the final destination at a distribution terminal strip close to the receiver. A multicore overall screened cable can be used for all circuits except AF line which should be a separate screened pairs and F1B put which should be a single screened wire.

2.4.2 Mains Input

This is connected by a 3 pin free socket SK6 RRS No 510-650, live, neutral and earth: the cable should be 3 core PVC insulated and PVC sheathed. The conductor size should be 24/0.2mm. The supply should be from a double pole switched, single pole fused, isolator: recommended type Crabtree 2847QG, with 5A cartridge fuse to BS 1362. There may be an alternative requirement for Marine use or other supply systems without a neutral, for which two pole fusing is usually fitted.

2.4.3 Mains Voltage Adjustment and Fuses

Before mains is applied to the receiver check for correct voltage setting. Remove the receiver bottom cover and locate the mains voltage selector. The plug on this has an arrow which must be pointing to the nominal mains voltage: see Fig. 2.2.

Check for correct fuse ratings FS1 & FS2* on back panel:

200-250 or 100-125V cartridge fuse, 4.0A, Slowblow RRS number Y5968

Fuse dimensions are 20mm x 5mm (0.8in x 0.2in).

*The receiver is supplied with FS2 short circuited so that the neutral is not fused. If the supply does not have a neutral the link must be cut away.

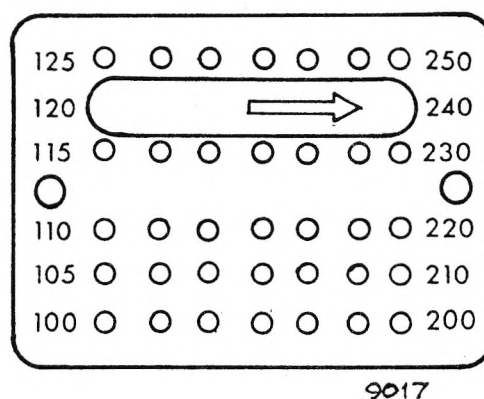


Fig. 2.2 Mains Voltage Selector

2.4.4 Main Receiver Earth

The main receiver earth is provided by means of a suitable braid or copper strip connected between the rear panel mounted earthing stud and a low resistance earth plane. This connection must be kept as short and as direct as possible; where practicable, the use of copper strip at least 30mm (1 1/4in) wide is recommended.

NOTE. When the receiver is installed with other equipment, e.g. transmitter(s), the receiver earth must be run separately from the other earth connections in order to avoid coupling RF interference into the receiver input circuits.

2.4.5 Aerial Input

The aerial feeder cable is connected to the receiver via a BNC coaxial plug which mates with socket SK3 on the rear panel. Note that BNC connectors are available in either 50 Ω or 75 Ω versions. If 50 Ω aerial feeder cable UR43 is used in the installation then use the 50 Ω plug supplied as standard (Rediffusion - 142-001). For 75 Ω feeder cable UR39, use 75 Ω plug type GE37571C7 which is available as an option (this plug will mate with the 50 Ω socket fitted to the receiver). Instructions for fitting these plugs to the feeder cable are given in Appendix 1 to this chapter.

When connecting the aerial to the receiver take care to locate SK3 correctly: the 1MHz external reference socket SK4 is also a BNC.

2.4.6 Aerial Demuting

The receiver aerial muting relay is capable of fast operate & release times. Muting of 60dB is obtainable at 30MHz, increasing to 90dB at 1.5MHz: this can be further reinforced by use of the desensing facility (see para. 2.4.7).

The external demuting contacts* are connected between pins 17 and 18 of SK1 (pin 17 at 0V). Closing the contacts demutes the receiver, i.e. receiver operational. These contacts are required to pass a current of approx. 5mA, and may be either conventional normally-closed relay contacts or a saturated semiconductor switch having a saturation voltage not greater than 2V. Opening the contacts or the semiconductor switch mutes the receiver by open circuiting the aerial signal path and grounding the receiver input.

The muting relay is automatically operated in the presence of large unwanted aerial signals (above 20V emf) in order to protect the receiver front end circuits.

***NOTE.** If the external muting facility is not required, a link must be connected between pins 17 and 18 of SK1 in order to energise the muting relay; without this connection, the receiver will remain muted. The protective muting circuit is still operational with this link connected.

2.4.7 Desensitising

The receiver may be desensitised (i.e. RF gain reduced) by the application of a positive DC voltage between pins 19 and 37 of SK1 (pin 19 at 0V). The voltage should not exceed +12V, from a source resistance of not more than 100 Ω . This will give desensitisation of up to 110dB, typically 126dB, with an attack time of less than 2mS.

2.4.8 External RF Gain Control

RF gain can be controlled by a voltage, varying between 0 and +9V, applied to SK1-pin 35 relative to 0V. The front panel control should be fully anti-clockwise.

2.4.9 Receiver Ready Output

An open collector active low is present at PL1 pin 6 on completion of a channel change, provided that the synthesiser is in lock.

2.4.10 AGC Output

The receiver AGC line is brought out to pin 18 of SK2. This can be used for monitoring or other purposes. The mating free plug PL2 is 37 way RRS P10142, hood with locking lever 153-003.

2.4.11 AF Outputs

These are as follows:

- (a) Line output: +10dBm (max.) 600 Ω floating, with centre - tap.
Connect the line to pins 30 and 31 of SK1 and the cable screen to pin 29.
- (b) Internal loudspeaker: this output can be switched off by the loudspeaker pushbutton switch, or is automatically switched off when a headphone plug is inserted into the jack.
- (c) External loudspeaker: impedance to be 8 Ω and to be connected between pins 32 and 33 of SK1 (pins 33 at 0V). It is not switched by the loudspeaker button.
- (d) Local headphones: 3mW, 600 Ω .
Connect to pins 11 and 12 of SK1 (pin 11 at 0V).

The level of b, c, d and e outputs can be adjusted by the AF gain control.

- (e) External headphones - 1mW, 600 Ω .
Connect to pins 11 and 12 of SK1 (pin 11 at 0V).
- (f) External monitor, for Remote Control only.
Connect to pins 13 and 14 of SK1 (pin 13 at 0V).

2.4.12 AF Sidetone Input

Provision is made for amplification of sidetone from an associated transmitter: this input is connected between pins 15 and 16 on SK1 (pin 15 at 0V)

2.4.13 External Master Reference Frequency

The internal reference oscillator (in module B12) gives a frequency within 5×10^{-8} in the temperature range -10°C to $+55^{\circ}\text{C}$. If a higher stability is required an external frequency standard at 1MHz can be used. The input is at coaxial SK4: the connector is 50 Ω BNC plug type Rediffusion - 142-P001). The signal level required is 0dBm into 50 Ω .

To select the external reference the selector switch S1 at the back of the receiver must be set to the EXT. position.

2.4.14 FIB Mode

If option 01 has been supplied, i.e. module 13 is fitted, the output can be connected directly to a teleprinter accepting 6-0-6V as input: the connection is to pins 4 and 1 (0V) on SK1. A single core screened lead is required, with screen connected to pin 1.

2.5 REMOTE CONTROL

Remote control of the R500N is available. A front panel local/remote switch is fitted, together with all the necessary wiring to socket SK5 on the rear panel. It is essential when using remote control that the same signalling speed (baud rate) is used throughout the system. See para 2.6.2.

Remote signalling is by means of serial data, with forward and return data being sent via separate twisted pairs (differential data). Remote control connections are made via the 7 pole DIN socket SK5 on the rear panel of the equipment. Pin connection details are given in table 2.3. The mating connector is Free 7 way DIN plug PL5, RRS No 144-001. Use separate 2 core overall screened cable for forward and return data paths. Cable type 16-2-2C to DEFSTAN 61-12 (part 5). A suitable cable for this application would be RRS ref C194.

2.6 OPERATIONAL SWITCH SETTINGS

2.6.1 Auto Interrogate Time Setting

Normally the display shows the working status of the Receiver and USE meaning IN USE: when the display is changed for a new command it remains in this state for a fixed time after last key operation and then reverts to the IN USE status. This is called "Auto - interrogate" and the actual time period can be set by means of links LK4 in the Processor module (A4) see fig. 2.5. There are four links a, b, c & d, left to right which can be fitted in one of two positions. In the following table '1' is the upper position and '0' is the lower position. The receiver is normally shipped with 40S selected.

Table 2.4 Link LK4 Settings

Time Seconds	Link Positions a b c d				Time Seconds	Link Positions a b c d			
0.15	0	0	0	0	40	0	1	0	0
0.3	0	0	1	0	80	0	1	1	0
0.6	0	0	0	1	160	0	1	0	1
1.25	0	0	1	1	320	0	1	1	1
2.5	1	0	0	0	640	1	1	0	0
5.0	1	0	1	0	1280	1	1	1	0
10	1	0	0	1	2560	1	1	0	1
20	1	0	1	1	5120	1	1	1	1

Only those settings close to 40 seconds are likely to be required.

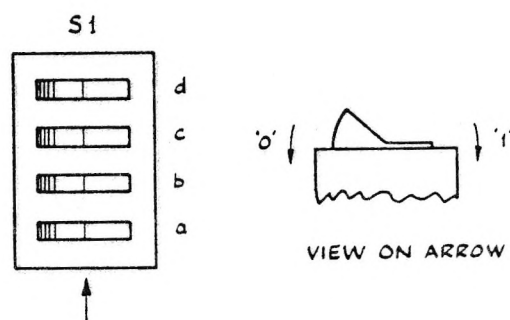
2.6.2 Baud Rate Setting

The remote control system signalling speed (Baud rate) must be the same at every equipment in a system. If this is not the case, communication between the various units will be impossible. The setting is made at switch S1 on the Processor PEC module A4 as follows:-

- (1) Disconnect the mains supply from the equipment by unplugging the mains lead from the rear panel mounted plug/filter PL6.
- (2) Refer to para 6.9. Hinge the front panel down as detailed in para 6.9(1) and (2). Do not disconnect any of the connectors on the board. Check that LK5 is in the 'R' position, as shown in fig 2.5.
- (3) Baud rate setting is carried out at the 4 bank miniature rocker switch S1, shown on fig 2.5. Switch settings are as detailed in Table 2.5 below (see diagram below table).
- (4) After setting, temporarily restore the mains supply.
- (5) Press the TST key followed by the 3 key to display the operating baud rate on the frequency digit display.
- (6) Remove the mains supply by unplugging the mains lead from PL6.
- (7) Hinge the front panel back into place and replace the fixing screws. Refit the top and bottom covers of the equipment.
- (8) Restore the mains supply.

Table 2.5 Switch S1 Settings

Nominal Baud Rate	S1 Switch Settings			
	d	c	b	a
50	0	0	0	0
75	0	0	1	0
110	0	0	0	1
134.5	0	0	1	1
150	1	0	0	0
300	1	0	1	0
600	1	0	0	1
1200	1	0	1	1
1800	0	1	0	0
2000	0	1	1	0
2400	0	1	0	1
3600	0	1	1	1
4800	1	1	0	0
7200	1	1	1	0
9600	1	1	0	1



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2.7 INSTALLATION TESTING

- (1) Connect the mains and switch on the supply isolator. The MAINS LED should be lit.
- (2) Switch the receiver to ON, AGC to ON and Fast, press MEM, USE. Check that the loudspeaker switch is set to ON.
- (3) Observe that there is some indication on the display.

Refer to Operating Procedures in Chapter 3

- (4) With the USE procedure Para 3.3.3, set the receiver Frequency and Service to those of a known station: check that the displays show as described. Turn up the AF and RF gains: the station should be received. If there is no signal and MUTED appears on the Service display this may be due to an associated Transmitter Transmit/Receive relay being at Transmit (See Note 1): check for this.
- (5) Find out the frequencies and services of channels to be preset. Enter the data for these using the "Memorise" procedure para 3.3.5, but for these tests choose stations such that all Modes and Bandwidths are used. (If necessary, reset later those not required operationally). Write down the Frequency and Service for each channel preset. Include F1B only if this is provided, i.e., Module 13 fitted.
- (6) Select any one of the preset channels on which a transmission can be expected and set the receiver to this by the USE procedure para 3.3.2. Check that the displays indicate as described and that a satisfactory signal is received. Repeat this on as many channels as possible.
- (7) On SSB stations use the UP/DOWN buttons to clarify the speech, checking that the displayed frequency does change 10Hz per push. On an A1A station check that the BFO control is giving a variation of test note between $\pm 3000\text{Hz}$.
- (8) Check the "Interrogate" procedure para 3.3.4 on the preset channels.
- (9) Check the AGC by changing from a weak signal to a strong signal: the output should change by less than 2:1.
- (10) Plug headphones into the PHONES jack on the front panel and check that they are working and that the loudspeaker goes off.
- (11) Check bandwidths by noting that a reduction in intelligibility occurs with each reduction in bandwidth on an AM broadcast station.
- (12) Check that any connected external circuits are working, i.e., AF line output, external phone output, sidetone input, external RF gain, desense input. The AF line output level is adjustable by R94 on the BFO/CIO/AF module (10).

Note:

If there is not an associated transmitter have pins 17 and 18 of SK1 been linked?

- (13) If a remote control is installed, set the R500N to remote and confirm that operation is possible from the remote control unit.

3 OPERATING INSTRUCTIONS

3.1 CONTROL & DISPLAY DESCRIPTIONS

Fig. 3.1 R500N Front Panel

- 3.1.1 Introduction
- 3.1.2 Pushbuttons
- 3.1.3 Keypad
- 3.1.4 Displays
- 3.1.5 Rotary Controls

3.2 CHANNEL PROTECTION

3.3 OPERATING PROCEDURES

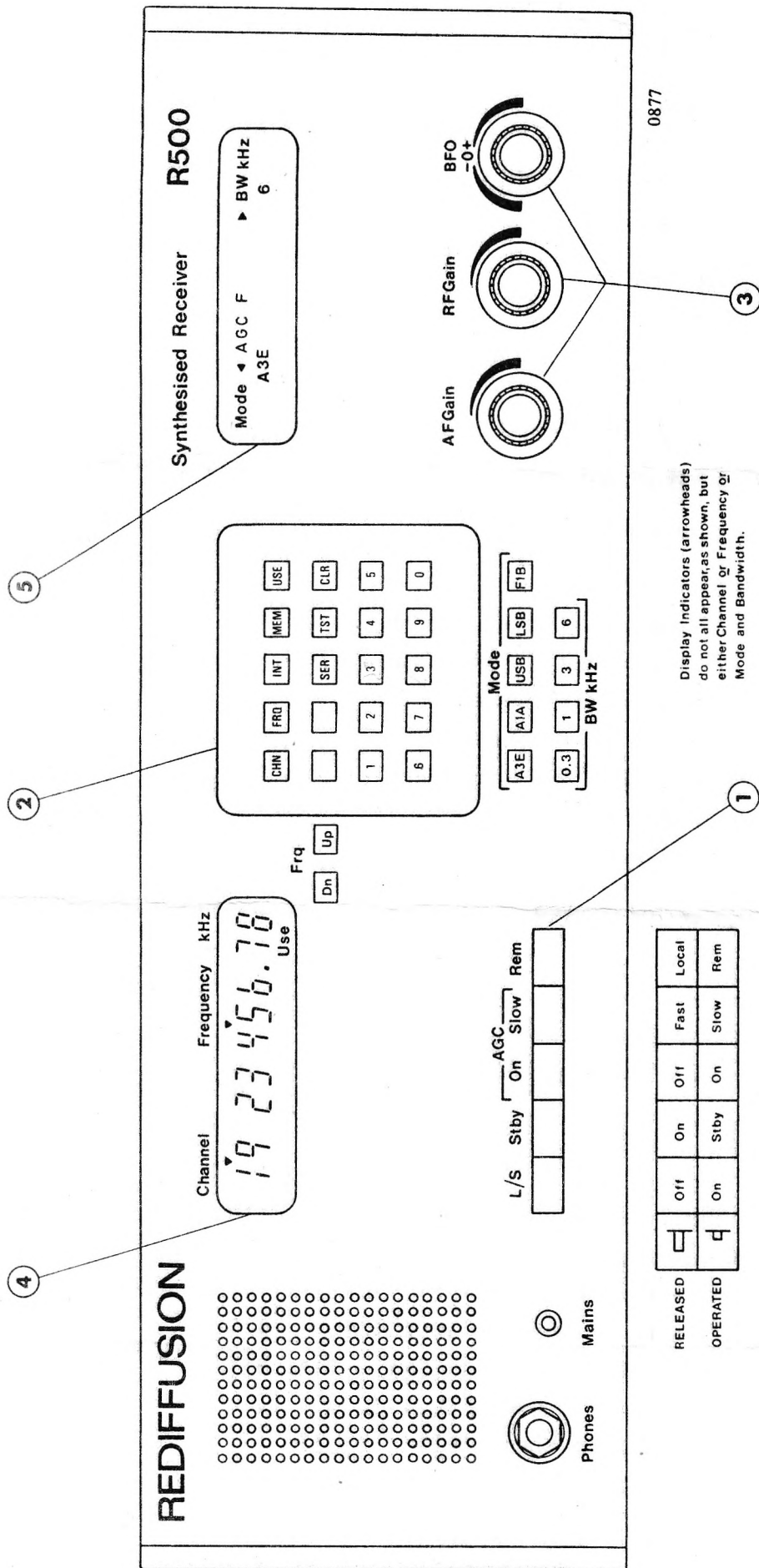
- 3.3.1 Preliminary Instructions
- 3.3.2 USE Procedure on Preset Channels
- 3.3.3 USE Procedure not on Preset Channels
- 3.3.4 Interrogate (INT) Procedure
- 3.3.5 Memorise (MEM) Procedure
- 3.3.6 Memorise into a vacant channel
- 3.3.7 Minimising Phase Noise
- 3.3.8 Remote Control Operation

3.4 USE OF OTHER CONTROLS

- 3.4.1 Clarifying
- 3.4.2 AF Gain Control
- 3.4.3 AF Gain Control and AGC
- 3.4.4 RF Gain Control and AGC

3.5 RECEPTION MODES

- 3.5.1 Reception of CW (A1A)
- 3.5.2 Reception of CW in the Presence of Adjacent Channel Interference
- 3.5.3 Reception of DSB signals (A3E) and Compatible AM (H3E)
- 3.5.4 Reception of AM in the Presence of Heavy Interference
- 3.5.5 Reception of MCW signals (A2A, H2A)
- 3.5.6 Reception of SSB Suppressed Carrier (J2A, J3E)
or SSB Reduced Carrier (R2A, R3E)
- 3.5.7 Reception of FSK Signals (F1B)



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WARNING

IT IS IMPORTANT TO NOTE THAT THE FRONT PANEL STANBY/ON PUSH BUTTON SWITCH DOES NOT DISCONNECT THE MAINS SUPPLY FROM THE UNIT.

TO REMOVE THE MAINS VOLTAGE FROM THE UNIT THE SUPPLY LEAD MUST BE UNPLUGGED FROM THE REAR PANEL OF THE UNIT, OR THE EXTERNAL ISOLATOR SWITCH OPERATED.

RELEASED	☐	Off	On	Off	Fast	Local
OPERATED	☐	On	Stby	On	Slow	Rem

FIG. 3.1

R500N FRONT PANEL

3 OPERATING INSTRUCTIONS

3.1 CONTROL AND DISPLAYS DESCRIPTION

See Figure 3.1 Front Panel.

3.1.1 Introduction

All operator procedures are carried out using a row of five pushbutton switches (1) on the keyboard (2) and three rotary controls (3). There are two displays, channel/frequency (4) on the left and service (5) divided into mode, AGC and bandwidth, on the right. Also on the front panel is a loudspeaker, phone jack and a mains LED indicator. There is no mains switch.

3.1.2 Pushbuttons

The five pushbuttons are push to operate and latch, push to release switches. From left to right these are:

Loudspeaker (L/S)

This switch is depressed to switch on the front panel loudspeaker.

Standby (Stby)

This switch is depressed to set the equipment to standby. In this condition there are no images on the displays and the keyboard is inoperative, but the reference oscillator supply is maintained; this reduces equipment warm up time and ensures that the optimum frequency accuracy and stability are rapidly achieved when the pushbutton is set to ON. When set to ON the left hand display shows the channel and frequency last in use and the word USE, while the right hand display shows the mode, AGC and bandwidth employed. The word MUTED is displayed for about thirty seconds, after which the receiver is operational on the parameters displayed.

AGC On

This switch is depressed to set the AGC ON and released to set the AGC OFF. The switch position must be "memorised" to become an effective change.

AGC Slow

This switch is depressed to set the AGC to slow and released to set the AGC to fast. The switch position must be "memorised" to become an effective change.

Remote (Rem)

This switch remains in the released position for local control and is depressed to transfer control of the receiver to a remote control device.

NOTE.

The remote button must not be depressed when operating locally since the local control is rendered inoperative.

3.1.3 Keypad

The keypad is used to set up the operating parameters of the unit. The keys are in three main groups: Prefix, Numeric and Command. Prefix keys determine the function which accepts the numeral(s) which are keyed in afterwards. The Command keys determine how the receiver circuits, memories and displays will respond.

Prefix Keys

Channel (CHN)

Pressed before a channel number (1-63) is keyed. Lights arrowhead indication display and sets display to '0'.

Frequency (FRQ)

Pressed before the frequency digits are keyed. Lights arrowhead indicator on display and sets display to '0'.

Service (SER)

Pressed before the corresponding numerals for the required service (mode and bandwidth) are keyed. Lights arrowhead indication display. A guide to the mode and bandwidth numerals is printed below the keyboard.

Numeric Keys

The numeric keys 0-9 are operated in succession for channel and frequency setting. Numbers appear on the right and move to the left at each successive keying. The display will stop at the correct position if too many digits are keyed in error, and will not overflow.

Command Keys

USE

Pressing this key puts the receiver into the operational state on the channel, frequency and service shown on the displays. USE is shown on the frequency display.

Interrogate (INT)

Keying a channel number and then INT causes the frequency and service stored in the channel selected to be displayed: the receiver continues to operate as last set up in USE, but INT is shown on the frequency display. When INT is displayed, each subsequent press of INT will increment the channel number and display its contents. In the absence of a new command, the receiver will revert to a display of channel in use after about 40 seconds.

Memorise (MEM)

Keying a channel number, selecting frequency, service, agc and then pressing MEM causes the displayed parameters to be stored in the channel selected. The receiver continues to operate as last set up on USE, but MEM is shown on the frequency display. After about 40 seconds the receiver will revert to a display of channel in use.

Clear (CLR)

If an incorrect numeral is keyed during frequency entry pressing the CLR key moves the display to the right, which cancels the most recent entry, allowing corrections to be made. This backspace facility may be used as many times as required.

Up and Down (DN)

When the receiver is in USE the frequency may be increased (UP) or decreased (DN) by the use of these keys as follows:

- (1) If pressed and released immediately will alter the frequency by one 10Hz step.
- (2) If pressed and held they will increase or decrease the frequency in 10Hz steps. Commencing slowly, the rate of change increases after 5 seconds to a maximum of 425Hz per second. The frequency will continue to change at this rate until the key is released.

Note: Operation of the UP or DN keys will cause the channel number to change to '0'. The keys should not both be pressed at the same time.

Test (TST)

- TST 1 Display shows all 8's and all legends
TST 2 Display shows Tuner Corrections see para. 7.6
TST 3 Display shows Baud rate
TST 4 Displayed 0 Normal (Not Muted)
number means:- 1 External Mute
 2 Synthesiser Out-of-lock
 3 External Reference Frequency Out-of-lock
TST 5 Display shows Auxiliary number of channel in use.

3.1.4 Displays

The two liquid crystal displays are back lit by electroluminescent panels. The displays respond to keypad operation and indicate the parameters selected.

Channel/Frequency Display

This display indicates a two digit channel number and a seven digit frequency readout. A decimal point denotes the frequency in kHz and the least significant digit is 10Hz. Arrow-head indicators show which prefix (CHN or FRQ) has been selected, and hence the position in which keyed numerals will appear. This display also includes the command word (INT, MEM or USE) indicating the current status of the displays.

Service Display

This display indicates the selected service mode, i.e., A3E, A1A, LSB, USB or F1B and the selected bandwidth. Arrowhead indicators shown when service is selected. When AGC is selected on the front panel pushbutton, AGC is displayed and the letter F (fast) or S (slow) is displayed to indicate the AGC speed. The display also includes a MUTED legend.

Muted Display

The MUTED legend can appear for one of five reasons:

- (1) When the receiver is initially switched on, set to on from standby, or reference changed from INT to EXT.
- (2) When an external mute is applied (Rx/Tx relay in transmitter - driver in Transmit state).
- (3) Excessive voltage at aerial input.
- (4) Tuning motors in built-in tuner running.
- (5) Synthesiser out-of-lock.

If the muted legend remains for more than about two seconds there is a fault condition, unless at first switch on or when the ref (INT/EXT) is changed, which will take 15-30 seconds to "lock" and hence extinguish the MUTED legend.

3.1.5 Rotary Controls

AF Gain

This controls the output to internal and external speakers, internal and external phones, but not line output or remote monitor. When AGC is switched on the audio output is maintained within 6dB for input signal variations of up to 100dB. It is therefore possible to set the AF gain control to a suitable listening level and then leave it at this level.

RF Gain

This controls the level of the output from the IF stages, and hence the input to the AF stages, if the AGC is switched off. Under most reception conditions optimum performance is achieved with the RF gain control set at maximum and the AGC set on.

BFO

When A1A (CW) operation is selected the BFO is automatically switched into circuit. The control is adjusted after centering the signal in the receiver pass band and gives a $\pm 3\text{kHz}$ variation.

3.2 CHANNEL PROTECTION

A facility is incorporated by which either channels 1 to 10 or all channels 1 to 63 can be protected. When protected, data stored in these channels cannot be overwritten. This facility is brought into operation by means of links on the processor board (module A4). If new data is to be entered into a protected channel carry out the following procedure.

- (1) Disconnect the mains supply to the receiver.
- (2) Hinge down the front panel for access to the processor PEC as detailed below.
- (3) Fit links 3A and 2B in position '1' (free)
- (4) Refit the front panel temporarily and re-connect the mains supply.
- (5) The channel data to be protected is stored using the procedures described in Paras. 3.3.5 and 3.3.6.
- (6) Disconnect the mains supply and hinge down the front panel.
- (7) To protect channels 1 to 10 only, fit link 3A in position '0' (protected). To protect all stored channels 1 to 63 fit link 2B in position '0' (protected).
- (8) Refit the front panel and re-connect the mains supply.
- (9) Use the interrogate procedure Para. 3.3.4 to confirm that channel data has been correctly entered into memory.

Access to Processor PEC

To alter links on the processor PEC it is necessary to hinge down the front panel, thus exposing the front face of the processor. Carry out the following procedure.

- (1) Disconnect the mains supply to the receiver.
- (2) Remove four M5 screws fixing receiver to cabinet.

- (3) Withdraw the receiver on its runners to their full extent.
- (4) Remove the top cover by removing four M3 screws.
- (5) Remove the bottom cover by releasing the Dzus fasteners (1/2 turn anticlockwise).
- (6) Remove the four M4 front panel fixing screws; there are two each side as shown in Fig. 6.1.
- (7) Ease the front panel forward approximately 6mm (1/4 in) and hinge the panel down on the pivot screws.
- (8) Refit in reverse order, ensure that front panel is pressed home to align M4 screw holes.
- (9) Re-connect the mains supply to the receiver.

3.3 OPERATING PROCEDURES

3.3.1 Preliminary Instructions

- (1) Check that the 'Mains' LED is illuminated, indicating the presence of mains supply.
- (2) Check that the 'REM' push button is released, for local control of the receiver.
- (3) Release the 'Stby' pushbutton to switch the receiver on. The unit may be muted for up to one minute following the application of the mains or when switching from standby to on. The muted legend in the mode display will show during this period.
- (4) The displays now show the channel number, frequency and service last in use, and the USE command word is indicated on the channel/frequency display. This applies when mains is applied or when switching on from standby.
- (5) Set loudspeaker (L/S) pushbutton on or off as required.
- (6) Set gain controls and BFO control as required.
- (7) The displays normally show USE, together with the present status of the receiver. The only exceptions are during the memorise or interrogate procedures, or following operation of the CLR (clear) key.

There are separate procedures for each command with two variations for USE. Note that INT (Interrogate) and USE (Preset Channel) assume that some if not all channels have been preset (data entered) using the MEM (memorise) procedure.

3.3.2 USE Procedure on preset channels

This procedure is used to operate the receiver on a previously stored channel.

<u>Action</u>	<u>Display</u>
(1) Press CHN	The channel display goes to '0'. The channel indicator appears.

- | | |
|---|---|
| | The command word (USE, INT, MEM) and the service indicators go off. |
| (2) Press numeral for 1st digit of channel No. | Numeral appears at right of channel window. |
| (3) Press numeral for 2nd digit of channel No. if required. | 1st digit moves to the left and 2nd digit appears at right. |
| (4) Press USE | The frequency digits, mode code, AGC (F or S) and BW numeral are called from store and displayed. The channel indicator remains. The USE command word appears. The Muted legend appears on the service display while the tuning motors are running and then goes off. |

The receiver is now operational on the frequency and service shown on the display, which were preset and stored for the channel selected.

Note: If any of the stored parameters are altered as detailed below the channel number will go to '0'.

Fine Tuning: press the UP/DN keys.

Mode or BW: press the SER key once, the mode and bandwidth numbers can now be altered.

AGC: press AGC ON and AGC Slow pushbuttons as required, then press USE.

Note: Equipments to software Programme No 91/21300/2 respond to AGC alterations as follows:

Press AGC ON and AGC F/S pushbuttons as required, then press MEM and USE. The receiver memory and display will update to the reset AGC and will then be operational on the channel preset.

3.3.3 USE Procedure not on preset channels

This procedure is used to operate the receiver on a frequency and service not stored in a preset channel.

<u>Action</u>	<u>Display</u>
(1) Press FRQ	The channel number does not change. Frequency display goes to '0'. Frequency indicator appears. Command word goes off (USE, INT, MEM). Service indicators go off.
(2) Press numerals for frequency, starting with most significant digit.	Numerals appear on the frequency display, starting at the right hand end and moving to the left.

- | | | |
|-----|--|---|
| (3) | Press SER | The service indicators appear.
The frequency indicator goes off. |
| (4) | Press numeral for mode number | The mode code appears. |
| (5) | Press numeral for the BW number | The bandwidth in kHz appears. |
| (6) | Press pushbuttons for AGC ON/OFF and AGC FAST/SLOW | |
| (7) | Press USE | The AGC and F/S display appears or alters.
The channel display goes to '0'.
USE appears on the display.
The MUTED legend appears on the service display while the tuning motors are running and then goes off. |

The receiver is now operating on the frequency and service shown on the displays. If necessary use the UP/DN keys for fine tuning. The receiver is in use but not on a channel.

3.3.4 Interrogate (INT) Procedure

The channel memory may be interrogated and the stored contents of any channel displayed. If the receiver is already in use, it will continue to operate on the last selected channel, although the displays will no longer be relevant to the operating parameters.

- | <u>Action</u> | <u>Display</u> |
|--|--|
| (1) Press CHN | The channel display goes to '0'.
The channel indicator appears.
The command word (USE, INT, MEM) and the service indicators go off. |
| (2) Press numeral for 1st digit of channel No. | Numeral appears at right of channel window. |
| (3) Press numeral for 2nd digit of channel No. | 1st digit moves to the left and 2nd digit appears at right. |
| (4) Press INT | The frequency digits, mode code, AGC (F or S) and BW numeral for the channel are called from store and displayed.
The INT command word appears.
The displays remain in this state for the duration of the auto interrogate time (about 40 secs) after which they revert to the operating status.
The INT command word is replaced by USE. |

Notes:

- (1) During the auto interrogate time, while the INT command word is still displayed, the INT key may be pressed again. The channel number will increment by 1 and the frequency and service stored in the next channel will be displayed. The INT key can be pressed as many times as required up to channel 63.
- (2) If the INT key is pressed while the channel display is at '0' the displays revert to the channel in use, and the USE command word appears on the channel/frequency display.
- (3) If the USE key is pressed while a channel is being interrogated (INT displayed) the INT command word will be replaced by the USE command word. The Muted legend appears on the service display while the tuning motor are running and then goes off. The receiver is now operational on the channel, frequency and service which were being interrogated.

3.3.5 Memorise (MEM) Procedure

This procedure is used to enter into memory, or change already memorised, frequency and service for a channel. If the receiver is in USE on a previously stored channel it will continue to operate on that channel, although the displays will no longer be relevant. This applies even if the channel in use is being changed. If the channel protection facility is already in use it is necessary to remove the protection before using the memorise procedure. Refer to Para. 3.2. Channel protection. If the memorise procedure is attempted with the channels protected the MEM command will not be displayed when the MEM key is pressed.

<u>Action</u>	<u>Display</u>
(1) Press CHN	The channel display goes to '0'. The channel indicator appears. The command word (USE, INT, MEM) and the service indicator go off.
(2) Press numeral for 1st digit of channel No.	Numeral appears at right of channel window.
(3) Press numeral for 2nd digit of channel No. if required	1st digit moves to the left and 2nd digit appears at right.
(4) Press FRQ	The channel indicator goes off. The frequency indicator appears. The frequency display goes to '0'.
(5) Press numerals for frequency, starting with most significant digit	Numerals appear on the frequency display, starting at the right hand end and moving to the left.
(6) Press SER	The service indicator appears. The frequency indicator goes off.
(7) Press numeral for mode number	The mode code appears.

- | | | |
|------|---|---|
| (8) | Press numeral for the
BW number | The bandwidth in kHz appears. |
| (9) | Press pushbuttons for AGC
ON/OFF and Slow/Fast | |
| (10) | Press MEM | The AGC, F/S display appears or alters and
the MEM command word appears. |

The channel selected and displayed is now entered into memory. The display will remain for the duration of the auto interrogate time (about 40 secs) and will then revert to a display of the channel in use. MEM will change to USE.

3.3.6 Memorise into a vacant channel

If it is required to enter frequency and service into a vacant channel do not key channel first; use para. 3.3.3 USE procedure not on a preset channel, items (1) to (6). Check display and press CHN and MEM. The processor will search for a vacant channel, the number of the channel found is displayed with the frequency and service selected and MEM command word appears. The displayed data has now been stored. If there is no vacant channel the channel display remains at '0' and the frequency and service are not stored. A vacant channel is defined by zero frequency or an invalid frequency digit. Channels can therefore be made vacant by using FRQ to clear the frequency display, followed by MEM.

3.3.7 Minimising Phase Noise

When possible, operate with the 10Hz digit at zero since lower synthesiser phase noise is present within 20Hz of the carrier in this condition. There should be little noticeable difference on speech circuits.

The improvement in phase noise is mainly beneficial to users having both ends of the link under their control and a narrow band system is in use, e.g., Piccolo.

3.3.8 Remote Control Operation

- (1) Check that the remote control mains lamp is lit, indicating the presence of mains supply.
- (2) Check that the R500N receiver 'Mains' LED is lit indicating the presence of mains supply.
- (3) Set the R500N front panel as follows:

Local/remote	set to Remote
Standby/On	set to On
L/S	set to Off
AF Gain	set to minimum
RF Gain	set to maximum
AGC Off/On	set to On
AGC Fast/Slow	set as required
- (4) Carry out remote control operating procedure and confirm that the R500N is responding.

3.4 USE OF OTHER CONTROLS

3.4.1 Clarifying

There is no SSB speech clarifier control as such; clarification is obtained by using the UP/DOWN frequency buttons.

3.4.2 AF Gain Control

This controls the audio output of the internal and external speakers, internal and external phones, but not line output or remote monitor.

3.4.3 AF Gain Control and AGC

The automatic gain control (AGC) circuits maintain the audio output variations to within 6 dB for input signal variations of up to 100 dB. It is therefore possible to set the AF gain control for a suitable listening level and then leave it at this setting.

3.4.4 RF Gain Control and AGC

NOTE 1 Alterations to the AGC pushbuttons only become effective after pressing MEM and USE.

NOTE 2 AGC cannot be altered on a protected channel. If it is necessary to change the AGC, first shift the operating parameters to channel 0 (press CHN and '0').

When AGC is switched on, the output from the 1.4 MHz IF stages, and hence the input to the audio stages is maintained at the ideal level for these stages. If the AGC is switched off and level adjustments made by use of the RF gain control, the output from the IF stages may be set too high, thus introducing distortion. Conversely, if the level is set too low, the signal/noise ratio will be degraded. Use of the AGC ensures optimum performance under most reception conditions, and operators wishing to use the receiver with the minimum of adjustment should simply set the AGC switch to FAST and the RF gain control fully clockwise.

However, under certain conditions it may be advantageous to vary the RF gain control and the AGC switch settings. Some of these conditions are detailed below.

AGC is normally switched off only when the received signal is accompanied by regular bursts of interference which hold down the gain of the receiver. If the AGC is left on, the gain will take time to recover due to the AGC decay time. With the AGC switched off, intelligibility will be reduced only whilst the interference is present. When it is desired to operate the receiver without AGC, either method A or B below may be adopted.

Note:

A 10 V DC voltmeter may be connected via a rear panel connection at 1SK2 pin 18, using the mating plug. The meter can be used to monitor the AGC control line; where a slight decrease in audio level is mentioned a slight increase in AGC voltage should be observed.

METHOD A

- (i) With the AGC switched on, turn the RF gain control fully clockwise and adjust the AF gain control for the required audio output level.

- (ii) Switch off the AGC and adjust the RF gain control to obtain the same audio output level as before.

METHOD B

- (i) With the AGC switched on, turn the RF gain control fully clockwise, and adjust the AF gain control for the required audio output level.
- (ii) Turn the RF gain control anticlockwise until the audio level decreases slightly. A condition has been reached where the voltage placed on the AGC line by the RF gain control has just overridden the AGC voltage.
- (iii) The receiver is still operating under optimum conditions and the AGC can now be switched off.

A method of setting the AGC and RF gain controls which may be beneficial when receiving signals of good strength is given in C below.

METHOD C

- (i) With the AGC switch set to FAST, turn the RF gain control fully clockwise and adjust the AF gain control for the required audio output level.
- (ii) Turn the RF gain control anticlockwise until the audio level decreases slightly and then turn it clockwise through about 45° (1/8th turn).
- (iii) The receiver is now operating with the AGC on, and will accommodate a drop in signal level, due to fading, of about 30dB. At the same time, full AGC is available to allow for increase in signal strength. This method of operation (alteration of AGC threshold) ensures that noise is not troublesome during gaps in transmission.

The receiver AGC system is able to compensate for increasing signal levels within 10mS (attack time). Hence AGC can be used on CW or SSB services without audio "thump" accompanying each character or word. In the SLOW position of the AGC switch, the decay time is between 1-4 seconds on these services. Thus in the intervals between characters or words the receiver gain will not change appreciably, and noise will not be troublesome during these intervals. In the absence of rapid fading of the signal, or bad impulse noise, it is therefore advantageous to set the AGC switch to SLOW when receiving CW or SSB signals.

The AGC should keep the audio output virtually constant, so if fading is experienced this will be due to the AGC decay time exceeding the fade period. In this case, the AGC switch should be set to FAST.

- (iv) The RF gain control must be set to a compromise position which allows clipping of the interference spikes without distortion of the wanted signal.
- (v) Finally re-adjust the AF gain control if necessary.

When working on CW, most transmitters emit a certain amount of carrier in the key-up condition. If the receiver AGC were allowed to decay rapidly during the key-up period, the carrier leak would be received at virtually the same level as the key-down carrier level; communication would then be impossible. This effect can be largely eliminated by setting the AGC switch to SLOW, with the RF gain control fully clockwise. However, for improved reception the method detailed in C above should be employed.

The settings of the RF gain control and AGC switch under various operating conditions are summarised in Table 3.1.

Table 3.1 Summary of Control Settings

Reception mode	Reception conditions	AGC switch position	RF gain control setting
A3E H3E	Good signal with slow fading	SLOW	Fully clockwise
A3E H3E	Heavy impulse noise interference	FAST	Adjust as detailed in method B above
A2A H2A	Good signal with rapid fading	FAST	Fully clockwise
A2A H2A	Heavy impulse noise interference	FAST or OFF	Adjust as detailed in method B above Adjust as detailed in method B. If reception is impossible try to receive on SSB or CW positions
J3E A1A	Good signal with slow fading	SLOW	Adjust as detailed in method C above
	Good signal with rapid fading	FAST	Adjust as detailed in method C above
	Good signal with deep fading	FAST	Fully clockwise
	Heavy impulse noise interference	OFF	Adjust as detailed in method B

3.5 RECEPTION MODES/BANDWIDTHS

3.5.1 Reception of CW (A1A)

When CW operation is selected, the BFO is automatically switched into circuit. Before adjusting the BFO however, the CW signal must first be centred in the receiver passband.

- (i) Select CW operation, with either 1kHz or 0.3kHz bandwidth.
- (ii) Set the receiver to the expected frequency.
- (iii) Use the UP/DOWN buttons to centre, if necessary, as the bandwidth is reduced.
- (iv) Adjust the BFO control for the desired audio frequency output from the receiver.

The 6kHz and 3kHz bandwidths are useful for searching. The wider bandwidths may also be employed during "netting" or listening on a calling channel when poor frequency stability of

other stations is experienced. Usually, however, once the signal has been tuned in, the bandwidth can be narrowed to 1kHz or 0.3kHz. Provided that the transmitter frequency is sufficiently stable, the inherent frequency stability of the receiver will normally permit the continuous use of the 0.3kHz bandwidth. This ensures better rejection of unwanted signals and improved signal-to-noise ratio.

3.5.2 Reception of CW in the presence of Adjacent Channel Interference

Use of the 0.3kHz bandwidth will reduce the interference from an adjacent channel provided that it is more than 150Hz off tune. A further remedy is to adjust the BFO control to produce a zero audio beat note with the interfering signal. The resultant audio output frequency will be the difference frequency between the wanted and unwanted signals.

3.5.3 Reception of DSB Signals (A3E) and Compatible AM (H3E)

Select AM (A3E mode) with the widest bandwidth possible. The accuracy of tuning required for DSB reception is not great, and once the frequency has been set up fine tuning is not normally necessary.

For reception of speech or music, the 6kHz bandwidth should normally be used, and this should be reduced only if interference is present. Use of the 3kHz bandwidth is justifiable only in conditions of severe interference, since this gives an audio bandwidth of only 1.5kHz - not particularly good for speech and useless for reception of music (see also para. 3.5.4 below).

However, the 3kHz bandwidth can be employed for the reception of compatible AM signals, which use full carrier and one sideband. In this case the receiver can be detuned to one edge of the passband, giving an audio bandwidth of almost 2.7kHz.

3.5.4 Reception of AM in the presence of Heavy Interference

When heavy adjacent channel interference is present, or bad selective fading occurs, better reception may sometimes be obtained by receiving an incoming DSB signal as if it were SSB. Operation on USB or LSB may be selected, depending on which sideband gives the least interference.

In the SSB mode of reception the incoming carrier is removed, and replaced by a reconstituted carrier generated within the receiver. This is advantageous during selective fading, when fading of the incoming carrier without corresponding fading of the sidebands causes envelope distortion. This distortion is not apparent on SSB reception because (i) the incoming carrier is replaced by a constant, high stability signal and (ii) a product detector is used in place of the envelope detector.

In the case of adjacent channel interference assume for example, that a DSB station 6kHz away is breaking through into the wanted passband. An envelope detector will demodulate the sidebands of the unwanted signal to produce unwanted audio information which will be superimposed on the wanted audio. However, if the wanted DSB signal is being received on SSB, the unwanted signal will be demodulated by the product detector to give a nominal 6kHz tone, which is far less obtrusive. Furthermore, if headphones are used for monitoring, this unwanted frequency may be attenuated by the inherent frequency response of the headphones.

3.5.5 Reception of MCW Signals (A2A, H2A)

Select AM (A3E mode). The 3kHz bandwidth should normally be selected for MCW reception. However this may be reduced to 1kHz if the modulation frequency is below 500Hz.

3.5.6 Reception of SSB Suppressed Carrier (J2A, J3E) or SSB Reduced Carrier (R2A, R3E)

On SSB services (USB or LSB mode) the preferred IF filter is 3kHz.

Set the receiver to the expected carrier frequency. Note that there is no incoming signal at this frequency, the carrier being suppressed at the transmitter. By use of the UP/DOWN buttons speech can be clarified to the nearest 10Hz. J2A can be received in this mode.

3.5.7 Reception of FSK Signals (F1B)

When receiving Frequency Shift Keyed (F1B) signals the receiver output is required to be in the form of a series of DC pulses (6-0-6V) suitable for direct driving of a teleprinter. The F1B Module (13) provides this by conversion from a narrow band audio signal centred on 1700Hz: the bandwidth (0.3kHz) and carrier insertion frequency are set automatically when F1B is selected.

Select F1B mode and set the receiver to the assigned frequency of the station required.

4 FUNCTIONAL DESCRIPTIONS

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- 4.1.1 Associated Handbook
- 4.1.2 Identification of Modules
- 4.1.3 Identification of Components
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4.4 MOTOR CONTROL - MODULE 8

Fig. 4.4 Motor Control Block Diagram

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Fig. 4.5 IF Module Block Diagram

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- 4.6 BFO/CIO/AF MODULE - A10
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 - Fig. 4.10 FIB Receive Module Block Diagram

4 FUNCTIONAL DESCRIPTIONS

4.1 INTRODUCTION

4.1.1 Associated Handbook

These descriptions are illustrated with block diagrams. For circuit diagrams and more detailed descriptions, the Repair Manual (H/B No. 1209-1) is required.

4.1.2 Identification of Modules

Every module, usually a PEC, has a reference number; the Chassis, Front Panel and some other assemblies are included in the numbering system. For the 2000 series of equipments, identical common modules have the same number; modules which have the same name but differ in detail for a specific equipment have a prefix letter. For the R500N the modules are:

A1	Chassis
A1a	Decoupling PEC (part of A1)
A1b	Aerial Filter (part of A1)
A2	Front Panel
A3	Keypad/Display Module
A4	Processor Module
A5	Mixer Module
6	Power Supply Assembly
7	Tuner Assembly
8	Motor Control Module (marked Motor Drive on PEC)
A9	IF Module
A10	BFO/CIO/AF Module
11	Synthesiser Module
B12	Reference Frequency Module
A13	F1 Module (optional)

4.1.3 Identification of Components

Components in each module are numbered from 1 onwards, eg. R1, R2 etc. For complete identification the module number prefix should be added eg. A9R1 is R1 in the IF module. However, in the text, to make easier reading the prefix is omitted unless there is clearly a need to distinguish between two components of the same number. PEC markings also omit the prefix.

Marking of Connectors

The removable connectors of a module (part of the chassis wiring) have a module number prefix, SK or PL as appropriate, and the connector number, eg. the mating connector for 8 PL1 on module 8 is 8SK1. There are a few flying lead connections; in this case the connector is SKA or PLA of the module to which it is attached.

4.2 OVERALL DESCRIPTION

See block diagram Fig. 4.1.

Individual module descriptions follow on at Section 4.3.

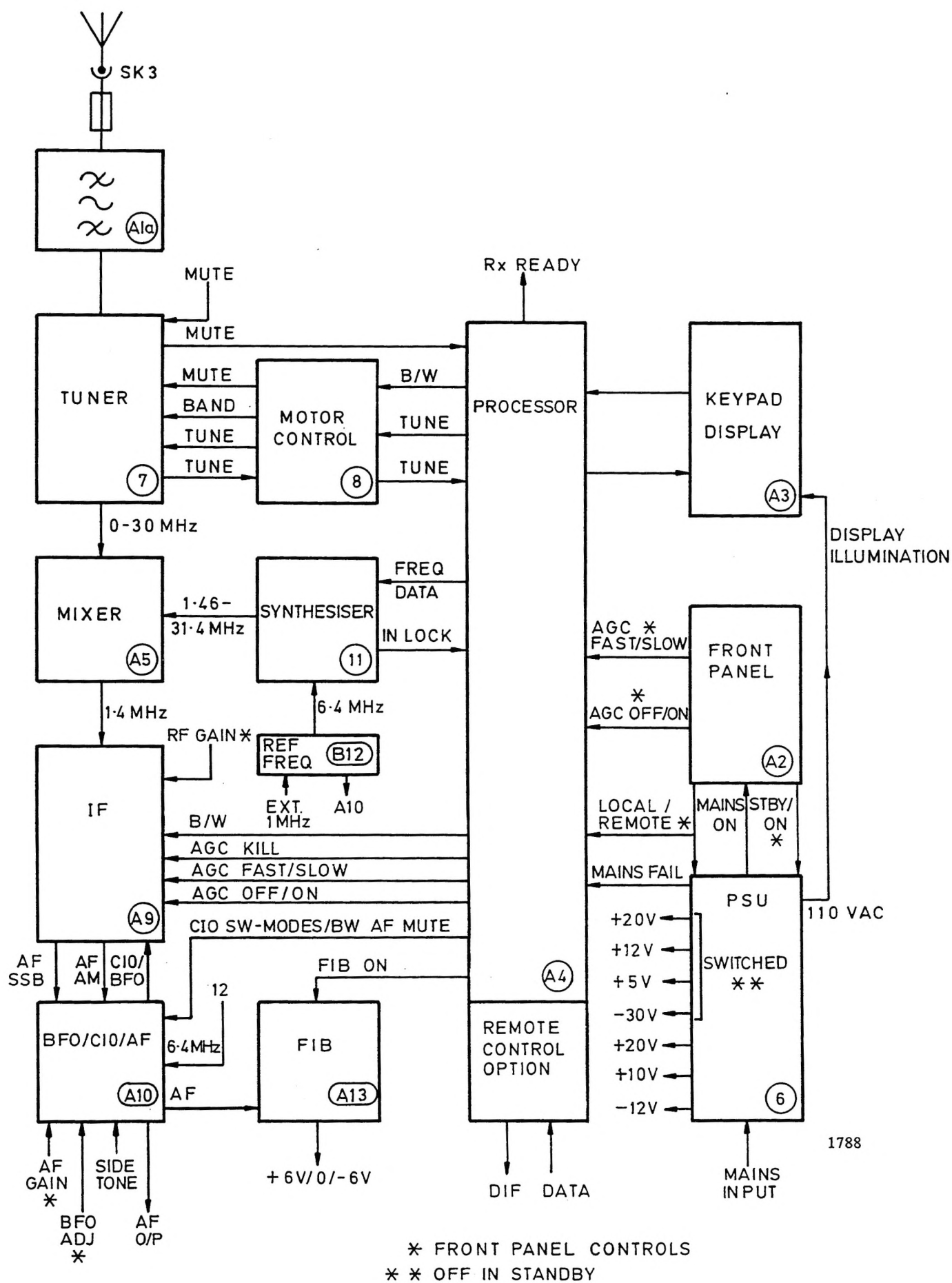


FIG. 4.1

R500N RECEIVER BLOCK DIAGRAM

4.2.1 Signal Path

The RF input from the aerial is brought to SK3 on the back of the receiver and fed to the Tuner via a fuse and lowpass filter. In the Tuner (module 7) the signal passes through muting relay contacts controlled by a protection circuit. The signal is then routed through two processor controlled coupled tuned circuits and an RF amplifier to the mixer (module A5), whose second input is from the processor controlled synthesiser (module 11). The mixer output is the IF, nominally 1.4MHz, but offset for certain services.

The IF signal from the mixer enters the IF (module 9) via a 6kHz crystal filter and preamplifier, followed by 3, 1 and 0.3kHz filters selected by relays under processor control. The filtered signal is then amplified by two tuned stages and applied to two detectors, an SSB product type and an AM amplitude type. Carrier insertion and BFO signals are fed in from module A10. An AGC voltage is derived at this stage and fed to the IF amplifiers under processor control. The AM and SSB AF outputs are fed to the next module.

The AF for the service in use is selected under processor control and amplified for line, phone and loudspeaker outputs in the BFO/CIO/AF (module A10). Provision is made for AF muting and sidetone introduction. A crystal oscillator (CIO) provides an offset Carrier Insertion signal for LSB. Another circuit provides a 1.4MHz Carrier Insertion signal for USB, locked to the reference frequency. These are switched under processor control. A variable BFO is fitted.

4.2.2 Frequency Selection

The received frequency is determined by the Synthesiser frequency; if the IF is the nominal 1.4MHz there will be an offset of +1.4MHz in the Synthesiser frequency (range 1.46 to 31.4MHz). There are other offsets as described in para. 4.2.4. The synthesiser frequency is set by a coded input from the microprocessor system (μ P), which in turn receives a coded input from the keypad; in converting keypad data to frequency the μ P incorporates the necessary offsets according to keypad inputs for Mode and Bandwidth. Keypad up and down keys provide for increments or decrements of 10Hz per press, or if held pressed increasing to a fixed rate of change of 425Hz per second after approximately 4 seconds.

The synthesiser output frequency is divided down from a Voltage Controlled Oscillator (VCO) and depends on control from a phase comparator; divided down samples of the VCO frequency and a reference frequency are fed to the comparator from which the control signal corrects any error thus locking the frequencies together. Those dividers which are programmable are set by coded inputs from the processor module.

The reference frequency is generated by an ovened crystal oscillator in the Reference Frequency module (B12). There is provision for an external reference frequency.

4.2.3 Tuner Control

A motor driven switch selects one of 6 bands; 60kHz-1MHz inserts a low pass filter; the remaining 5 bands insert tuner coils; fine tuning is by motor driven variable capacitors. Both motors are fed from the Motor Control module (8) and are controlled by coded inputs to this module from the processor module.

4.2.4 Frequency Offsets

For SSB services only one filter is used for both upper and lower sideband; for USB the nominal IF of 1.4MHz is used but for LSB an offset moves the carrier to the other end of the pass band and the IF is 1396.7kHz. For AM/CW services with 6kHz bandwidth the nominal 1.4MHz IF is used. For the narrower bands (3kHz, 1kHz and 0.3kHz) cascaded sideband filters are used and a different offset is used so that the IF is 1398.3kHz; this IF is also used for the F1B option.

The demodulator for USB uses 1.4MHz for carrier insertion but for LSB the frequency must be 1396.7kHz and this comes from a crystal controlled Carrier Insertion Oscillator in the BFO/CIO/AF module (A10). The BFO in this unit provides a variation of ± 3 kHz based on 1.4MHz for 6kHz bandwidth but on 1398.3kHz for the other bandwidths. See Fig. 4.2 for filter responses and summary of selectivities etc.

4.2.5 Processor, Keypad and Display

The processor contains the Microprocessor IC itself, several memories, and input/output ICs etc. The Operator uses the keypad to select preset channels or to set Frequency, Service and Bandwidth independently. The processor system accepts data from the keypad (and the front panel AGC switches), then sends data to the synthesiser, the tuner and the two displays for Channel/Frequency and Mode/Bandwidth and AGC; at the same time it controls all the switching for Mode, Bandwidth, Carrier Insertion, BFO etc.

4.2.6 F1B Option

If the F1B option is required there is an additional module (A13). The received signal in this mode produces frequency modulated AF at a nominal 1700Hz with deviation of ± 85 Hz. The purpose of the module is to convert this to a 6-0-6V DC output.

4.2.7 Chassis and Front Panel

The chassis (1) has a mid level deck with modules, mostly PECs, mounted above and below. External connections are all at the back. The front panel (2) carries controls for AF and RF gain, BFO and pushbuttons for Loudspeaker, Standby/On, Local/Remote and AGC fast/slow and Off/On.

The panel forms the base for an assembly which comprises the keypad/display module (3) and the processor module (4). The panel can be lowered for access to the modules. For details of front panel items see chapter 3 and Fig. 3.1; for details of chassis layout see Fig. 5.2.

4.3 TUNER - MODULE 7

See block diagram Fig. 4.3.

NOTE.

The tuner is a sealed, factory aligned and calibrated unit. The sub-modules are not replaceable individually, but are described separately in the following paragraphs for the sake of clarity.

4.3.1 Sub Assemblies

The tuning components are mounted in a rigid frame designated module 7 assembly; on this assembly are sub-modules as follows:

- (1) Input Filter Assembly - HF1-7a & HF2-7c

Output Filter Assembly - HF1-7b & HF2-7d

Comprising inductors, trimmers, transformers, switches etc.

- (2) Protection PEC - 7g

- (3) Amplifier PEC - 7f

- (4) Output Monitor PEC - 7e

- (5) Decoupling PEC - 7h
- (6) The switch motor and homing wafers.
- (7) The variable capacitors and stepping motor.
- (8) Low frequency filter PEC - 7j.

4.3.2 Protection - Module 7g

The RF from the aerial passes to this module (via an input fuse and a filter): at its input there is a voltage surge spark gap suppressor. The signal passes through the contacts of the mute relay, RL1 to the changeover relay RL3. The normally set contacts of RL3 pass the output to the filter assembly 7a-7d. When RL3 is energised for the low band the output passes via LF filter 7j. At normal input levels the mute relay is energised so that the N/O contacts are closed.

A sample of the RF input goes via a capacitor potentiometer to an RF amplifier and rectifier. The DC level acts on a Schmitt trigger which operates the muting relay: with an input emf up to 20V the relay is energised and above this the trigger operates to release the relay and so cut off the RF input.

A parallel relay has N/C contacts which now short circuit the output, i.e. the filter input. When the mute relay releases MUTED appears on the Service display. There are two additional inputs which operate the mute relay, i.e.

Receiver Mute - Relay releases when the associated Transmitter Driver is in the transmit condition.

Motors Running - Relay released when Band Switch or Capacitor motors are running.

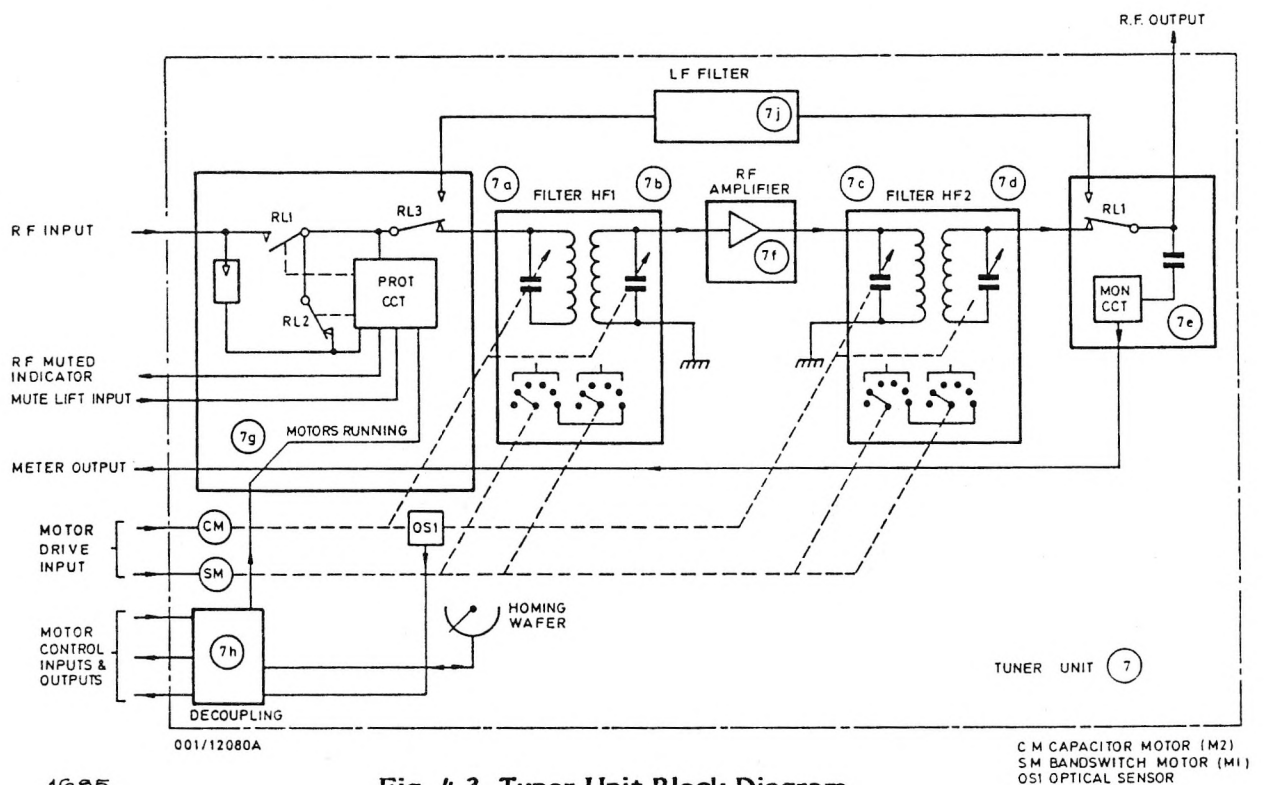


Fig. 4.3 Tuner Unit Block Diagram

4.3.3 Tuning Elements

This part of the assembly contains the inductors and their switches, the variable capacitors and the two motors. Band switching under processor control is by ganged wafer switches. Six positions are used; for 60kHz - 1MHz the bandswitch energises relays in Module 7g and 7e which insert a low frequency filter 7j. There are five bands covering 1-30MHz, each band has two filters connected via the RF amplifier, module 7f.

Both filters have two mutually coupled inductors for each band arranged around the associated band switch wafers: fine tuning is by double gang variable capacitors for each filter. The two gangs are coupled together and to the stepping drive motor.

4.3.4 Band Switch Motor Operation

See block diagram Fig. 4.3.

The homing wafer rotor is a disc with one notch in it, so that it connects to all contacts except one. The processor logic puts an earth on one contact only, i.e. the selected one: while the selected contact is in contact with the disc which is now earthed a drive transistor is turned on and the motor runs. When the notch comes opposite the selected contact the disc is not held to earth, goes to high, and this stops the motor.

When a band change is required a different contact is earthed, the disc is earthed causing the motor to run until the notch is opposite the new selected contact. Hysteresis is provided at band edges to avoid excessive band-changing. The edges affected are 2000/2025, 4000/4050, 8000/8100, 16000/16200kHz

4.3.5 Capacitor Motor Operation

The motor is a stepping type with four stator windings and a multipole permanent magnet rotor: rotation is caused by applying pulses to the windings in a rotating sequence. Alternate windings give a magnetic flux reversal and rotor poles are alternate north and south. Each pulse moves the rotor one step and there are 48 steps per revolution.

The motor is geared to the capacitors so that 500 pulses are required to cover the 150° capacitor movement. The pulses come from the processor via the Motor Control PEC (8): they are applied in either an "up" or "down" sequence to give motor reversal. The processor logic determines the number of pulses and direction of the sequence.

4.3.6 Optical Limit Switch

This acts when a vane mounted on the capacitor drive interrupts the light beam in an LED/photo-transistor switch. It is used as a reference for an automatic checking sequence of the processor programme.

4.3.7 Amplifier - 7f

This is a two stage wideband transistor amplifier. The first stage comprises one transistor, transformer coupled to the second stage which has four transistors in a parallel/push pull arrangement: the output is transformer coupled. The overall gain through the filters and amplifier is 6dB $\pm$ 3dB.

4.3.8 Output Monitor - 7e

The monitoring function is not used in the receiver application of the tuner. The output from the filter assembly 7a - 7d, used for 1-30MHz signals, passes via the normally set contacts of RL1 to the mixer. When RL1 is energised for the low band, 60kHz to 1MHz, the output from the LF filter 7j is fed to the mixer.

4.3.9 Decoupling PEC -7h

PL4. This mainly contains decoupling capacitors for a number of external connections at

4.3.10 Low Frequency Filter - 7j

This filter rejects frequencies above 1MHz. Links are provided at the input to allow the use of either a 50 ohm aerial or a high impedance aerial input.

4.4 MOTOR CONTROL - MODULE 8

This module controls the band switch and the capacitor motors. The band to be selected is identified by BCD code on 4 wires from the processor module (4): this data appears momentarily as single pulses and so it is applied to a latch which stores it until the next change. The data from the latch is passed to a BCD to decimal decoder, the 10 outputs of which go to the contacts on the homing wafer. There are five bands and a low frequency filter, which is selected automatically if the Receiver frequency is below 1MHz. The contact for the selected band is earthed by the decoder, all the other outputs of which are open circuit. There is provision for four more bands used in a different application. The 12V motor supply is via transistors switched via the homing wafer rotor disc.

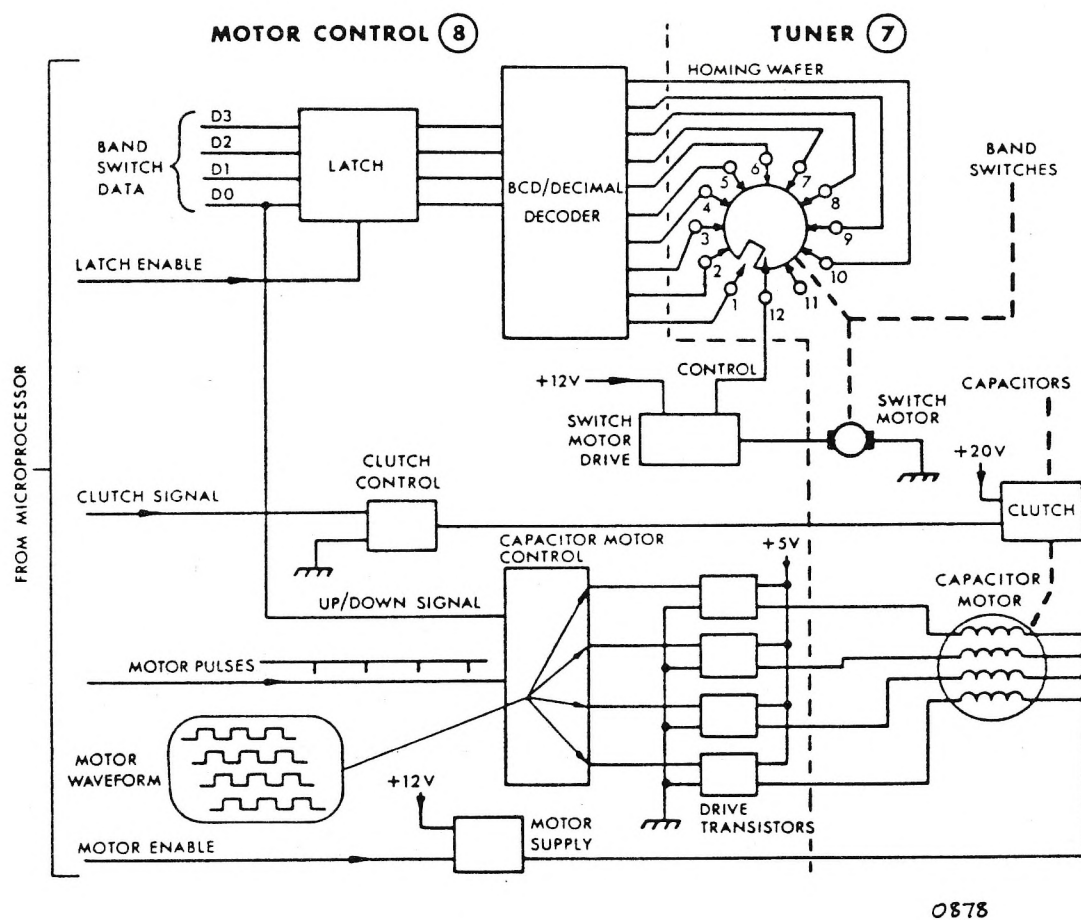


Fig. 4.4 Motor Control Block Diagram

The stepping motor for the capacitors requires a supply on each of the four windings via transistors which are switched on and off in sequence by pulses: the pulses associated with any two adjacent windings are displaced by 90° and the system is similar to a 4 phase supply.

The fact that two windings are always energised at any one time gives a definite locking action when the motor stops. The four "phases" are derived in two IC's from an incoming train of pulses, the frequency of which determines motor speed. The processor module sends out the specific number of pulses corresponding to the required capacitor position.

The controlling transistors are in the earthy end of the motor windings. The 12V supply for the motor is via a transistor which conducts whenever the microprocessor is active: otherwise the transistor is off and a reduced current is fed to the motor to maintain the locking action.

4.5 MIXER - A5 & IF MODULE - A9

4.5.1 Mixer

Four FET's are used in a double - balanced ring modulator preceded by a buffer pre-amplifier. The input from the Synthesiser is via a thin film hybrid amplifier.

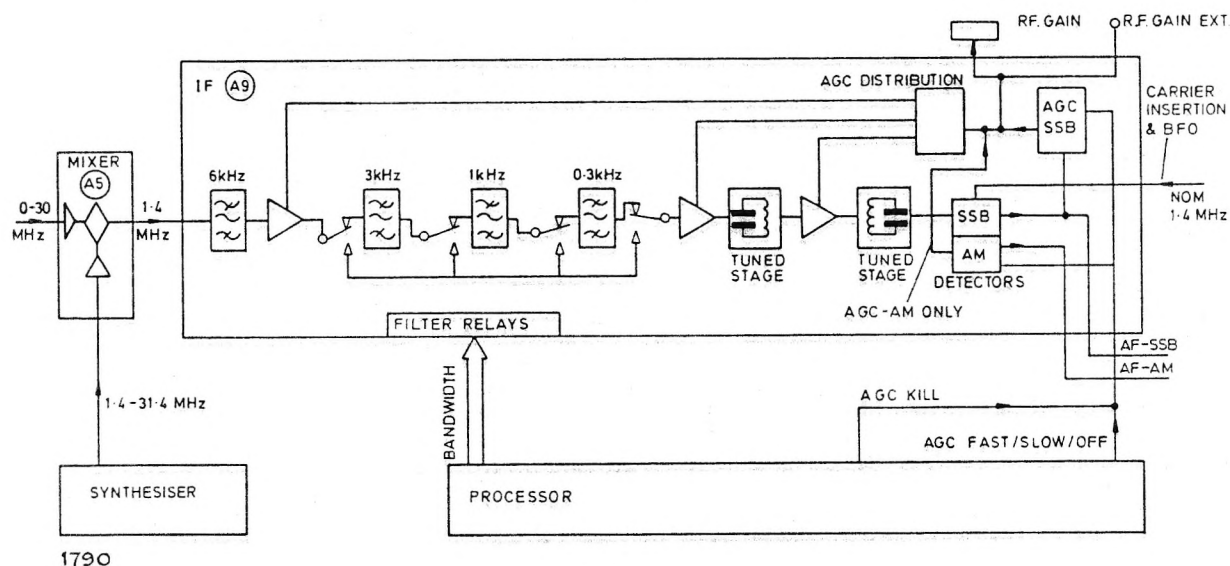


Fig. 4.5 IF Module Block Diagram

4.5.2 IF Amplifier and Filters

The 6kHz crystal filter is at the input and is always in circuit: following this is a two stage FET amplifier which also provides impedance matching. There are three switched crystal filters giving bandwidths of 3kHz, 1kHz & 0.3kHz, followed by a two stage amplifier using special communications type ICs, with gain set by a DC signal from the AGC or manual gain control. Each of these amplifiers has an associated tuned stage using one transistor. The gain control signal is also applied to the FET amplifier. Filter switching is by relays controlled from the processor.

4.5.3 Detectors and AGC (AM)

A special communications type IC provides AM & SSB demodulation: for SSB there is a Carrier Insertion input for the signal provided from the BFO/CIO/AF module (A10). For CW service the SSB demodulator is used with the BFO variable frequency instead of carrier insertion. This IC also provides a DC signal for AGC on AM only, applied to the three IF amplifiers. Fast or slow switching changes the AGC time constant and there is AGC on/off switching. When the channel is changed the processor resets the AGC via a "kill" pulse.

4.5.4 AGC (SSB)

A special communications type IC is used: this monitors the SSB audio signal and provides the DC control signal for AGC which is applied to the three IF amplifiers. Fast and slow switching changes the AGC time constant and there is AGC on/off switching and an AGC "kill" pulse.

4.5.5 AGC Distribution & Manual Gain Control

There is transistor buffering between the AGC line source and the control inputs to the amplifiers, to reduce loading on the source. The "manual" control is introduced at the common point of the AM and SSB AGC sources. AGC on/off and fast/slow are processor controlled from instructions in memory.

4.6 BFO/CIO/AF MODULE - A10

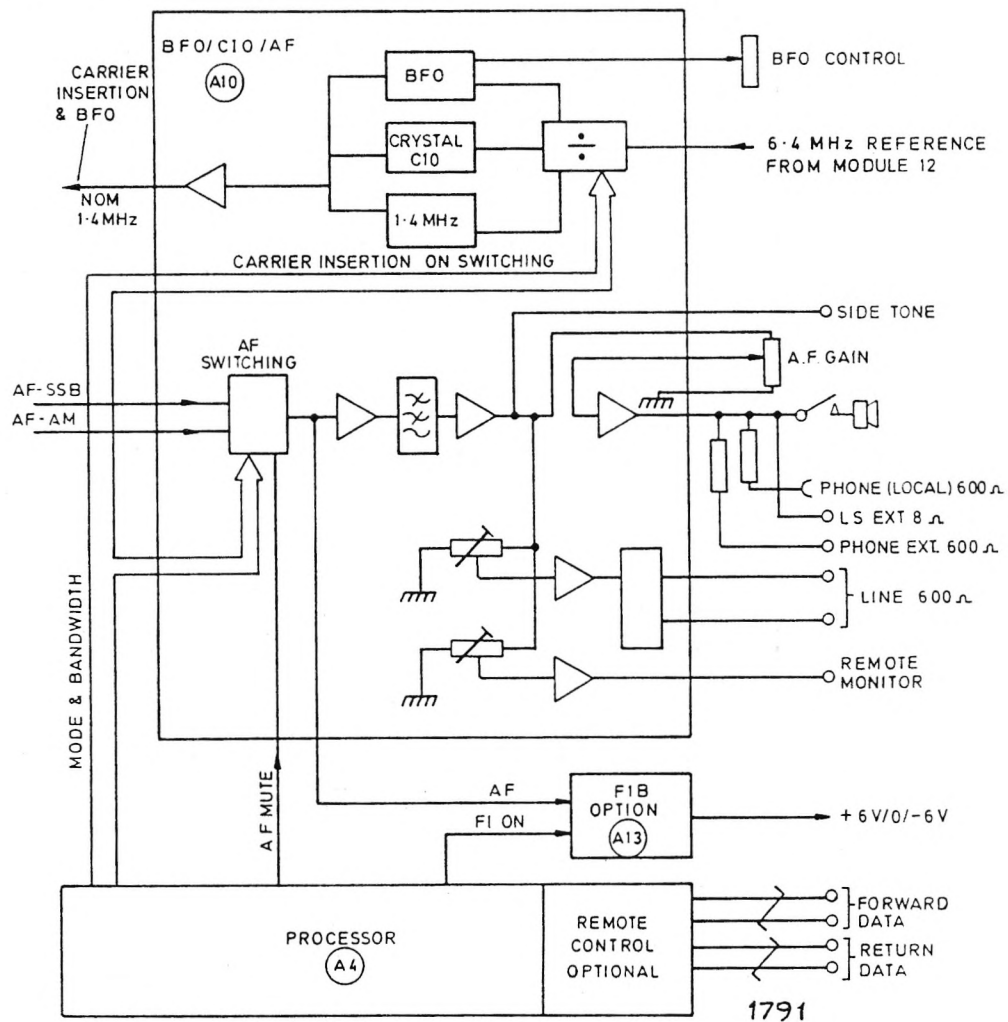


Fig. 4.6 BFO/CIO/AF Block Diagram

4.6.1 Insertion Frequencies

Depending on the Service/Bandwidth selected one of three signals from this module is applied to the products detector in the IF module, as follows:

- (a) SSB (USB) - Carrier Insertion at 1.4MHz obtained by using a 6.4MHz signal from the Reference Frequency module (12): there are two stages of division to give 800kHz and 200kHz. The 7th harmonic of the 200kHz is selected by a crystal filter and amplified.
- (b) SSB (LSB) - Carrier Insertion at the offset frequency 1396.7kHz generated in a crystal controlled oscillator.
- (c) CW/BFO - A signal at 1.4MHz $\pm$ 3kHz for the 6kHz bandwidth or at 1398.3kHz $\pm$ 3kHz for the other bandwidths.
Generated in a variable frequency oscillator with front panel control.

The offset is applied by control from the Processor when 3kHz, 1kHz or 0.3kHz bandwidth is selected.

There is a common transistor amplifier for the selected insertion frequency output.

4.6.2 Audio Frequency Output Path

The required audio frequency signal is selected from the two inputs AF-AM and AF-SSB, by IC switches controlled from the Processor according to Service selected: a third IC switch provides an AF mute (signal cut off) activated from the processor when MUTED appears on the display. See Para. 3.1.4. The selected AF signal goes on to an IC amplifier, a low pass filter and a transistor stage: the signal then divides into three paths as follows:

- (a) to the output IC amplifier via the AF gain control on the front panel: the output goes to the internal loudspeaker, front panel phone jack and external connections for loudspeaker and phones
- (b) to the external connections for the 600 Ω balanced line via an IC amplifier and a transistor amplifier stage: there is a preset gain control.
- (c) to the external connections for the remote monitor output via an IC amplifier: there is a preset gain control.

4.6.3 Sidetone

Sidetone AF from an associated Transmitter Driver is combined with the Receiver AF at the output of the transistor stage.

4.6.4 FIB (Optional)

There is an AF output without amplification for the FIB convertor module, A13.

4.7 SYNTHESISER MODULE - 11

See block diagram Fig. 4.7

A single loop phase lock system is used, which gives the minimum number of spurious frequencies, but a very large division ratio: however, specially designed ICs for division and phase comparison are used. The signal is generated by a voltage controlled oscillator (VCO)

operating in the frequency range 170 to 232MHz: this is first divided by 3, 4 or 5 in a prescaler stage set by processor control. A further prescaler divides by 10 or 11: the frequency is then divided by a variable number in a programmed divider (2 ICs) to provide a comparison frequency which is compared with a reference: any error results in an output which varies the VCO frequency so that the error is reduced. Thus the VCO frequency is locked to the reference.

The output path is from the prescaler to five divide by two stages set by processor control to give division by 4, 8, 16 & 32 plus a permanent divide by 2. These varied amounts of division make possible the use of a single VCO operating over a limited practical range.

The main divider uses two special programmable divider IC's operating in sequence. The divide number is determined by 4 bit serial data from the processor via a latch for each divider: the latches and dividers are "clocked" by pulses from the "select" inputs, by the processor. Data and select inputs pass via two level changing ICs.

The divided down frequency (comparison frequency) goes to the phase comparator in the comparator and reference division IC. This IC receives a 6.4MHz input, from the Reference Frequency Module (B12), which is divided down to the comparison frequency in an internal programmable divider set by processor control. The division steps coincide with the steps of the output divide by two stages. This reference frequency is the other input to the phase comparator and any error output is used to control the VCO frequency so as to minimise the error. The VCO frequency being locked to the reference, the module output frequency is also locked.

Data which sets the reference frequency divider and the divide by two stages is passed via a latch: another latch passes data for setting the prescaler. These two latches are clocked by two "select" inputs from the processor.

A control line from the processor to switching circuits in the synthesiser causes a change in time constant associated with the phase comparator IC when the 10Hz digit is set to '0' compared to being set to 1-9. In conjunction with a programme instruction to reduce the division ratio by a factor of 10, this control provides a reduction in synthesiser output phase noise to meet the more stringent requirements of certain services, e.g. Piccolo and HF transmitters, which do not require 10Hz increments.

4.8 REFERENCE FREQUENCY MODULE - B12

The accurate and stable 6.4MHz reference frequency is generated by a crystal oscillator in a temperature controlled oven. Provision is made for adjusting the frequency to compensate for drift after extended periods of operation; coil core adjustment gives coarse frequency control, while a preset potentiometer alters the voltage on a varactor diode in the oscillator circuit to give fine control. Frequency accuracy and stability using the internal reference are within ± 5 parts on 10^8 .

If greater frequency accuracy is required, a high stability external frequency standard of 1MHz may be employed. When the external reference is selected (via a rear panel mounted Int/Ext Ref. switch), the varactor diode in the oscillator circuit is disconnected from the 'fine control' potentiometer and connected instead to the output from a phase comparator. The 6.4MHz oscillator is then locked to the external 1MHz frequency standard by means of a phase locked loop, using a 200kHz comparison frequency.

4.9 PROCESSOR MODULE

See block diagram Fig. 4.8.

4.9.1 Introduction

The processor module is a microcomputer having many detailed functions which are made possible because, using digital signals, the microprocessor IC can carry out a large number of operations in a very short time, including certain types of calculation: these operations are determined by instructions which are initially in written form called "Software". The various steps in the "Software" programme are in numerical form and are stored in part of an IC memory system: sometimes this is referred to as "Firmware" after a programme has been entered.

The module itself is called the "Hardware" and comprises the microprocessor IC (μP), a number of memory ICs, decoder and input/output packages. The fast stepping of the system depends on a stream of "clock" pulses (844.8kHz) derived from a clock oscillator (5.07MHz).

Three kinds of memory are used:-

EPROM This contains the permanent instructions and is already programmed when the receiver is dispatched.

EAROM This is used as the channel memory and also for storing the corrections required by the tuner motor control.

RAM This is used to store data temporarily during the various stages of the programme cycle.

4.9.2 Routing of Digital Signals (Buses)

Within the Processor module data is exchanged between IC's in parallel form with up to 8 bits at a time requiring a common 8 line data bus. Similarly there is a 13 bit address bus. The 8 bit data bus is extended to the Keypad/Display module (3) together with part of the address bus. Data is transmitted to other modules on 4 bit buses. In Fig. 4.8. a bus symbol is used for "decoded" addresses (i.e., 'select' lines) in this case all the lines do not go to all the modules, i.e. not strictly a bus. Data transfers between the receiver and a remote control device are in serial format, transmitted via differential lines. The signalling speed must match the remote controller, in accordance with the procedure in chapter 2.6.2.

4.9.3 Module Functions

The module receives data from the keypad or remote control device for Channel No., Frequency and Service and from the front panel switches for channel AGC status (on/off, fast/slow). Channel data is used to address an appropriate part of the memory. Frequency data is processed to give instructions to the Synthesiser module (11) in the form of sequential data for the division numbers used by the various dividers.

These numbers allow for the frequency offsets, determined by the Service selected, data for which is already in the system. The synthesiser also receives "select" signals which operate selector latches to route the data within the module.

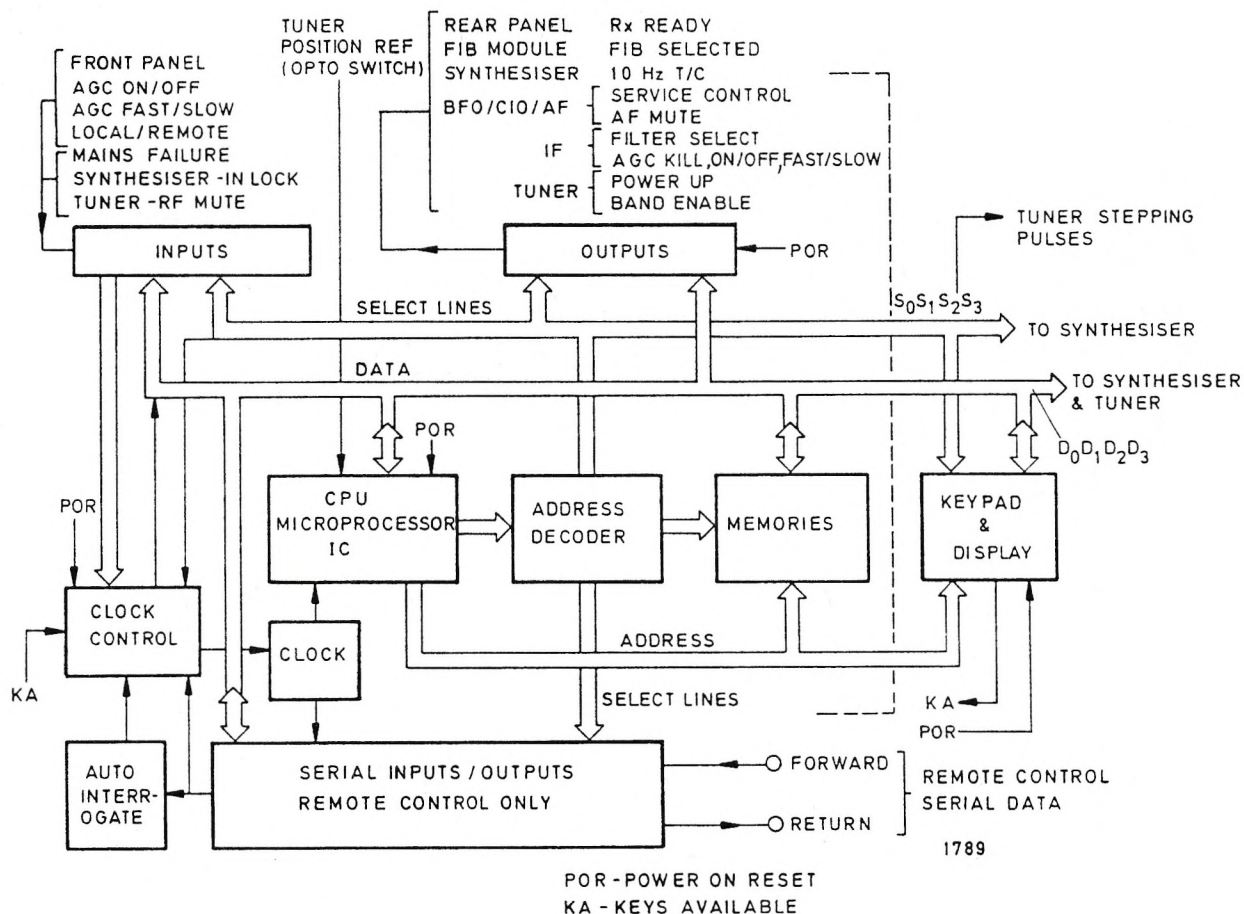


Fig. 4.8 Processor Block Diagram

Processor module outputs go to the IF module (A9) to select the filters according to bandwidth given by the service data, and to set the AGC 'off' 'on' and 'fast' or 'slow'.

Mode and Bandwidth data go to the BFO/CIO/AF module (A10) to select Carrier Insertion Oscillator (at 1.4MHz or offset) or BFO (at 1.4MHz or offset) and to select AM/AF or SSB/AF from the IF module.

The commands from the keypad are also received and decoded to give the selected procedure, e.g. USE, INT, MEM. Note that data going to the receiver itself, i.e. to the Synthesiser, IF, BFO/CIO/AF and Tuner modules, only changes when the command is USE.

4.9.4 Control of Tuner Motors

Instructions to the Tuner are in two groups: for band switch setting 4 bit data is provided to give position information as a number (0-9). For capacitor setting the present position is always retained in memory. Frequency data is converted into a number from which a capacitor position is calculated: this number is compared with the present position and the number of steps determined by the difference is sent to the Motor Control module together with a direction signal.

There is an automatic procedure whereby the capacitor is returned to a fixed position (near to maximum capacity) indicated to the processor module by the optical position switch. This occurs when the receiver is first switched to ON either from standby or mains off. After a fixed number of change instructions a routine position check is made automatically.

Since the variable capacitors do not have an exact linear law the system includes preset corrections: these are stored in part of the EAROM and add or subtract motor pulses from the calculated value at a number of frequencies in each band. The correction will have been entered before the receiver is dispatched: there are however facilities for changing the correction if necessary, see Chapter 7.

4.10.9 KEYPAD/DISPLAY MODULE - 3

See block diagram Fig. 4.9.

4.10.1 Introduction

This PEC is located very close to the back of the front panel so that the two display packages are mounted on the board but visible from the front: the keyboard is mounted on the front panel and has a 9 wire multipin connector.

The keypad and the displays use a common 8 bit data bus working to and from the Processor module: only the service display and the legend indicators in the numerical display make use of all the lines. An address decoder uses 3 address lines from the Processor module: 2 other address lines are used by two of the numerical display drivers.

The microprocessor (μP) is not running all the time but if the receiver is ON there will always be some form of display: even if the receiver is switched to ON from mains off or standby the μP will have started and at first there will be random displays but after a settling period the displays should show the complete status at the last USE command. If no keys are pressed the microprocessor will stop.

4.10.2 Displays

All the displays are liquid crystal type which have a conducting back plane in front of which are the character elements. The displays are backlit by electroluminescent panels. Special driver ICs are used, i.e. two types for numerical displays and another type for all the others. The back plane is fed continuously with square pulses at 100-120Hz: each character element is also fed via its driver with these pulses but they can be in or out of phase with the backplane. When in phase the element is off and when 180° out of phase it is on: the phase change occurs in the driver according to the input from the processor module.

For the numerical characters the drivers (3 off) receive BCD code from the Processor: for the other characters each element uses one of the data lines and there are 6 ICs selected two at time. The drivers all contain latches so holding the input data which is

received sequentially: thus the drivers have to be enabled momentarily to cause a display to change and it is then latched until the next change is required. Three of the address lines from the processor operate a decoder to give 7 select outputs: three of these are used for the numerical display and three for the other display.

The numerical display drivers also require two address lines direct. Two of the numerical display drivers contain 100-120Hz pulse generators but only one is used, the other being disabled: the output of the active one is fed to all the other drivers as well as the display backplanes. The decimal point (Frequency), Mode and BW kHz are always on provided there is a +5V supply. The backplane pulse line is connected to these elements via an inverter so that an out of phase 'on' condition is provided.

4.10.3 Keypad

There are 20 key operated switches arranged in a 5 x 4 matrix which only requires 9 wires to the display PEC. The keypad encoder IC12 defines any key pressed in 5 bit binary code. When a key is pressed a "data available" signal appears at DA on the IC and clocks IC13 which sends out "keys available" (KA) and this starts the microprocessor: when the address decoder output is S0, which is the select for IC12, DA is released via IC3 to the D5 data line and the key code from IC12 is already connected to the D1-D4 lines so that the key pressed is identified by the microprocessor.

4.11 POWER SUPPLY - MODULE 6

A mains transformer has individual secondaries feeding rectifiers and smoothing for seven unregulated DC supplies: each of these has an associated voltage regulator. The regulated outputs are:

- | | |
|--------------------|-------------------|
| (a) +20V | (e) +5V switched |
| (b) +20V switched | (f) -12V |
| (c) +10V | (g) -30V switched |
| (d) +12V switched. | |

The supplies marked "switched" are not available in the "Standby" condition.

In order that the EAROM in the Processor (3) retains its memory it is necessary for the +5V to be on before the -30V and off after the -30V. The "standby-on" switching provides for this and there is also a mains failure detector which switches off the -30V instantly while the +5V is held up sufficiently by the smoothing capacitor.

The module has two mains fuses, the fuse in the neutral line being linked out normally. The transformer has two tapped primaries used in series for 200-250V or in parallel for 100-125V: the appropriate connections are made by the position of the plug in the voltage selector panel.

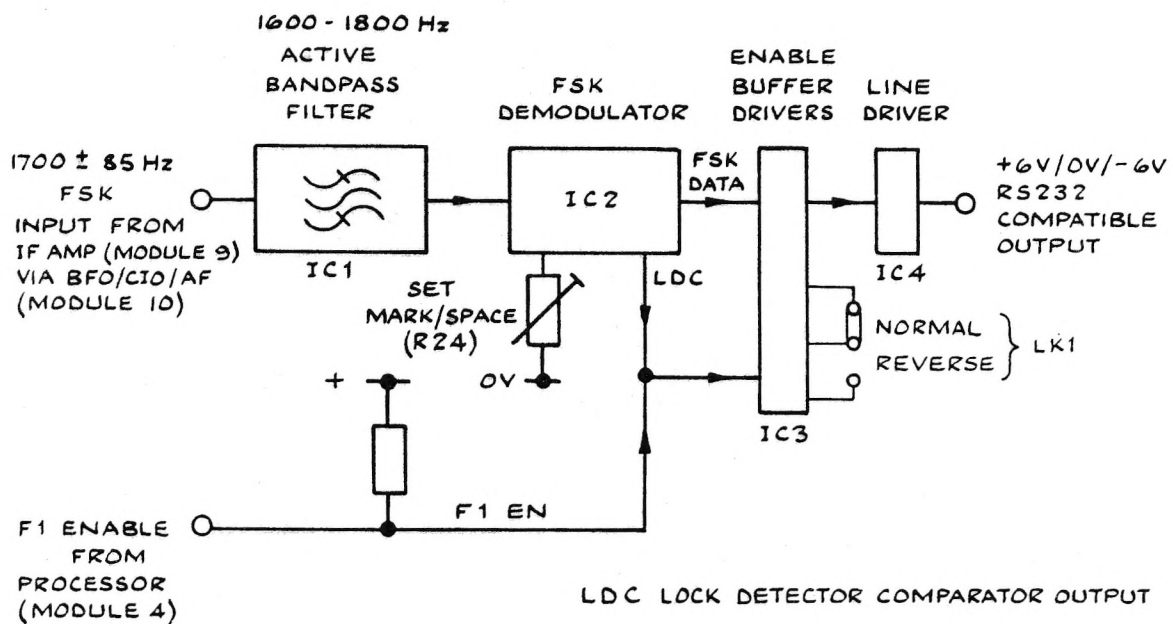
Provision is made for remote control of "Standby-on" switching when applicable: also when remote control is in use the Remote Standby condition switches off only the +20V supply (b) above, all the other supplies remaining on.

4.12 FIB RECEIVE - MODULE A13

This module is an optional fitment (Option 01) to the R500N Receiver. It will operate on any narrow band FSK signal having a shift of $\pm 85\text{Hz}$ and a maximum keying speed of 110 Bauds that is within the operational frequency range of the Receiver. The DC output may be set for +ve or -ve mark keying conventions. All necessary connections are available in the Receiver, fitting being a simple matter of inserting the PEC in its correct position.

The PEC is mounted on the right hand side of the lower level of the screened compartment behind the front panel of the Receiver (see Fig. 5.2).

On the PEC an on tune FSK signal of $1700\text{Hz} \pm 85\text{Hz}$ is fed via an active bandpass filter, FSK demodulator, gating circuits and a line driver to provide a $+6\text{V}/0\text{V}/-6\text{V}$ RS232 compatible output. A link LK1 in the gating circuits allows the keying sense to be reversed if required.



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FIG 4.10 FIB RECEIVE MODULE - BLOCK DIAGRAM

5 FAULTFINDING TO MODULE LEVEL

5.1 ARRANGEMENT OF TEST PROCEDURES

5.2 TEST EQUIPMENT REQUIRED

5.2.1 Rediffusion Optional Extras

5.2.2 Customer Supply

5.3. LIST OF MNEMONICS USED

5.3.1 Test points

5.3.2 Module Replacement

5.4 LOGIC LEVELS

5.5 MEASUREMENT TOLERANCE

5.6 STEP BY STEP PROCEDURES

Tests A,B,C,D,E,F,G,H,J,R

Fig. 5.1 Motor Pulses

FIG. 5.2 R500N CHASSIS LAYOUT

5 FAULTFINDING TO MODULE LEVEL

For location of modules see Fig 5.2.

For access to modules (removal of covers) see Chapter 6.

5.1 ARRANGEMENT OF TEST PROCEDURES

These instructions form a guide for faultfinding to module level. Whenever appropriate a step-by-step question and answer procedure is given leading to the need to replace a module. If repair facilities exist the Repair Manual (H/B No. 1209-1) must be used for further tests which assist in carrying out a repair.

Test procedures are lettered: 'A' tests are carried out first and these in general refer to other lettered tests according to the observations made.

The circuit areas of the lettered tests are:

A	General
B	Power supplies
C	Muting system
D	Processor and/or display
E	Synthesiser/Reference frequency module
F	IF/AF/Mixer
G	Tuner
H	Motor control [Marked "Motor Drive" on PEC (8)]
J	Filter switching
R	Remote control.

5.2 TEST EQUIPMENT REQUIRED

5.2.1 Redifon Optional Extras

Mute/Demute test connector to mate with 1PL1 on rear panel.

37 way free socket with link between pins 17 and 18, Redifon part no. C12899.

RF Test Leads: identified by coloured sleeves.

- (a) Orange - Tuner bypass, to Redifon drg P45560.
- (b) Blue - 1.4 MHz test signal, to Redifon drg P45561.
- (c) Slate - RF Voltmeter (with 50 ohm resistor), to Redifon drg 001/12274A.
- (d) Test lead No. 1 (to Redifon drg. P29351/S, NSN 6625-99-527-2566).
- (e) Test lead No. 2 (to Redifon drg. P29352/S, NSN 6625-99-527-2567).
- (f) Test lead No. 3 (to Redifon drg. P29353/S, NSN 6625-99-527-2568).
- (g) Test lead No. 4 (to Redifon drg. P29354/S, NSN 6625-99-527-2569).

NOTE. Items (d), (e), (f) and (g) are from Accessory Box 'B' for CJP, NSN 5820-99-527-4816.

5.2.2 Customer Supply

The recommended items are:-

Multimeter	multirange test meter, e.g. AVO model 8.
RF voltmeter	50 ohm, e.g. Racal 9301A.
Logic probe	CMOS/TTL, e.g. Sansei 3100A (see Note).
Oscilloscope	Dual trace, 30 MHz bandwidth, 50 mV sensitivity.

Frequency meter	e.g. Racal universal counter/timer 9905.
Signal Generator	1-40 MHz from a 50 ohm source, e.g. Marconi Instruments TF2002B.

NOTE A suitable supply is required to drive the Logic Probe; pins 2 & 1 (0 V) on SK2 of the receiver may be used.

5.3 LIST OF MNEMONICS USED

5.3.1 Test Points

Modules have two kinds of test point:

- (a) Test pins designated TP.
- (b) Probe pads designated PP, since these are to be used with meter probes, and other similar devices. On the PECs these have numbers without a prefix: pins not intended for testing also have numbers without a prefix.

5.3.2 Module Replacement

In the GO TO column R/R means replace the module, or if facilities exist repair it using instructions given in the Repair Manual.

NOTE The tuner module is supplied as a sealed, factory aligned and calibrated unit, and the calibration seals must not be broken. Alignment and re-calibration which would be required after any repair work requires the use of special test gear, tools, leads, screens and test jig. For this reason faulty tuner modules must be returned to Redifon MEL for repair.

5.4 LOGIC LEVELS

Where logic levels 'Hi' or 'Lo' ('1' or '0') are referred to there are two sets of limits:

		<u>Inputs</u>	<u>Outputs</u>
TTL	'Lo'	< 0.8 V	< 0.4 V
	'Hi'	> 2.0 V	> 2.4 V
CMOS	'Lo'	< 30% of supply	0 V
	'Hi'	> 70% of supply	Just below supply.

Normally the logic probe will be used which takes account of these levels.

Some logic signals use open collector gates in which case the limits vary for each application. For the tests which follow TTL levels are marked (T) and CMOS (C). For open collector gates the actual voltages are given.

5.5 MEASUREMENT TOLERANCE

All readings should be within $\pm 20\%$ of that shown unless otherwise indicated.

5.6 STEP BY STEP PROCEDURES

A tests

Receiver switched to ON, Local, and has been set for Channel, Frequency, Service and USE. Also note that, if necessary, the Mute/Demute test connector is connected to 1PL1 on the rear panel.

Fault No received signals and displays either on or off.

For receivers which normally operate under remote control, should an apparent fault occur, it is essential to verify receiver operation under local control. Follow the procedures detailed in paras. 3.3.1 and 3.3.2, ensuring that the receiver responds correctly. Incorrect responses indicate a receiver fault requiring investigation. If receiver operation is normal, first check that the baud rate conforms to the system standard; press TST, 3 on the keypad to display the baud rate. If this is not to the system standard reset as described in chapter 2 para 2.6.2. To check remote operation set the R500N as described in para 3.3.8 and carry out the 'R' test procedure.

			Remarks	GO TO
A1	Is the mains LED lit?	YES		A2
		NO	Does anything show on the display; if so MAINS is on and LED faulty. If not check supply isolator and fuses. Check receiver fuses.	
A2	Are the displays showing: (a) Nothing?	YES	Check power supplies. If these OK check at TP3 on display module for +5V; if NO - wiring fault.	B Tests
	(b) Headings but no numerals?	YES		A2c
	(c) Press "TST" and numeral 1; does display show all 8s and all legends except AGC?	YES		A2d
		NO		D Tests
	(d) Channel No, Frequency, Mode code and Bandwidth (B/W) numeral?	YES		A3
A3	Does MUTED appear on the service display?	YES	Check power supplies (B Tests); if these OK, proceed with C Tests.	C Tests
		NO		A4
A4	Select a new frequency, mode and B/W; has the display changed to show this?	YES		A5
		NO	Check power supplies (B Tests); if these OK, Processor/Display fault.	D Tests

			Remarks	GO TO
A5	Set frequency to 1kHz LSB; turn up AF and RF gain controls. Is a tone heard?	YES		A6
		NO	IF/AF/Mixer fault.	F Tests
A6	Set frequency to a previously used well known strong station below 1MHz e.g. a Broadcaster. Is this received?	YES	Tuner fault.	G Tests
		NO	Check RF input fuse FS3.	A7
A7	Check for aerial fault; connect to another aerial at 1SK3, or disconnect aerial coaxial and replace by a connector with a length of wire connected. Set frequency to a well known strong station; is this received?	YES	Aerial fault	
		NO	Replace aerial connector	A8
A8	Remove top cover; with RF test lead (a) connect together 1SKA and 5PL1 on the mixer. Are signals now received?	YES	Tuner fault	G Tests
		NO		A9
A9	Select A3E & 6kHz B/W; turn AF and RF gain controls to maximum. Is "noise" heard?	YES		A10
		NO	IF/AF fault	F Tests
A10	Reduce AF gain to give about half noise level; change to 3kHz B/W: (a) Has the noise level gone to zero?	YES	3kHz filter fault, IF module (9) fault	R/R
	(b) Does the noise level go down?	YES		A11
		NO	IF filter switching fault	J Tests
A11	Change to 0.3kHz B/W; (a) Has the noise level gone to zero?	YES	1kHz or 0.3kHz filter fault IF module (9) fault	R/R
	(b) Does the noise level go down?	YES		A11c
		NO	IF filter switching fault	J Tests
	(c) Increase the AF gain; does the noise level increase?	YES	IF and AF stages working; filter switching working. Tuner fault.	G Tests

B Tests - Power Supplies

B1 Test

Outputs from the power supply (6) are brought to chassis rear connector SK2. For test purposes a mating plug can be wired to a tag board for use with a multimeter. Details of test voltages are given below; voltage tolerances $\pm 5\%$, except -30 V which is $\pm 10\%$.

SK2 Pin	Operating Voltage	Standby Voltage	Referred to SK2 Pin
2	+4.75 to 5.25 V	+1.2 V	1
4	+9.5 to 10.5 V	+10 V	3
6	+11.4 to 12.6 V	+1.2 V	5
8	+19.0 to 21.0 V	+1.2 V	7
10	+19.0 to 21.0 V	+20 V	9
12	-11.4 to 12.6 V	-12 V	11
14	-27.0 to 33.0 V	-1.0 V	13

If all supplies are present and correct voltage, proceed to the next 'A' test. If any of these supplies is not present continue with these tests.

B2 Test

Access is now required to the bottom of the receiver and the bottom cover should be removed. Remove mains supply whilst working on the receiver and restore for each test. Locate 1TS1 and remove the fanning strip. Check 1TS1 for the voltages given below with the standby/on switch in the On position.

1TS1 Terminal	Voltage	Referred to
1, 2	+20 V	┌ Chassis earth bonding bolt └
3	+20 V	
4, 5	+12 V	
6	+10 V	
7, 8	+5 V	
9	-12 V	
10	-30 V	

If all supplies are present and correct voltage, there is a fault in one of the modules or in the wiring.

Replace the fanning strip on 1TS1. With the standby/on switch in the On position remove the supply connectors from each module in turn to locate the faulty module, i.e. when the supply is restored (or corrected) on 1TS1.

Supply connectors are as follows:

Module	Connector	Module	Connector
Motor Control	8SK1	IF	9SK1
Tuner	7SK2	BFO/CIO/AF	10SK8
Synthesiser	11SK1	Ref. Frequency	12SK4
Mixer	5SK4		

CAUTION

Switch to Standby, remove Processor connector 4SK6, switch to On. Check supplies at 1TS1, switch to Standby, replace 4SK6 and switch to On. This procedure is IMPORTANT and must be followed if stored information in the processor is not to be lost or corrupted.

If the fault is not located in this way two possible faults should be expected, either faulty wiring which should be checked, or faulty power supply module. To check the power supply module proceed through B3 and B4 to B5.

B3 Test

Locate PEC 6b in the power supply.

Check 6TS1 for the following voltages (standby/on switch in On position).

6TS1 Pin	Voltage	Referred to
1	8.6 V rms	6TS1 Pin 11
2	8.6 V rms	6TS1 Pin 11
4	-44.7 V	Chassis earth bonding bolt
5	+20 V	Chassis earth bonding bolt
6	+9.7 V	Chassis earth bonding bolt
7	-21.5 V	Chassis earth bonding bolt
8	+29.4 V	Chassis earth bonding bolt

If any of these voltages is incorrect the power supply unit should be replaced or repaired (refer to R500N Repair Manual). If all are correct proceed to B4.

B4 Test

Measure the following voltages on PEC 6b.

Component	Voltage	Referred to
IC3, pin 2	+10 V	Chassis earth bonding bolt
IC12, pin 3	-12 V	Chassis earth bonding bolt
C23, negative end	-30 V	C23, positive end

If any of these is incorrect replace PEC 6b.

If all of these are correct proceed with test B5.

B5 Test

It is necessary to have access to the pins on the PEC 6a; the board together with the heatsink can be removed without disconnecting the wires. Remove the mains supply while doing this. Do not remove the cover over the regulator ICs. There are two large holes in this cover which give access to the main screws: undo these and the assembly is then released. Take care to support it so that there is no strain on the wires; the pin identification numbers will now be visible. Check the following voltages with the standby/on switch in the On position.

Pin No.	Voltage	Referred to
12	0 V	Chassis earth bonding bolt
17	0 V	Chassis earth bonding bolt
22	0 V	Chassis earth bonding bolt

If there is a voltage appearing on any of the above pins there is a fault in PEC 6b, the standby/on switch, or the wiring.

Pin No.	Voltage	Referred to Pin No.
24	+20 V	23
25	+20 V	26
19	+12 V	18
14	+5 V	13

If any of these voltages is incorrect replace PEC 6a.

If all of the above tests are correct the power supplies are all working.

C Tests Muting System

Fault MUTED showing permanently on service display.

Bring forward the top of the Front Panel assembly - see para 6.13 (1) and (2). The TUNER LED (D4) on the Processor module can now be observed; for correct operation this should be out, indicating that there is not an RF mute condition. If this is out, and since MUTED is showing on the display, the Synthesiser must be "out of lock": GO TO Test C1.

If the LED is lit this indicates:

- (a) An excessive RF input voltage. Go to Tests C2 to C4.
- (b) Tuning motors running.
- (c) External mute from Tx/Rx relay in associated Transmitter driver: Go to Tests G7 to G9.

			Remarks	GO TO
C1	TUNER LED out - Synthesiser "out of lock". With logic probe check on Synthesiser TP6. Is this 'Hi'?	YES	Synthesiser, Ref. Freq. module or Processor fault.	E/D Tests
		NO	Wiring fault.	
C2	TUNER LED lit. Disconnect aerial at connector 1SK3; has MUTED on the display gone off, and is TUNER LED now out?	YES	Excessive voltage on aerial (> 20V emf). After eliminating fault reconnect aerial.	External check
		NO		C3
C3	It is assumed that the tuning motors are not running because of some other fault. On Motor Control module check with logic probe at PP23 (T).	Hi		C4
		Lo	This is the correct state for motors running; check other mute conditions.	G Tests: Start at G7
C4	Check with logic probe at PP8 on Motor Control module (T).	Lo	Motor Control module fault.	R/R
		Hi	Processor fault.	D Tests

D & E Tests

- D Display
 Processor
- E Synthesiser
 Ref. Freq. module.

The Display and the Synthesiser are fully dependent on outputs from the Processor which are in the form of multiplexed serial digital signals. These cannot be checked without special equipment; such tests as are possible are given in the Repair Manual.

Where this Manual refers to a D or E test, modules must be eliminated by substitution; the preferred order of replacement is:

Processor/Display	Replace whole front panel assembly (Modules 2, 3 & 4).
Synthesiser/Processor	Replace Synthesiser first then the Processor or the front panel assembly (Modules 2, 3 & 4).
Synthesiser/Ref. Freq. module	Replace Synthesiser first, then Ref. Freq. module.

The complete Front Panel Assembly reference is 627-065.

IMPORTANT NOTE

Whenever a Processor is replaced by a spare or locally repaired module, the original EAROM (IC1) must be transferred to the replacement module. This is because the Tuner corrections are stored in this memory, which is therefore specific to the Tuner and not the Processor.

If a Tuner is replaced by a spare, a pre-programmed EAROM is supplied with the replacement Tuner, and this must be fitted to the Processor in place of the original one.

F Tests IF/AF and Mixer Modules

Fault No received AF output

Access is now required to the bottom of the receiver, and the bottom cover should be removed. The Mixer cover should also be removed.

F1 Power Supply tests

Check at the following points using the multimeter (DC). All voltages shown include tolerance of $\pm 5\%$.

Mixer (5)	PP7 & TP6 (0V)	...	+19.0 to 21.0V
	PP8 & TP6 (0V)	...	-11.4 to 12.6V
IF (9)	PP35 & TP8 (0V)	...	+19.0 to 21.0V
	PP30 & TP8 (0V)	...	+11.4 to 12.6V
BFO/CIO/AF (10)	PP57 & TP31 (0V)	...	+19.0 to 21.0V
	PP55 & TP31 (0V)	...	+11.4 to 12.6V
	PP56 & TP31 (0V)	...	+4.75 to 5.25V

IF Tests

Note that changes to AGC status must be put into memory, e.g. press MEM, USE.

On module 9 unless shown otherwise			Remarks	GO TO
F2	Set Receiver to 1kHz, LSB. Set AGC on, RF gain to max. Connect RF voltmeter to TP7 and TP6 (0V). Level 200mV rms. (This is a 1.4MHz signal). Is the voltage present?	YES		F3
		NO	Check Mixer and Synthesiser.	F12
F3	Switch AGC off. Has the signal at TP7 and TP6 (0V) gone to greater than 1V rms? (i.e. Is AGC working?)	YES	AGC is working but not necessarily to specification.	F4
		NO	Fault in IF module (9).	R/R

AF & Carrier Insertion Tests

			Remarks	GO TO
F4	Set receiver to 1kHz, LSB. Set AGC on, RF gain to max. Connect multimeter (set to AC) to TP11 & TP28 (earth). Level 208mV rms. This is the AF output signal. Is the voltage correct?	YES		F5
		NO		F6
F5	At the same point check the frequency using the counter. Is it 1000Hz?	YES		F10
		NO	Check carrier insertion, tests F7 and F8. If F8 YES, Synthesiser fault.	R/R
F6	With RF voltmeter check carrier insertion signal at PP29; level 140mV rms. Is the voltage correct?	YES		F7
		NO		F8
F7	At the same point check the frequency using the counter. Is it 1396.7kHz?	YES	Detector fault in IF (9)	R/R
		NO		F8
F8	Measurements on Module 10 Carrier insertion check. Receiver set as for F3. With RF voltmeter check at PP41; level 140mV rms. Is the voltage correct?	YES	See test F5	F9
		NO	Fault in BFO/CIO/AF (10)	F11
F9	At the same point check the frequency using the counter. Is it 1396.7kHz.	YES	Wiring fault	F10
		NO	Fault in BFO/CIO/AF (10)	F11

			Remarks	GO TO
F10	Measurements on module 10 AF check. Receiver set as for F4; with multimeter (set to AC), check at PP49; level 88mV rms. Is the voltage correct?	YES	Fault in BFO/CIO/AF (10).	F11
		NO	Wiring fault.	
F11	Before replacing module 10, check that the correct inputs are coming from the processor. With the receiver set as for F4, check with multimeter at the following probe pads. 35 'hi' 9V 36 'hi' 12V 37 'lo' 0.7V 45 'lo' 0.6V 46 'lo' 0.6V 47 'hi' 12V. Are these voltages correct?	YES	Fault in module 10.	R/R
		NO	Fault in Processor (4).	R/R
F12	Mixer/Synthesiser Tests. Set receiver to 1.4MHz, A1A, 3kHz B/W, RF gain to zero, BFO to centre. On BFO/CIO/AF (10), check with RF voltmeter at PP42. Level 140mV rms. Is this voltage correct?	YES		F13
		NO	Fault in BFO/CIO/AF (10).	R/R
F13	At the same point check the frequency using the counter. Is the frequency 1398.3kHz?	YES		F14
		NO	Fault in BFO/CIO/AF (10).	R/R
F14	Using RF Test lead (b) connect 10PL3 to 5PL1. With RF voltmeter check on module 9 at pin 18 (Mixer output via 6kHz filter). Level 40mV rms. Is this voltage correct?	YES	Fault in IF (9).	R/R
		NO		F15

			Remarks	GO TO
F15	With RF voltmeter check on Mixer (5) at PP10: Level 250mV. Is this voltage correct?	YES		F16
		NO	Fault in Synthesiser (11) or Ref. frequency (12).	F17
F16	At the same point check the frequency: Is it 2798.3kHz?	YES	Fault in Mixer (5)	R/R
		NO	Fault in Synthesiser (11) or Processor (4) or Ref. frequency (12).	F17
F17	On Synthesiser (11) check with RF voltmeter at PP7: Level 224mV rms. Is this voltage correct?	YES		F18
		NO	Fault in Ref. freq. (5)	R/R
F18	At the same point check the frequency. Is it 6.4MHz?	YES	Fault in Synthesiser (11) or Processor (4).	D/E Tests

G Tests Tuner Module (7)

Measurements

Remove Receiver top and bottom covers and lower the front panel (see para 6.13); this allows the ends of the switch and capacitor shafts to be seen, to check movement.

Receiver switched to ON.

			Remarks	GO TO
G1	Change frequency from one mid band to another mid band, e.g. 3MHz to 5MHz; does the band switch move?	YES		G3
		NO		G2
G2	Does the band switch motor run?	YES	Mechanical fault on Tuner.	Replace Tuner
		NO		H Tests
G3	Set to 7.840MHz and press USE. Capacitor shaft indicator moves to 2 o'clock. Set to standby, capacitor shaft moves to 9 o'clock. Set standby to ON; capacitor shaft indicator moves to 2 o'clock. Does the shaft move correctly as above?	YES		G5
		NO		G4
G4	Does the capacitor motor run? (With finger "feel" shaft at back of motor).	YES	Mechanical fault on Tuner.	Replace Tuner
		NO		H Tests
G5	Connect RF signal generator set to 900kHz at 1V to 7PL1. Use RF voltmeter connected to 7PL5 by RF test lead (c): (a) Set Receiver to 900kHz USB. Has the band switch gone to position 9 (LF)?	YES		G5b
		NO		H Tests
	(b) Is the meter reading 400mV?	YES		G11
		NO		G6

			Remarks	GO TO
G6	Remove 7SK2; on this socket check with multimeter (DC) at contact 10 & earth (to locate contact see Fig. 5.2). (a) Is the reading +20V?	YES		G6b
		NO		B Tests Wiring
	(b) Check at contact 6 & earth. Is the reading +5V?	YES		G7
		NO		B Tests Wiring
G7	With multimeter check for continuity between contacts 2 & 8 (see Fig. 5.2). Is the reading zero ohms? Replace 7SK2.	YES		G9
		NO	External mute condition or wiring fault.	G8
G8	Locate PEC 1a on chassis (bottom rear); connect pin 29 to pin 40. Is the RF voltmeter reading now correct (G5b)?	YES	Check reason for external mute condition. If essential, the Receiver can be used with pins 28 & 29 shorted and external mute disabled. Having corrected external mute condition:	G10
		NO		G9
G9	Remove 7SK4; check with logic probe at socket contact 2(c); see Fig. 5.2. Is the level "lo"?	YES	Tuner fault, Protection Module - 7g.	Replace Tuner
		NO	False mute from Motor Control (8).	H Tests
G10	Set receiver to 1.4MHz. (a) Has the band switch moved?	YES		G10b
		NO		D/H Tests
G10	(b) Has the capacitor rotor moved?	YES		G11
		NO		D/H Tests

			Remarks	GO TO
G11	Set the RF Signal Generator to 1.4MHz at 500mV. Is the reading: (a) 270mV approximately?	YES	Tuner OK, wrong diagnosis.	
	(b) Zero or low?	YES	Tuner or Processor fault.	Replace as req'd.

H Tests Motors & Motor Control Module (8)

Faults Motors not running when they should.

Measurements on Motor Control module (8)

Receiver switched to On

Check with multimeter (DC) at PP2 for +5V (preset to 5V)
 PP3 for +20V
 PP4 for +12V.

			Remarks	GO TO
	If voltages not present.			B Tests or wiring
	If voltages are present, proceed as follows: Band switch motor not running: Stepper motor (capacitors) not running:			Tests H1-6 Tests H7-12
H1	Change Receiver frequency across bands with logic probe at PP9 (T). Initially "hi", "lo" going pulse at change.	YES		H2
		NO	Processor fault	D Tests
H2	(a) With multimeter check at PP21 & earth. Goes to 10-12V at change?	YES		H3
		NO		H2b
	(b) Disconnect motor by removing 7SKA from 8PL3: recheck at PP21. Goes to 10-12V at change?	YES	Motor fault	H3
		NO		H4
H3	Remove 8SK1; measure motor resistance with multimeter at PP21 & earth. Is this 13 ohms? See Note below	YES		H4
		NO	Motor or wiring fault. If wiring correct, fault is in motor	Replace Tuner
Note: A short circuit indication may be a module fault; recheck with 7SKA removed. If short circuit indication not present there is not a module fault.				
H4	With multimeter check at PP22; does this go "lo" at change or remain "lo"? "lo" = approx. 1V	YES	Module fault	R/R
		NO		H5

			Remarks	GO TO
H5	Remove 8SK4 and with logic probe check at PP33 to 37; only one should be low, the others being indeterminate. Set receiver to each band and check that the correct PP is "lo": 1 - 2MHz 33 2 - 4MHz 34 4 - 8MHz 35 8 - 16MHz 36 16 - 30MHz 37 Is the correct PP "lo"?	YES	Tuner or wiring fault. If wiring correct, fault is in Tuner.	Replace Tuner
		NO		H6
H6	Set receiver to the middle of each band in turn. Connect oscilloscope, one trace to PP9, the other to PP11 to 14 in turn. Trigger oscilloscope from falling edge at PP9. Press and hold the UP key. PP11 to 14 should be as follows when PP9 is low. MHz PP11 12 13 14 1 - 2 H L H L 2 - 4 L L H L 4 - 8 H H L L 8 - 16 L H L L 16 - 30 H L L L Are these all correct?	YES	Module (8) fault	R/R
		NO	Fault in processor (4).	D Tests
H7	Stepper motor not running. Change receiver from one end to the other of one band. With logic probe at PP8 (C). Initially "lo", goes "hi" at frequency change.	YES		H8
		NO	Processor fault	D Tests
H8	With logic probe at PP10 (T). Initially "hi", "lo" going pulses at frequency change.	YES		H9
		NO	Processor fault	D Tests
H9	With multimeter (DC) check at PP15 & 18; initially at 1.4V, rising to >5V at frequency change	YES		H11
		NO		H10

			Remarks	GO TO
H10	Disconnect module supplies by removing 8SK1. With multimeter measure the resistance of each motor winding, i.e: PPs 15 to 16, 15 to 17, 18 to 19, 18 to 20. Is the resistance 11Ω ? See Note below.	YES		H11
		NO	Motor or wiring fault. Check Tuner (7).	G Tests
Note: A short circuit indication may be a module fault; recheck with 7SKA removed. If short circuit not present there is not a module fault.				
H11	Check with oscilloscope at PPs 16, 17, 19 & 20. Initially 1.5V; square wave at frequency change.	YES	Pulse phasing wrong.	H12
		NO	Module fault	R/R
H12	With a dual trace oscilloscope observe the pulses at PPs 16, 17, 19 & 20 (to earth) with adjacent pairs on each trace, i.e. 16/19, 19/17, 17/20 & 20/16. There should be a 90° phase shift in each case. Are these correct ? See Fig. 5.1.	YES	No fault in motor control module (8); motor could be mechanically stalled. Replace Tuner module (7) if necessary.	
		NO	Motor control module (8) fault	R/R

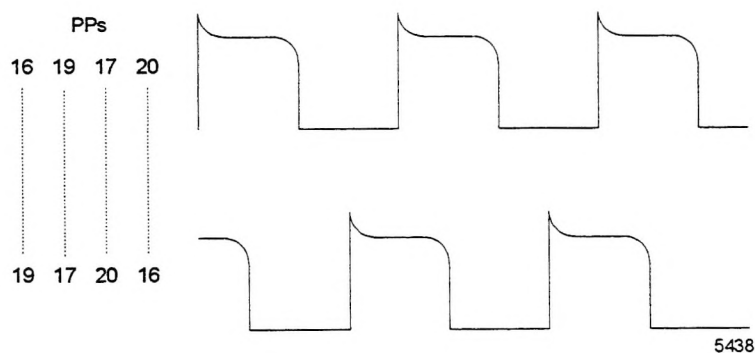


Fig. 5.1 Motor Pulses

J Tests IF Module (9)**Fault** Bandwidth not as selected.

			Remarks	GO TO
J1	Check for +12V at PP30; is this correct?	YES		J2
		NO	Power supply or wiring fault.	B Tests
J2	With multimeter check voltage at pads as follows with appropriate B/W selected: B/W PP 6 31 3 32 1 33 0.3 34. Is the reading 1V?	YES	IF Module (9) fault*	R/R
	Is the reading 12V?	YES	Processor fault or wiring fault	R/R
* If a zero reading is obtained this could indicate an open circuit relay coil or a wiring fault. The former can be checked by a resistance measurement (multimeter) as follows:				
	Remove 9SK1 PP30 to PP31 250 ohms $\pm 10\%$ PP30 to PP32, 33 or 34 600 ohms $\pm 10\%$			
	If resistance is high there is an IF module fault. Replace 9SK1.			R/R

R Tests

These tests are to be carried out using the remote controller front panel controls with the suspect receiver set to REMote mode. For detailed operating procedures refer to the relevant Remote Controller instruction manual. It is recommended, if at all possible, that the receiver and remote controller be operated at the same site for ease of fault diagnosis.

R1 Check that the baud rate setting at the remote controller conforms to the system standard. If this is not the case, reset to the required baud rate. Disconnect and reconnect the mains supply to reset after baud rate setting.

R2 In accordance with the remote controller operating instructions, check that it is possible to establish system control from the remote station, e.g. RC151/RC153 'Control' lamp lit (not flashing).

R3 Using appropriate remote controller operating procedures, attempt to select a new channel and check for correct response indication.

R4 Should either or both R2 and R3 tests give a fail indication, test the integrity of the system data link cabling.

R5 The location of a unit failure, inferred by intact cabling but incorrect system responses, is most readily identified by unit substitution, either physically, or electrically within the system, where this is possible.

R6 A fault in the receiver will probably entail replacement of the Processor PEC (module A4) - refer chapter 6 para 6.9 for details. The relevant instruction manual should be consulted where a remote controller fault is suspected.

TUNER BAND CORRECTIONS												TUNER UNIT SER NO	
												7	
BAND 1			BAND 2			BAND 3			BAND 4			BAND 5	
FREQ MHz	STEPS		FREQ MHz	STEPS		FREQ MHz	STEPS		FREQ MHz	STEPS		FREQ MHz	STEPS
			16.192			8.096			4.048			2.024	
			15.680			7.840			3.920			1.960	
30.336			15.168			7.584			3.792			1.896	
29.312			14.656			7.328			3.664			1.832	
28.288			14.144			7.072			3.536			1.768	
27.264			13.632			6.816			3.408			1.704	
26.240			13.120			6.560			3.280			1.640	
25.216			12.608			6.304			3.152			1.576	
24.192			12.096			6.048			3.024			1.512	
23.168			11.584			5.792			2.896			1.448	
22.144			11.072			5.536			2.768			1.384	
21.120			10.560			5.280			2.640			1.320	
20.096			10.048			5.024			2.512			1.256	
19.072			9.536			4.768			2.384			1.192	
18.048			9.024			4.512			2.256			1.128	
17.024			8.512			4.256			2.128			1.064	
16.000			8.000			4.000			2.000			1.000	

CAPACITOR NOMINAL STEPS
512
480
448
416
384
352
320
288
256
224
192
160
128
96
64
32
0

The display now shows the Band, 'nominal steps' and the stored correction for the frequency currently in use. This will be displayed for the duration of the Auto Interrogate time (normally set to approx. 40 seconds) after which it reverts to the channel and frequency currently in use.

N.B. This procedure is valid at all frequencies except 30.336 MHz. Although this frequency can be used in the ENTER mode, it is not valid in the AUTO mode. The required correction can thus be entered at this frequency, but not subsequently checked; check instead at the highest usable frequency of 29.99999 MHz, when an interpolated correction will be displayed (see also Note 5).

4. To revert to the correction procedure after display of a stored correction, proceed as follows:

Press CHN and INT keys to restore the channel and frequency currently in use to the display (not necessary if the Auto Interrogate time has elapsed).

Reset the Processor switch to ENTER.

Press the USE key although USE already displayed.

This returns the unit to step (3) of the correction procedure.

5. Do not attempt to enter corrections at frequencies other than those listed on the Calibration Record Card. The corrections at intermediate frequencies may however be displayed by using the TST 2 procedure, when the software will interpolate between the corrections at the two adjacent calibration frequencies. If a correction is inadvertently entered at an intermediate frequency, repeat the correction procedure at the adjacent calibration frequencies as listed on the Record Card.

7.6.6 Display of Tuner Corrections

The corrections can be displayed without disturbing the front panel fixings as follows:

- (1) Press CHN
- (2) Press FRQ
- (3) Press numeral keys for frequency required
- (4) Press USE
- (5) Press TST
- (6) Press 2.

The display now shows the band, 'nominal steps' and the stored correction for the frequency entered. This will be displayed for the duration of the Auto Interrogate time (normally set to approx. 40 seconds) after which it reverts to channel 0 and the frequency entered.

7.7 POWER SUPPLY VOLTAGES

7.7.1 -30 V Supply

- (1) Remove the receiver bottom cover, then switch the unit ON.
- (2) Locate terminal strip 1TS1, and connect a digital voltmeter between terminal 10 and chassis (meter -ve lead to chassis).
- (3) Check that the voltage reading is $-30\text{ V} \pm 5\%$ (-28.5 to -31.5 V). If the reading is within these limits no further action is required.

Table 6.1 R500N Module Identification (continued)

Module No.	Description	Redifon MEL Drg. No.	Redifon MEL Part No.
6b	PSU Input/Output Assembly	012/12094A	639-021
7	Tuner Unit Assembly (C/W Exclusive EPROM)	001/12080N	637-036 (4)
8	Motor Drive PEC	001/12087A	639-003
A9	IF Amplifier PEC	001/12097A	627-059
A10	BFO/CIO/AF PEC	001/12098A	627-002
11	Synthesiser PEC	001/12093A	639-007
11a	VCO Assembly	001/12090A	639-022
B12	1MHz Ext. Ref. Frequency	001/12234A	639-017
13	F1B PEC	001/12105A	627-009

- (1) Module A2 includes modules A3 and A4 less 4IC1, IC2, IC3
- (2) Module A3 see para 6.12.3 for details
- (3) Module A4 see para 6.12.1 for details
- (4) Module 7 see para 6.12.2 for details.

6.1.3 Return of Modules for Repair

Requests for the repair of modules should be forwarded to the Service Manager, Redifon MEL Ltd, quoting the Module Number, Description, Drawing Number and Part Number given in Table 6.1 and stating the nature of the failure. All requests for repair must be accompanied by an official order giving address(es) for dispatch and billing.

In the event that a processor PEC (Module 4) is returned the EAROM (IC1) should be removed and retained by the customer. See note below.

If a tuner unit (module 7) is returned the EAROM (IC1) is to be removed from the processor PEC and dispatched with the tuner unit. See note below.

NOTE The EAROM is an MOS Integrated circuit and should be stored or transported in materials which are antistatic (in antistatic tubes, plugged into conductive foam or wrapped in aluminium foil). Care should be taken when removing or inserting the device to ensure that the pins are not distorted.

Orders for spare modules should be addressed to the Spares Dept. of Redifon MEL Ltd, quoting the Module Number, Description and Drawing/Part Number given in Table 6.1. See section 6.13 for further information regarding the return of certain modules for repair.

6.1.4 Replacement of Modules

Sections 6.2 to 6.12 below each cover one module or sub-assembly; generally details for removal are given, replacement being the reverse procedure.

- (4) Enter the required correction by pressing the UP (+ve) or DOWN (-ve) key the number of times given by the correction number on the Record Card for the frequency in use. For example, +5 means press the UP key 5 times, -5 means press the DOWN key 5 times. The display will show the number entered, incrementing or decrementing each time the button(s) is/are pressed (see Note 1). On the display, a -ve correction is prefixed by a minus sign, no sign being indicated for a +ve correction.
- (5) Now press the MEM key to memorise this correction (see Note 2). The display will revert to the selected channel number and the frequency currently in use.
- (6) Using the same channel, change the frequency to the second correction point (1.064 MHz), press MEM then USE, and repeat the correction procedure as above.
- (7) Repeat for all 17 correction points listed for this band, up to 2.024 MHz.
- (8) For corrections on the next band (Band 4), first set the selected channel to the middle of the new band (3 MHz) and press MEM then USE. The Tuner motors will be heard to run (MUTED legend shows on the Mode display), confirming that the band has changed.
- (9) Using the same channel, change the frequency to the first correction point for this band (2.000 MHz), and press MEM then USE. Repeat the procedure as for Band 5, using the 17 listed frequencies up to 4.048 MHz.
- (10) Repeat the whole procedure on the remaining bands, ie. Band 3, 4.000-8.096 MHz (17 frequencies); Band 2, 8.000-16.192 MHz (17 frequencies); Band 1, 16.000-30.336 MHz (15 frequencies).
- (11) After the final correction has been entered, set the Processor switch 4S2 back to AUTO and press the CLR key. The receiver is now ready to operate.

NOTES

1. If the number of correction steps has been miscounted, the following example shows how the error can be corrected.

Tuner correction steps to be entered	+5
Correction entered in error	+6 (on UP key)
Entry required to correct error	-1 (on DOWN key)
Corrected entry	+5 (the + is not displayed).

This can be repeated as many times as necessary before the MEM key is pressed. Since the 'nominal steps' are at intervals of 32, a correction greater than +16 cannot be entered.

2. If a correction is already stored in the EARM for the frequency in use, it will remain unaltered until the MEM key is pressed while the new correction is displayed [step (5) of the correction procedure].
3. At any time, the actual correction stored in the EARM can be displayed as follows:

Press the CLR key (display changes to channel and frequency currently in use).
Set the Processor switch to AUTO.
Press the USE key although USE already displayed.
Press the TST key followed by numeral 2.

6.4 IF MODULE - A9

- (1) Remove the following items:

Receiver bottom cover.
Module cover.
Coaxial connector 9SK2.
Coaxial flying lead connector 9SKA (from 5PL3 on the mixer).
Multipin connector 9SK1.

- (2) The PEC is fixed by seven hexagon pillars (size M3); undo these and lift the board away.

6.5 BFO/CIO/AF MODULE - A10

- (1) Remove the following items:

Receiver bottom cover.
Module cover.
Coaxial connectors 10SK1 & 10SK2.
Multipin connectors 10SK6, 10SK7 & 10SK8.

- (2) The PEC is fixed by six hexagon pillars (size M3); undo these and lift the board away.

- (3) When fitting of the replacement module is completed, check its operation in accordance with section 7.5, and adjust as necessary.

6.6 SYNTHESISER MODULE - 11

6.6.1 Access Only

- (1) Remove the following items:

The receiver top and bottom covers.
The tie strap between the synthesiser top cover and the tuner unit.
The synthesiser top cover.

6.6.2 Removal

- (1) Remove the receiver top and bottom covers.
- (2) Lower the front panel (see section 6.12).
- (3) Remove multipin connector 11SK1.
- (4) Lower the retaining plate in front of the module, first undoing the two screws at the upper corners and then lifting slightly for the bottom to clear.
- (5) Remove coaxial connectors 11SK2, 11SK3 & 11SK4.
- (6) The PEC is mounted in guides and can now be pulled out.
- (7) When fitting of the replacement module is completed, check its operation in accordance with section 7.3, and adjust as necessary.

- (5) Raise the front panel and refit the retaining screws.

7.5 BFO/CIO/AF ADJUSTMENTS

7.5.1 BFO Adjustments

Select A1A mode, 6 kHz B/W. Set the BFO control to mid position. Connect the frequency meter to 10PL2 on the BFO/CIO/AF module. Adjust 10L1 with a non-magnetic screwdriver to give 1.4 MHz $\pm$ 200 Hz at 10PL2.

7.5.2 Line Output Level Adjustment

- (1) Connect a mating socket to 1PL1 on the receiver rear panel. A wire link must be connected between contacts 17 and 18 of this socket. Unless this is done the receiver will be permanently muted.
- (2) Load the live output, contacts 30, 31 with a 600 ohm 1/2 W resistor and connect an audio frequency millivoltmeter across the load. Disconnect the aerial.
- (3) Withdraw the receiver about 75 mm (3 in) to expose the adjustment holes in the left hand side.
- (4) Tune the receiver to 6.399 MHz on USB with RF gain at maximum, AGC to ON, slow. A 1 kHz output should be audible on the internal loudspeaker. Set line gain control R94 to give 0.775 V (0 dBm) or as required across the 600 ohm resistor.

7.5.3 Remote Monitor Level Adjustment

Remove the 600 ohm load and meter connections from contacts 30, 31 and connect to contacts 14 and 13 (0 V). With the receiver set as per para 7.5.2, set remote monitor gain control R83 to give 0.775 V (0 dBm) or as required across the 600 ohm resistor.

7.6 TUNER CORRECTIONS

7.6.1 Introduction

Each Tuner unit has its own Calibration Record Card, which is stored in the clear plastic wallet attached to the top cover of the Module. A blank Calibration Record Card is shown in Fig. 7.1. The figures entered on the Card with the unit were established during factory testing of the unit. The entry of corrections can take up to an hour, and the procedure detailed below should be used only if absolutely necessary.

If the Calibration Record Card is lost the correction steps can be displayed as described in para 7.6.6, and entered onto a blank card as shown in Fig. 7.1.

7.6.2 Need to Carry Out the Tuner Correction Procedure

The need to carry out the Tuner correction procedure is only likely to arise if the stored corrections have inadvertently been lost. In this case all corrections on the Calibration Record Card must be re-entered.

- (8) Check and if necessary adjust the processor clock frequency in accordance with section 7.4.

6.10 KEYPAD/DISPLAY MODULE - 3

- (1) Remove the processor module as described above.
- (2) Remove multipin connectors 3SK1 & 3SK2.
- (3) At the left hand side of the chassis, locate and lift free the brown wire twisted pair lead which runs from the keypad/display board to 2-pin connector 3PLD/6SKD. Disconnect 3PLD.
- (4) Undo the ten hexagon pillars (size M3) and lift the board away, taking care that connector 3SK2 passes through the rectangular hole.
- (5) Before fitting the replacement PEC, check that the links are correctly fitted in accordance with para 6.13.3.

6.11 POWER SUPPLY UNIT - 6

6.11.1 PEC - 6b

- (1) Remove the following items:

Receiver top cover.
Multipin connectors 6SK3, 6SKC and 6SK5.
Fanning strip from 6TS1.

- (2) The PEC is fixed by four crosshead screws; undo these and lift the board away.
- (3) When fitting of the replacement PEC is completed, check and if necessary adjust the -30 V supply in accordance with para 7.7.1.

6.11.2 Heatsink Sub-Assembly - 6a

- (1) Remove the following items:

Receiver top cover.
Multipin connector 6SKB from 6PL3

- (2) The sub-assembly is fixed by two crosshead screws accessible through holes in the transistor cover on the heatsink; undo these and remove the sub-assembly taking care to guide the connector through the gap at the back of the power supply.
- (3) When fitting of the sub-assembly module is completed, check and if necessary adjust the +5 V supply in accordance with para 7.7.2.

6.11.3 Complete Power Supply Assembly

The fixing screws are shown in Fig. 5.2 as A, B and C.

- (1) Remove the following items:

Receiver top and bottom covers.

7 PERIODICAL CHECKS AND ADJUSTMENTS

7.1 INTRODUCTION

The R500N has a minimum of preset adjustments; these have been factory set and should not be altered except in the following circumstances:

- (1) If one of the modules listed below (section 7.2) has been repaired by the user. The procedures for checking and adjusting are given in the Repair Manual, except for line output level. This is adjusted by R94 on BFO/CIO/AF module (A10).

Replacement modules received from Redifon should not be altered, except for 10R94 (see para 7.5.2).

- (2) The reference frequency should be checked once every six months and corrected, if necessary, as described in section 7.3.
- (3) The Processor module "clock" frequency should be checked once a year and adjusted, if necessary, as described in section 7.4.
- (4) It is recommended that the whole receiver be checked out about once a year, referring to the Repair Manual for details.

Remove the receiver top and bottom covers for access and replace when adjustment is completed.

7.2 MODULES WITH PRESET ADJUSTMENTS

Processor (A4)
Power Supply (6)
IF (A9)
BFO/CIO/AF (A10)
Reference Frequency (B12)

7.3 REFERENCE FREQUENCY ADJUSTMENT

A high accuracy frequency meter is required to measure the synthesiser output frequency (recommended meter: Racal Universal Counter/Timer 9912 with high stability reference option 04A). The receiver should have been on for at least 1/2 hour, preferably 1 hour, before this check is carried out.

The frequency check is carried out as follows:-

- (1) Load the following conditions:

Frequency	28.60000 MHz
Mode	USB
- (2) Press USE. The tuner motors may be heard to run, depending on what frequency was previously in use.
- (3) Undo the front panel fixing screws; there are two on each side as shown in Fig 6.1. Pull the front panel forward approximately 6 mm (1/4 in), and hinge the panel down on the pivot screws.

- (3) Pull the front panel forward approximately 6 mm (1/4 inch) and hinge the panel down on the pivot screws.
- (4) Remove the multipin connectors 4SK2, 4SK4, 4SK5, 4SK6, 2SK1.
- (5) At the left hand side of the chassis, locate and lift free the brown wire twisted pair lead which runs from the keypad/display board to 2-pin connector 3PLD/6SKD. Disconnect 3PLD.
- (6) Remove the two pivot screws by undoing the Nyloc nuts on the inside of the chassis side members. This releases the panel.

6.12.2 Replacement

Front panel replacement is generally the reversal of the removal procedures above. However the following points should be noted.

- (1) When fitting the front panel assembly to the chassis, the Nyloc nuts on the pivot screws should be tightened just sufficiently to remove end play from the fixings (do not omit the washers). Check that the panel slides freely and can be raised and lowered about the pivots without undue effort.

6.13 FAULTY MODULE RETURNED FOR REPAIR

6.13.1 Processor Module

If a processor PEC (Module 4) requires repair, remove and retain EAROM 4IC1 and EPROMs 4IC2 and 4IC3 prior to dispatch of the faulty module. Observe normal MOS handling precautions. Unless one or more of these devices are faulty, all three should be fitted to the replacement module, in which case no recalibration is necessary. Programmed channel and tuner correction data is stored in 4IC1, and equipment operating routine software is stored in 4IC2 and 4IC3.

If 4IC1 is replaced, the tuner corrections must be re-entered (see section 7.6) with reference to the printed card affixed to the tuner module. Channel operating parameters will also need to be reset (see Chapter 3).

Replacement devices for 4IC2 and 4IC3, ordered as a pair, will contain the latest issue software appropriate to the equipment serial number, which must be quoted on the spares order.

If a replacement processor PEC is fitted, check and if necessary reset the switches and links in accordance with the table below.

S1	Baud rate	See para 2.6.2.
S2	Enter/Auto	Set to Auto unless entering tuner corrections.
LK1		Not fitted.
LK2A	F1B offset	Normally set to position '0'.
LK2B	┐ Channel data	┐ see section
LK3A	┐ protection	┐ 3.2.
LK3B	Coded channel output	Set to position '0'.
LK3C	Spare	Set to position '0'.
LK4	Auto Interrogate time	See para 2.6.1
LK5	Local/Remote.	Set to position 'R'.
LK6	Normal/Test	Set to position 'N'.

7 PERIODICAL CHECKS AND ADJUSTMENTS

7.1 INTRODUCTION

7.2 MODULES WITH PRESET ADJUSTMENTS

7.3 REFERENCE FREQUENCY ADJUSTMENT

7.4 PROCESSOR 'CLOCK' OSCILLATOR ADJUSTMENT

7.5 BFO/CIO/AF ADJUSTMENTS

7.5.1 BFO Adjustments

7.5.2 Line Output Level Adjustments

7.5.3 Remote Monitor Level Adjustment

7.6 TUNER CORRECTIONS

7.6.1 Introduction

7.6.2 Need to Carry Out the Tuner Correction Procedure

7.6.3 Procedure When Processor or Tuner has been Changed

7.6.4 Switching to Correction Condition

7.6.5 Correction Procedure

7.6.6 Display of Tuner Corrections

Fig. 7.1 Tuner Unit Module 7 Calibration Record Card

7.7 POWER SUPPLY VOLTAGES

7.7.1 -30 V Supply

7.7.2 +5 V Supply

6.13.2 Tuner Module

If a tuner unit (module 7) is returned for repair, the EAROM (4IC1) must be removed from the processor PEC (module A4) and dispatched with the tuner unit. After repair the tuner will be recalibrated and a new set of corrections entered in the EAROM. This will be returned with the tuner for replacement in its original position on the processor PEC, and no recalibration is necessary.

6.13.3 Keypad/Display Module

If a keypad/display module (3) is returned for repair and a replacement module 3 is fitted check, and if necessary reset, the display element links on the PEC in accordance with the following table:

LK1	Dec. point (R500, R505)	a-b
LK2	Dec. point (DU500, DU505)	a-b
LK3	A3E	b-c
LK4	BW/kHz arrow head	a-b
LK5	BW/kHz	a-b
LK6	B9W	a-b
LK7	H2A	a-b (if fitted)
LK8	A3E (R500, R505)	a-b (if fitted)

Module 8, as described in section 6.8.

Mains connector (floating) 6SKA near the voltage selector panel.

Multipin connectors 6SK4 & 6SK5 (PEC 6b)

2-pin connector 6SKD

- (2) At the rear of the receiver locate two screws (A) at the inner end of the power supply unit; undo these.
- (3) Near the back of the receiver on the PSU side there is a recessed M4 screw (B) with a nut on the inside; undo and remove these.
- (4) Under the chassis are six M3 screws (C) which can be distinguished by the slotted holes in the chassis; undo these and the unit can then be removed. Lift the unit away carefully so that the voltage selector goes through the cut-out in the chassis, while the heatsink assembly clears the tabs on the rear plate.
- (5) When fitting of the replacement module is completed, check and if necessary adjust the +5 V and -30 V supplies in accordance with section 7.7.

6.12 FRONT PANEL ASSEMBLY

6.12.1 Removal

This assembly comprises the front panel itself (module A2), keypad/display (module A3) and the processor module (A4).

Note: It is not necessary to remove the complete panel assembly for replacement of individual modules A3 or A4. This procedure is given only for use when the complete assembly is to be replaced.

- (1) Remove top and bottom covers by removing the four M3 screws (top cover only) and then releasing the Dzus fasteners (1/4 turn anticlockwise to release).
- (2) Undo the front panel fixing screws; there are two on each side as shown in Fig. 6.1 below.

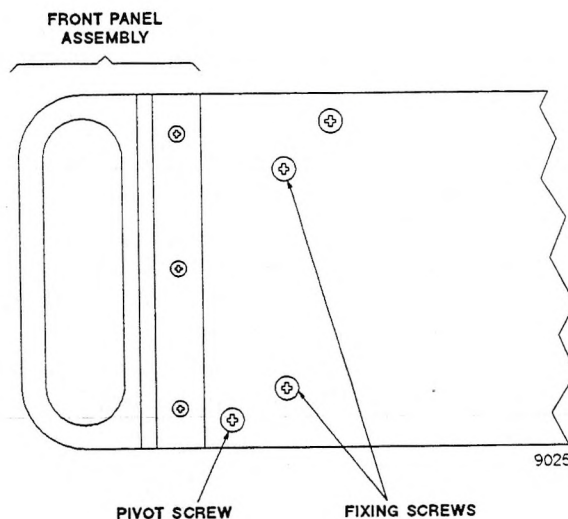


Fig. 6.1 Front Panel Fixing Details

- (4) Connect the frequency meter to the unused coaxial connector 11PL3 on the synthesiser module (11) using test lead No. 1 (NSN 6625-99-527-2566). The frequency reading should be 30.000 000 MHz $\pm$ 15 Hz.
- (5) If the frequency is outside these limits fine adjustment is by means of a multi-turn preset potentiometer 12R3 on the reference frequency module (B12). In the event that the correct reading cannot be obtained using the fine adjustment, a coarse adjustment is available. Proceed as follows.
- (6) Switch off, remove all coaxial and multipin connectors from modules 11, B12 and A13 (if fitted), and remove the retaining plate from the front of this module compartment. Withdraw module B12 and extract the oven adjusting tool. Refit module 12.
- (7) Refit all the coaxial and multipin connectors to these modules, switch the unit on and allow to warm up for at least 1/4 hour.
- (8) Remove the rubber bung from the end of the crystal oscillator oven. With the fine adjuster 12R3 set at approximately mid position in its travel, adjust the coil core inside the oven (using the alignment tool 5120-99-462-9739 supplied) to set the frequency as near as possible to 30 MHz.

CAUTION. Take care not to disengage the coil core during this adjustment.

In the event that the correct reading cannot be obtained check the frequency at 12PL2 on the reference frequency module. This should be 6.4 MHz $\pm$ 1 Hz. Refit the rubber bung after this adjustment.

- (9) Make the final frequency correction on the fine adjuster 12R3.
- (10) Switch off, disconnect the frequency counter and all module 11, B12 and A13 connectors. Withdraw module B12, refit adjusting tool and refit module B12.
- (11) Refit the retaining plate to this module compartment and refit all the connectors.
- (12) Raise the front panel and refit the retaining screws.

7.4 PROCESSOR CLOCK OSCILLATOR ADJUSTMENT

- (1) Undo the front panel fixing screws; there are two on each side as shown in Fig 6.1. Pull the front panel forward approximately 6 mm (1/4 in), and hinge the panel down on the pivot screws.
- (2) Connect a frequency counter to TP14 on the processor module. Set the rear panel switch S1 to 'Ext' (or, if an external standard is connected, remove the lead connected to SK4). The MUTED legend will indicate and the processor clock will run. The normal oscillator frequency is 5.0688 MHz, and the frequency should be within 1% of this figure (5.018 to 5.119 MHz).
- (3) If the frequency reading is outside these limits, the oscillator should be reset to the nominal frequency by adjusting the core of inductor L7, using a non-magnetic screwdriver.
- (4) On completion, reset rear panel switch S1 to 'Int' (or reconnect the external standard to SK4).

6.7 REFERENCE FREQUENCY MODULE - B12 AND F1B MODEM - MODULE A13 (OPTIONAL)

- (1) Remove the receiver top and bottom covers.
- (2) Lower the front panel (see section 6.12).
- (3) Remove the following items:

Retaining plate at front of the module compartment; undo two screws at the upper corners and lift away.

From module B12:

Coaxial connectors 12SK1, 12SK2 & 12SK3.

Multipin connector 12SK4.

From module A13:

Multipin connector 13SK1.

- (4) The PECs are mounted in guides and can now be pulled out.
- (5) When fitting of a replacement module B12 is completed, check its operation in accordance with section 7.3, and adjust as necessary (there are no adjustments for module A13).

6.8 MOTOR CONTROL MODULE - 8

- (1) Remove the following items:

Receiver bottom cover.

Multipin connectors 8SK1, 8SK2, 8SK4 & 7SKA (from 8PL3).

- (2) The PEC is fixed by four crosshead screws; undo these and lift the board away.

6.9 PROCESSOR MODULE - 4

- (1) Remove the receiver top and bottom covers.
- (2) Lower the front panel (see section 6.12).
- (3) Remove the following connectors:

Multipin 4SK2, 4SK3, 4SK4, 4SK5 & 4SK6.

- (4) The PEC is fixed to hexagon pillars by ten crosshead screws; undo these and lift the board away.
- (5) From the processor PEC removed in step (4), extract EAROM 4IC1 and EPROMs 4IC2 and 4IC3 (observe normal MOS handling precautions). Fit these devices into the replacement PEC in accordance with para 6.13.1.
- (6) Set the switches and links on the replacement processor PEC in accordance with para 6.13.1.
- (7) Fit the replacement PEC by reversing steps (3) and (4).

7.6.3 Procedure When Processor or Tuner has been Changed

- (a) When a Processor module has been changed, unless the fault happens to be in the EAROM (4IC1), the original IC can be transferred to the new Processor. This IC contains all the required correction information for the Tuner, and no recalibration is necessary. If it becomes necessary to replace the EAROM, the correction procedure must be carried out to program the new EAROM as detailed in paras 7.6.4 and 7.6.5 below.
- (b) Each replacement Tuner unit received from the factory is accompanied by a pre-programmed EAROM. When a Tuner unit is replaced, the EAROM fitted in the Processor module must be replaced by the one accompanying the new unit.

7.6.4 Switching to Correction Condition

Corrections can only be entered when switch 4S2 on the Processor module is switched from the AUTO correction to the ENTER corrections position. There is also a centre switch position (straight line law), which is not used in these procedures.

For location of switch 4S2 see Fig. 5.2(a). It is not necessary to hinge the front panel down for access to this switch; after removal of the receiver top cover, the switch is accessible at the top edge of the Processor PEC.

7.6.5 Correction Procedure

The corrections to be entered are taken from the Calibration Record Card stored in the clear plastic wallet attached to the top cover of the Tuner. For each correction point (15 in Band 1, and 17 each in Bands 2 to 5), the Record Card gives a frequency and a +ve or -ve correction. The red keys on the keyboard are used to enter these corrections, UP for +ve and DOWN for -ve.

Before commencing the procedure detailed below, confirm that the Serial numbers on the EAROM (4IC1), on the Tuner unit and on the Calibration Record Card are identical. Then proceed as follows.

- (1) Set the Processor switch 4S2 to ENTER, and press the CLR key.
- (2) Select a vacant channel, and into it enter the lowest frequency correction point shown on the Chart, ie. 1.000 MHz on Band 5 (a blank Chart is shown in Fig. 7.1). Press MEM followed by USE. The Tuner motors may be heard to run, depending on the frequency previously in use. The MUTED legend will show on the Mode display while the Tuner motors are running, and will then go off.
- (3) As the USE key is pressed, the display changes to show the Band number in the Channel window, and in the Frequency window 3 digits which denote the nominal capacitor position (relative to the reference position) for the frequency selected. This is the number which appears in the 'nominal steps' column at the left of Fig. 7.1. The 'nominal steps' number is followed by the correction number which, in the ENTER mode, is initially zero.

For locations of modules and associated connectors, refer to Fig. 5.2 at end of chapter 5.

6.1.5 Metric Fixings

All fixings mentioned in this chapter are metric, and screws are generally of the crosshead type. When removing fixing screws, be careful not to let the washers fall into the equipment, otherwise trouble may be experienced later with intermittent short circuits.

6.1.6 Connector Removal

Most types used are of push on pull off construction. Exceptions are on the rear panel, eg. BNC (bayonet ring) and 'D' type which have a locking slide.

6.2 TUNER UNIT - 7

NOTE The tuner unit is a sealed, factory aligned and calibrated unit, and is therefore only replaceable as a complete unit.

- (1) Remove the following items:

- Receiver top and bottom covers.
- The tie strap between this module and the synthesiser top cover.
- Coaxial connectors 1SKA and 7SK5.
- Multipin connectors 7SK2 and 7SK4.
- Flying lead connector 7SKA from 8PL3 (motor control).

- (2) Turn the receiver on to its left hand side. The tuner is fixed by four captive M5 crosshead screws accessible from the bottom of the receiver.
- (3) Locate the IF module (9); in front of this are two of the screws which are larger than any other nearby. The two rear screws are accessible through holes in module 9 PEC.
- (4) Release the tension on all the screws before fully undoing; hold the unit against the chassis to prevent any sudden movement, and fully undo the screws.
- (5) Pull the unit slightly forward so that the band switch motor clears the hole in the rear plate, and carefully remove completely.
- (6) Fitting the replacement is the reverse of the above procedure.
- (7) Remove the existing EAROM (4IC1) from the processor PEC (module 4) and substitute the EAROM supplied with the replacement tuner unit, in accordance with para 6.13.2.

6.3 MIXER MODULE - A5

- (1) Remove the following items:

- Receiver bottom cover.
- Coaxial connectors 5SK1, 5SK2 & 9SKA (from 5PL3).
- Multipin connector 5SK4.
- Mixer box cover.

- (2) On the side of the mixer box next to the BFO/CIO/AF PEC (module 10), slacken the two hexagon headed screws using a 4BA flat spanner.
- (3) The PEC is fixed by two crosshead screws; undo these and lift the board out.

TUNER BAND CORRECTIONS										[7] TUNER UNIT SER. No.	
BAND 1		BAND 2		BAND 3		BAND 4		BAND 5			
FREQ. MHz	STEPS	FREQ. MHz	STEPS	FREQ. MHz	STEPS	FREQ. MHz	STEPS	FREQ. MHz	STEPS		
		16.192		8.096		4.048		2.024			
		15.680		7.840		3.920		1.960			
30.336		15.168		7.584		3.792		1.896			
29.312		14.656		7.328		3.664		1.832			
28.288		14.144		7.072		3.536		1.768			
27.264		13.632		6.816		3.408		1.704			
26.240		13.120		6.560		3.280		1.640			
25.216		12.608		6.304		3.152		1.576			
24.192		12.096		6.048		3.024		1.512			
23.168		11.584		5.792		2.896		1.448			
22.144		11.072		5.536		2.768		1.384			
21.120		10.560		5.280		2.640		1.320			
20.096		10.048		5.024		2.512		1.256			
19.072		9.536		4.768		2.384		1.192			
18.048		9.024		4.512		2.256		1.128			
17.024		8.512		4.256		2.128		1.064			
16.000		8.000		4.000		2.000		1.000			

CAPACITOR NOMINAL STEPS
512
480
448
416
384
352
320
288
256
224
192
160
128
96
64
32
0

FIG. 7.1 TUNER UNIT MODULE 7 CALIBRATION RECORD CARD

6 MODULE REMOVAL & REPLACEMENT

For location of modules and connectors see Fig. 5.2.

6.1 GENERAL INFORMATION

6.1.1 Replacement of Fuses

Mains fuses are FS1 and FS2; FS3 is the RF input fuse. All are at the rear of the receiver. The fuse is in a screw-cap type holder; when unscrewed the fuse comes out with the cap. Fit the new fuse to the cap and screw into the holder.

Fuse ratings are as follows:

Mains	100–125 V or 200–250 V	4.0 A time lag	NSN 5920-99-529-3900.
RF input		2.0 A quick acting	Redifon MEL Part No. 221-090.

Fuse dimensions are 20 mm x 5 mm (0.8 in x 0.2 in).

6.1.2 Spare Modules

Spare modules are available for this equipment as listed in Table 6.1.

Orders for spare modules should be addressed to the Spares Department of Redifon MEL Ltd, quoting the Module Number, Description, Drawing Number and Part Number.

Table 6.1 R500N Module Identification

Module No.	Description	Redifon MEL Drg. No.	Redifon MEL Part No.
	HF Synthesised Receiver Type R500N	001/12071N	607-068
A1b	Aerial Filter Assembly	001/12233A	639-015
A2	Front Panel Assembly	001/12101N	627-065 (1)
A3	Keypad/Display PEC	001/12102NA	635-035 (2)
A4	Processor PEC (basic)	010/12103N	635-037 (3)
4IC1	EAROM (unprogrammed)		359-057 (3/4)
4IC2	EPROM	91/P38300/	
4IC3	EPROM		
	└─ Matched pair ─┘		
A5	Mixer PEC	001/12210A	627-009
6	Power Supply Unit Assy.	001/13637A	639-028
6a	Heatsink Assembly	010/12094A	639-019

- (4) If the voltmeter reading is outside these limits, remove the top cover from the unit and locate preset potentiometer R29 on PEC 6b. Adjust the potentiometer for an indicated voltage of $-30\text{ V} \pm 0.5\text{ V}$.
- (5) In the event that the correct reading cannot be obtained, reference should be made to the Repair Manual.

7.7.2 +5 V Supply

- (1) Connect the digital voltmeter between 1TS1 terminal 7 or 8 and chassis (meter -ve lead to chassis).
- (2) Check that the voltage reading is $+5\text{ V} \pm 5\%$ (4.75 to 5.25 V). If the reading is within these limits no further action is required. If the reading is outside these limits proceed as follows.
- (3) Switch the unit to STANDBY and remove the 4 crosshead screws securing the cover plate and Warning label to the heatsink assembly 6a.
- (4) Switch the unit ON, and locate preset potentiometer R23 on PEC 6a; this is accessible through a hole in the heatsink (towards the left hand end looking from the rear). Using an insulated screwdriver, adjust the potentiometer for an indicated voltage of $+5\text{ V} \pm 0.01\text{ V}$.
- (5) Switch the unit to STANDBY, disconnect the voltmeter and refit the cover plate and Warning label. Ensure that the appropriate face of the Warning label is displayed.
- (6) In the event that the correct reading cannot be obtained, reference should be made to the Repair Manual.

6 MODULE REMOVAL & REPLACEMENT

6.1 GENERAL INFORMATION

6.1.1 Replacement of Fuses

6.1.2 Spare Modules

Table 6.1 R500N Module Identification

6.1.3 Return of Modules for Repair

6.1.4 Replacement of Modules

6.1.5 Metric Fixings

6.1.6 Connector Removal

6.2 TUNER UNIT - 7

6.3 MIXER MODULE - A5

6.4 IF MODULE - A9

6.5 BFO/CIO/AF MODULE - A10

6.6 SYNTHESISER MODULE - 11

6.6.1 Access Only

6.6.2 Removal

6.7 REFERENCE FREQUENCY MODULE - B12 AND F1B MODEM - MODULE A13 (OPTIONAL)

6.8 MOTOR CONTROL MODULE - 8

6.9 PROCESSOR MODULE - 4

6.10 KEYPAD/DISPLAY MODULE - 3

6.11 POWER SUPPLY UNIT - 6

6.11.1 PEC - 6b

6.11.2 Heatsink Sub-Assembly - 6a

6.11.3 Complete Power Supply Assembly

6.12 FRONT PANEL ASSEMBLY

6.12.1 Removal

6.12.2 Replacement

Fig. 6.1 Front Panel Fixing Details

6.13 FAULTY MODULES RETURNED FOR REPAIR

6.13.1 Processor Module

6.13.2 Tuner Module

6.13.3 Keypad/Display Module

APPENDIX 1

SIMPLEX/DUPLEX MONITOR MP500

The MP500 is an option which may be used in conjunction with the R500N when the receiver forms part of a transmitter system.

SIMPLEX/DUPLEX MONITOR MP500

CONTENTS

1. DESCRIPTION
2. INSTALLATION
Table 2.1 'D' Connector SK2 Details
3. OPERATION
4. MAINTENANCE
5. REPLACEMENT
6. ILLUSTRATIONS
Fig 1 Rear Panel
Fig 2 Typical Cable Positioning
Fig 3 Front Panel
Fig 4 Circuit Diagram

SIMPLEX/DUPLEX MONITOR MP500

1. DESCRIPTION

The Simplex/Duplex Monitor MP500 is used in conjunction with the R500N receiver to provide switching for transmitter control of receiver muting and desense, with sidetone injection in the simplex mode. In duplex mode the receiver is demuted. The front panel provides a receiver AF output to a standard navy headset via a 19 way connector. Other receiver outputs, listed in Table 2.1 are available at rear panel socket SK2.

2. INSTALLATION

- (1) Fit the 1U high MP500 panel immediately adjacent, preferably below, the R500N receiver in a suitable 19 in (482mm) rack.
- (2) Fit the mating plug, part of rack wiring, to 15 way socket SK2 on the simplex/duplex monitor rear panel. See Table 2.1 for connection details.

Table 2.1 'D' Connector SK2 Details

SK2 Pin No.	Function
2	Ov (AF Line pair screen)
1	AF Line pair
9	AF Line pair
12	Ready (switching capability 24V 25mA)
13	Desense
5	Mute
4	Ov (mute)
11	Ov (sidetone screen)
3	Sidetone
10	Ov (sidetone)
8	Data screen
14	+ RTN data
6	- RTN data
7	- FWD data
15	+ FWD data

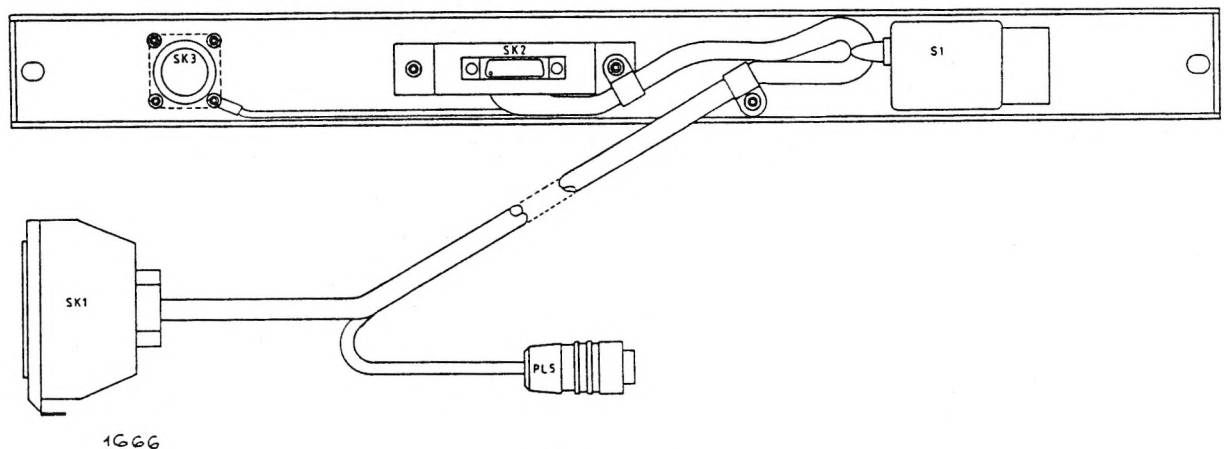


Fig 1 Rear Panel

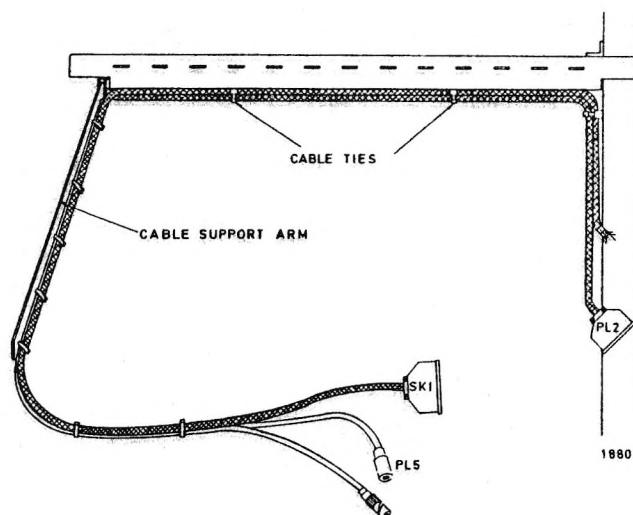


Fig 2 Typical Cable Positioning

- (3) Position cable from MP500, terminating in SK1/PL5, to follow route of rack wiring to rear of cabinet, via cable support arm to R500N. Fit cable ties to anchor cable. Fig 2 shows typical cable positioning. Ensure that cable is able to follow the R500N in its movement on telescopic slides with no risk of strain or fouling.
- (4) Connect socket SK1 to chassis mounted plug PL1 on the R500N receiver.
- (5) Connect plug PL5 to chassis mounted socket SK5 on the R500N receiver.
- (6) Set the MP500 front panel switch to DUPLEX and carry out the procedure in chapter 2, para 2.7 Installation Testing. Note that external RF Gain, desense, Sidetone and Mute functions are inoperative. Connect earphones to MP500 front panel socket SK3 and set R500N front panel loudspeaker pushbutton to OFF. Confirm that AF is audible from earphones and is controlled by the R500N front panel AF Gain control. The READY output should be operating.
- (7) Set the MP500 front panel switch to SIMPLEX and note that if the associated transmitter is not energised the R500N operates as in (6).
- (8) With the MP500 set to SIMPLEX and the associated transmitter energised the R500N should be Muted and desensed. The R500N service display should show MUTED and the transmitter AF output (sidetone) should be audible from the earphones.

3. OPERATION

- (1) With the MP500 set to DUPLEX the receiver will operate as described in chapter 3 Operating Instructions. If required connect earphones to SK3 on the MP500 front panel and switch the R500N loudspeaker off.

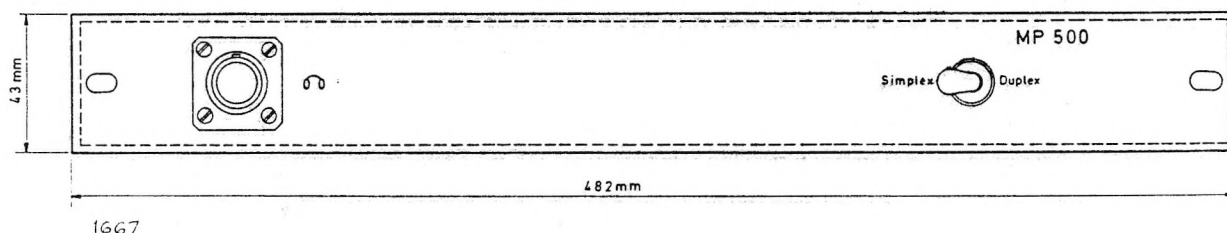


Fig 3 Front Panel

(2) With the MP500 set to SIMPLEX the receiver operates in conjunction with an associated transmitter. When the transmitter is not energised the receiver operates as described in chapter 3 Operating Instructions. When the transmitter is energised the receiver is muted and desensed. The R500N service display will show MUTED and the transmitter AF output will be audible from earphones, if connected, or the R500N loudspeaker.

4. MAINTENANCE

Should a fault occur in the simplex/duplex monitor remove it from the rack and replace with a new unit.

5. REPLACEMENT

Removal of a faulty unit requires the temporary removal of the associated receiver R500N to provide access. The cable ties securing the cable terminating in SK1/PL5 must be removed, and careful note made of the cable position, fig 2 shows a typical installation. Fitting of a new unit should follow the instructions in para 2 Installation.

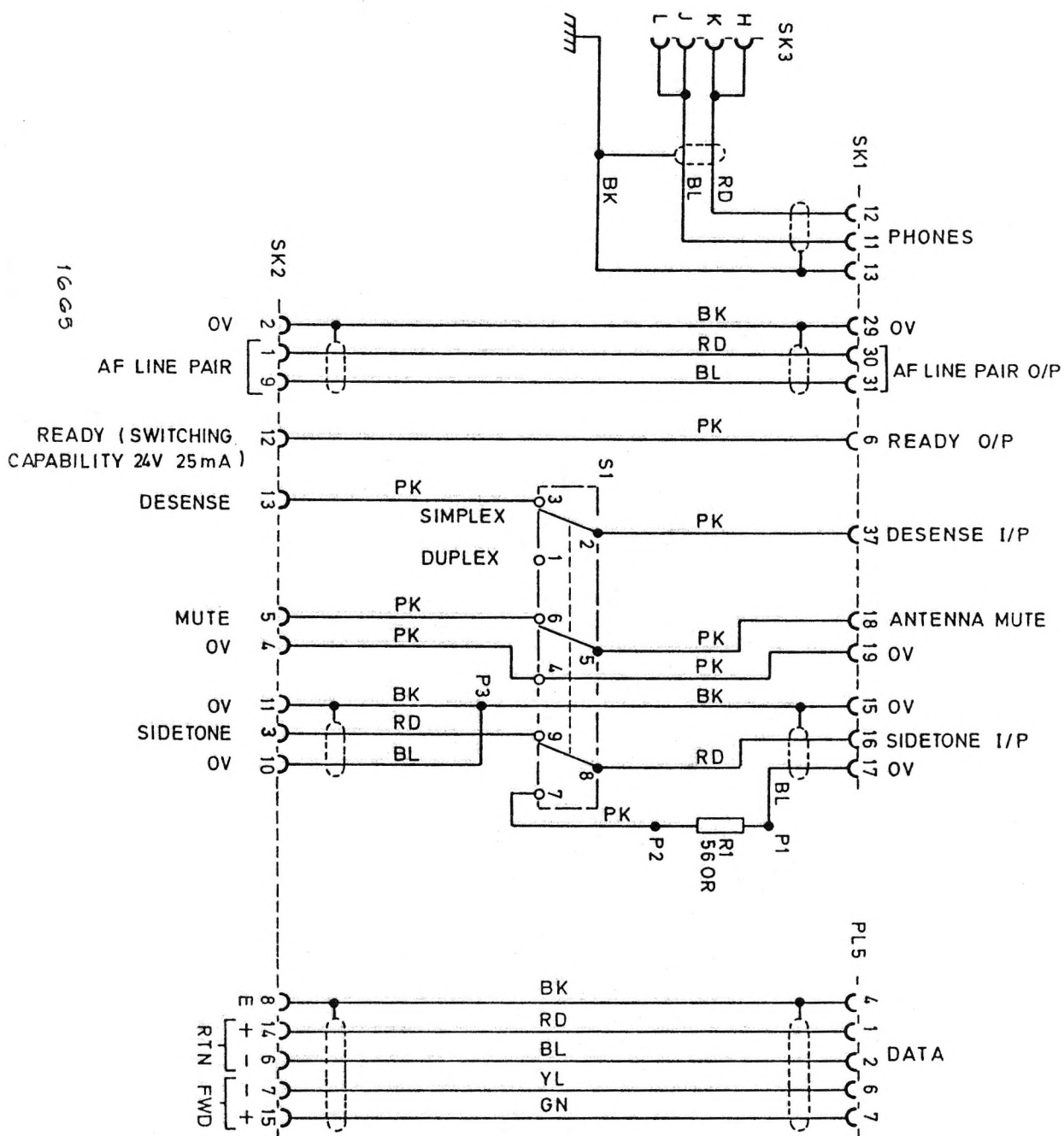


FIG 4 CIRCUIT DIAGRAM

CONTENTS

1 DESCRIPTION AND SPECIFICATION

- 1.1 DESCRIPTION
- 1.2 SPECIFICATION

2 INSTALLATION AND TESTING

- 2.1 UNPACKING
- 2.2 SITING
- 2.3 CONNECTIONS
- 2.4 TESTING

Table

- 2.1 MP505N to Receiver Connectors
- 2.2 Receiver Connection Details
- 2.3 Headphone Connection Details
- 2.4 System Connection Details

3 OPERATING INSTRUCTIONS

- 3.1 SIMPLEX
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- 3.3 CONFIDENCE CHECK

- 3.3.1 On Air
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4 MAINTENANCE

- 4.1 ROUTINE MAINTENANCE
- 4.2 REPAIR

- 4.2.1 Return of Equipment for Repair

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5 REPLACEMENT

6 ILLUSTRATIONS

- Fig. 6.1 Front Panel
- Fig. 6.2 Rear View
- Fig. 6.3 Typical Cable Positioning
- Fig. 6.4 MP505N Circuit Diagram
- Fig. 6.5 Confidence Check Block Diagram

1 DESCRIPTION AND SPECIFICATION

1.1 DESCRIPTION

Monitor Panel type MP505N is a 1U high panel used in conjunction with Redifon R500N and R505N receivers, to provide monitoring and interfacing facilities when used in the Integrated Communication System type ICS6. The unit provides a headphone signal for monitoring the receiver output and transmitter sidetone, and interfaces with the ICS6 control system for the following functions:

- Receiver remote control
- Receiver 'Ready' indication
- Receiver aerial input
- Receiver aerial muting
- System confidence check signalling.

There are no front panel controls on the unit (see Fig. 6.1). The front panel carries only a 19 way socket for connection of a standard headset.

The Monitor Panel is fitted with a flying lead which is terminated in 5 plugs/sockets for connection to the associated receiver, while connections into the control system are made at a 15 way socket on the rear of the Monitor Panel. In the ICS6 system, control is exercised by the Distribution Control Outfit (DCO) type KMY(1).

Each transmitter/receiver pair in the ICS6 system is operated in simplex, the receiver being muted whenever its associated transmitter is keyed. The transmitter drive unit and receiver of each pair are normally set to the same channel from the KMY(1).

Duplex operation may be obtained either by using the non-allocated receivers RxGP 1 - RxGP 3 (since these are not muted during transmission), or by using the receiver of a different pair (since that will not be muted by the transmitter in use).

A system confidence check can be invoked from the KMY(1). This check may be performed on any selected transmitter with any selected receiver, provided that they are set to the same frequency and mode. This condition will usually be met by transmitter/receiver pairs set to the same channel, but the 'flexible pairing' method employed permits comprehensive checking of the various transmit/receive paths. The confidence check arrangement is illustrated in block diagram form in Fig. 6.5.

The circuit diagram of the MP505N Monitor Panel is shown in Fig. 6.4.

1.2 SPECIFICATION

Dimensions	Height	43 mm (1 3/4 in)
	Width	482 mm (19 in)
	Depth	121 mm (4 3/4 in) overall including fixed connectors
		Unit occupies depth of 98 mm (3 7/8 in) behind front panel
		Full cabinet depth required for cabling

2 INSTALLATION AND TESTING

2.1 UNPACKING

Immediately on receipt of the equipment, examine the unopened packing case for signs of damage, then inspect the contents for damage or shortages. If any damage or shortage is found, notify the Carriers (if applicable) and the Quality Manager of Redifon Limited within 3 working days of receipt. Should it become necessary to return the equipment for any reason, contact Redifon Limited for details of the 'Return' procedure.

After inspection, partially repack the equipment and store in a clean dry area until required for installation. Avoid storage areas and wrapping which would subject the equipment to condensation or temperature extremes.

2.2 SITING

The MP505N Monitor Panel (shown in Fig. 6.1) is suitable for mounting in a standard 483 mm (19 in) rack or cabinet. The height of the front panel is 43 mm (1 3/4 in), and it occupies 1U of rack height. The Monitor Panel should be mounted immediately below the associated receiver, and is simply retained by its front panel screws.

Position cable from rear of Monitor Panel to follow route of existing rack wiring to rear of cabinet. Fit cable ties to anchor this cable to the rack side and to the cable support arm for the associated receiver; typical cable positioning is shown in Fig. 6.3. Ensure that the cable can follow the receiver in its movement on the telescopic slides, with no risk of straining or fouling.

2.3 CONNECTIONS

(1) At the rear of the R500N or R505N receiver, plug in the connectors listed in Table 2.1. For information, the connections to these plugs/sockets are detailed in Table 2.2.

TABLE 2.1 MP505N TO RECEIVER CONNECTORS

Cable connector	Connect to	Function(s)
R500N/R505N:		
SK1	PL1	AF monitor, Mute, Rx ready
PL2	SK2	Supply, AF/AF1 line output*
PL3	SK3	Aerial input
PL5	SK5	Remote control data
R505N only:		
SK7	PL7	AF2 line output

* AF line output from R500N, AF1 line output from R505N.

(2) At the rear of R500N receivers, dress back and secure the unterminated socket SK7 (no ISB connection).

(3) System connections are made at 'D' connector SK8 on the rear panel of the MP505N (see Fig. 6.2). These connections are detailed in Table 2.4.

(4) The input from the receive aerial is connected to SK6 on the Monitor Panel. This socket is mounted on the attenuator screened compartment (see Fig. 6.2).

(5) It only remains to connect the headphones to the 19 way socket on the MP505N front panel. The headphone connection details are listed in Table 2.3.

TABLE 2.2 RECEIVER CONNECTION DETAILS

MP505N Connector	Pin No.	Function
SK1	6	Rx ready
	11	0V for 12
	12	AF monitor output
	13	0V (screen)
	19	0V for 37
	37	Rx desense
	17	Linked to 18
	18	for aerial mute
PL2	3	0V for 20, 21
	6	+12V switched
	20]	AF/AF1 line output* (600Ω balanced line)
	21]	
PL3	-	Aerial input to receiver (coaxial)
PL5	1	+ Return data
	2	- Return data
	4	Earth
	6	- Forward data
	7	+ Forward data
SK7	4]	AF2 line output, ISB (600Ω balanced line)
	9]	
	5	Centre tap

* PL2 pins 20/21 provide AF line output from R500N, AF1 line output from R505N.

TABLE 2.3 HEADPHONE CONNECTION DETAILS

MP505N Connector	Pin No.	Function
SK4 (Front panel)	H, K J, L M	AF/AF1 monitor output* 0V for above Screen

* AF output from R500N, AF1 output from R505N. No provision is made for monitoring second ISB channel AF2.

TABLE 2.4 SYSTEM CONNECTION DETAILS

MP505N Connector	Pin No.	Function
SK8	1]	AF/AF1 line output
	2]	(600Ω balanced line)
	3	AF/AF1 screen
	4	0V for 12, 13
	5	Confidence check enable
	6	Earth for data lines (7, 8, 14, 15)
	7	+ Forward data
	8	- Forward data
	9]	AF2 line output, ISB
	10]	(600Ω balanced line)
	11	Centre tap for 9, 10
	12	Rx Ready signal
	13	Receiver desense
	14	+ Return data
	15	- Return data

2.4 TESTING

(1) Carry out the receiver Installation Testing in accordance with section 2.7 of the R500N User's Manual (handbook no. 1208-1) or the R505N User's Manual (no. 1239-1). Confirm that the receiver is operating correctly.

(2) If an ISB test signal is available with the R505N receiver, check that operation of the USB/LSB Monitor switch on the receiver causes the loudspeaker output to switch between the sidebands. Headphones plugged in to the receiver front panel jack socket will mute the loudspeaker, and will similarly switch between sidebands.

(3) Set the receiver Loudspeaker switch to Off (button out), and check that receiver audio output is heard from headphones plugged into the 19 way socket on the front of the Monitor Panel. Headphones connected at the Monitor Panel will not switch between sidebands on ISB.

(4) For non-allocated receivers RxGP 1, 2 or 3, it may be confirmed that the Rx Ready signal is available, by observing the Rx Ready lamp at Control Outfit KMY(1). However, this indication is conditional upon the System Control Unit RC160 not detecting any fault on the serial link to the particular receiver. For paired receivers Rx 1 - 7, this is not a true indication in any case, since it is provided by a hard wired link in the control console.

(5) With transmitter/receiver pairs being worked in simplex, the above reception conditions will be met only while the paired transmitter is not being keyed.

(6) When the paired transmitter is keyed, the receiver should be muted. Check that the R500N/R505N mode display shows the MUTED legend, and that the transmitter AF output (sidetone) is present in the Monitor Panel headphones.

(7) The 70 dB attenuator cannot be checked independently; it is switched in and out of circuit by commands on the 'Rx Conf.' control line during the confidence check run by the KMY(1).

3 OPERATING INSTRUCTIONS

3.1 SIMPLEX

(1) In the ICS6 system, the transmitter/receiver pairs work in simplex. The transmitter and receiver are normally set to the same channel from Control Outfit KMY(1). While the transmitter is not being keyed, receiver operation is as described in chapter 3 of the User's Manual (R500N, handbook no. 1208-1; R505N, handbook no. 1239-1).

(2) On ISB reception, the upper or lower sideband may be selected for monitoring (at the receiver) by operation of the USB/LSB Monitor switch on the R505N receiver front panel.

(3) If required switch the receiver loudspeaker off (L/S pushbutton out) and use the Monitor Panel headphones for monitoring purposes. Headphones connected at the Monitor Panel will not switch between sidebands on ISB reception.

(4) When the paired transmitter is keyed, the receiver is muted and the receiver mode display shows the MUTED legend. Transmitter AF output (sidetone) will be audible from the headphones.

3.2 DUPLEX

(1) In the ICS6 system, duplex working may be set up in one of two ways.

- (i) By using the non-allocated (general purpose) receivers RxGP 1, RxGP 2 or RxGP 3, since these are not muted during transmission.
- (ii) By using the receiver of a different pair, which will therefore not be muted by the transmitter in use.

(2) On duplex, the receiver operates as described in chapter 3 of the User's Manual (R500N, handbook no. 1208-1; R505N, handbook no. 1239-1).

(3) On ISB reception, the upper or lower sideband may be selected for monitoring (at the receiver) by operation of the USB/LSB Monitor switch on the R505N receiver front panel.

(4) If required switch the receiver loudspeaker off (L/S pushbutton out) and use the Monitor Panel headphones for monitoring purposes. Headphones connected at the Monitor Panel will not switch between sidebands on ISB reception.

3.3 CONFIDENCE CHECK

Confidence checks on the ICS6 communication system are carried out from Control Outfit KMY(1), and may be either 'On Air' or 'Off Air'. The check may be performed on transmitter/receiver pairs set to the same channel; it may also be performed on any selected transmitter with any selected receiver, provided that they are set to the same frequency and mode. A block diagram of the confidence check arrangement is shown in Fig. 6.5.

System parameters checked are gain, noise and AGC. These checks are carried out sequentially and automatically following selection at the Confidence Check panel of the KMY(1).

Notes ...

- (1) The transmitter and receiver pair to be checked must be set to the same frequency and mode.
- (2) If the pair being checked normally operate in two frequency simplex, it will be necessary to temporarily alter one of them for this check, and to return it to its operating frequency on completion.

3.3.1 On Air

- (1) When the On Air confidence check is initiated, the transmitter under test is modulated by a 1 kHz tone and transmits over the air in the normal way.
- (2) The radiated signal is picked up by the receive aerial, and is routed via the Aerial Multicoupler, the Aerial Switching Panel and the MP505N, to the input of the receiver under test.
- (3) A switching signal on the 'Rx Conf.' control line from the Confidence Check panel activates a pair of relays in the MP505N, inserting the 70 dB attenuator in series with the aerial signal to the receiver.
- (4) The demodulated 1 kHz output from the receiver is returned to the Confidence Check panel where it is measured and shown on the 'Gain' display.
- (5) A 1 kHz stop band filter is then inserted in the returned audio line (at the Confidence Check panel). The resultant noise level is measured and shown on the 'Noise' display.
- (6) The 'Rx Conf.' signal from the Confidence Check panel then switches off and removes the 70 dB attenuator from the receiver aerial signal path. The new audio level fed back to the Confidence Check panel is measured and compared with the previous level. The change in level is shown on the 'AGC' display, and gives an indication of the effectiveness of the receiver AGC.
- (7) On completion of these checks, all commands are returned to the non-active state. The transmitter and receiver may then be returned to their operational status by disconnecting them from the Confidence Check panel and re-allocating to a User. If one of the frequencies was altered as a preliminary to this check, it must be reset before being returned to operation.

Note ...

In using the On Air procedure there is a possibility of pick up from other transmissions using the same or adjacent frequencies. Therefore this test may not give consistent results on system performance.

3.3.2 Off Air

- (1) When the Off Air confidence check is initiated, the transmitter under test is modulated by a 1 kHz tone and its output routed to the dummy load in the Common Aerial Working Outfit CA100. This routing is controlled by the 'Tx Conf.' control line from the Confidence Check panel. The transmitter output should be set to its maximum level.
- (2) A -35 dB sample is taken from the dummy load and fed via the Confidence Check input of the Aerial Multicoupler (a further 40 dB attenuation), the Aerial Switching Panel and the MP505N, to the input of the receiver under test.

(3) A switching signal on the 'Rx Conf.' control line from the Confidence Check panel activates a pair of relays in the MP505N, inserting the 70 dB attenuator in series with the aerial signal to the receiver.

(4) The demodulated 1 kHz output from the receiver is returned to the Confidence Check panel where it is measured and displayed as before.

(5) The measurements of gain, noise and AGC function are then carried out as for the On Air check.

(6) On completion of these checks, all commands are returned to the non-active state. The transmitter and receiver may then be returned to their operational status by disconnecting them from the Confidence Check panel and re-allocating to a User. If one of the frequencies was altered as a preliminary to this check, it must be reset before being returned to operation.

Note ...

Provided that this test is conducted on a clear channel, the results will be more consistent than for the On Air check, since the measurements do not depend upon the performance of the aerials.

4 MAINTENANCE

4.1 ROUTINE MAINTENANCE

No routine maintenance is recommended beyond cleaning. Generally keep the exterior of the equipment clean and periodically inspect it, making sure that it is mechanically in good order.

At six monthly intervals, remove the front panel screws and swing the Monitor Panel forward from the rack (it will be retained by its wiring). Using a soft brush, remove any accumulation of dust from the unit. Check that all mechanical items are secure in their mountings. Carry out a visual check of the internal wiring, ensuring that any internal plug/socket connections are secure.

Examine the external cables, plugs and sockets for damage or corrosion - a thorough check may require removal of the associated receiver from the rack. Ensure that all units are refitted in their respective locations on completion.

4.2 REPAIR

No repair of the MP505N Monitor Panel is possible. Should a fault occur in the Monitor Panel, remove it from the rack and replace with a new unit.

4.2.1 Return of Equipment for Repair

Requests for the repair of faulty equipment should be forwarded to the Service Manager, at the address shown below. This panel also includes all relevant telephone numbers.

When returning an equipment, quote the equipment type and serial number, together with description and drawing/part number as given in Table 4.1. Also describe the circumstances and nature of the fault. Such requests must be accompanied by an official order, giving address(es) for dispatch and billing.

The Service Manager,	Telephone	0293-518855
Redifon Limited,	(International +44 293 518855)	
Newton Road,		
Crawley,	Fax	0293-561096
West Sussex,	(International +44 293 561096)	
England.		
RH10 2TU	Telex	877131

TABLE 4.1 EQUIPMENT DETAILS

Type	Drawing Number	Part Number
MP505N	001/13840N/1	617-120

5 REPLACEMENT

Replacement of a faulty MP505N Monitor Panel requires the temporary removal of the associated receiver R500N or R505N to provide access. Pull the receiver forward far enough to gain access to the earth strap (at the front right hand side of the unit, behind the front panel). Remove the strap, and slide the receiver out to the full extent of the runners. Remove all connectors from the rear of the receiver, and withdraw it from the rack.

Disconnect the plug from 'D' type socket SK8 at the rear of the MP505N, and remove the RF feed cable from SK6 on the attenuator screened compartment. Cut the ties securing the cable run from the Monitor Panel along the side of the rack and the cable support arm. Make careful note of the cable positioning (a typical arrangement is shown in Fig. 6.3). Upon removal of the front panel screws the Monitor Panel may be withdrawn.

Fitting and testing of a new unit should be in accordance with the instructions given in chapter 2 of this Appendix.

6 ILLUSTRATIONS



Fig. 6.1 Front Panel

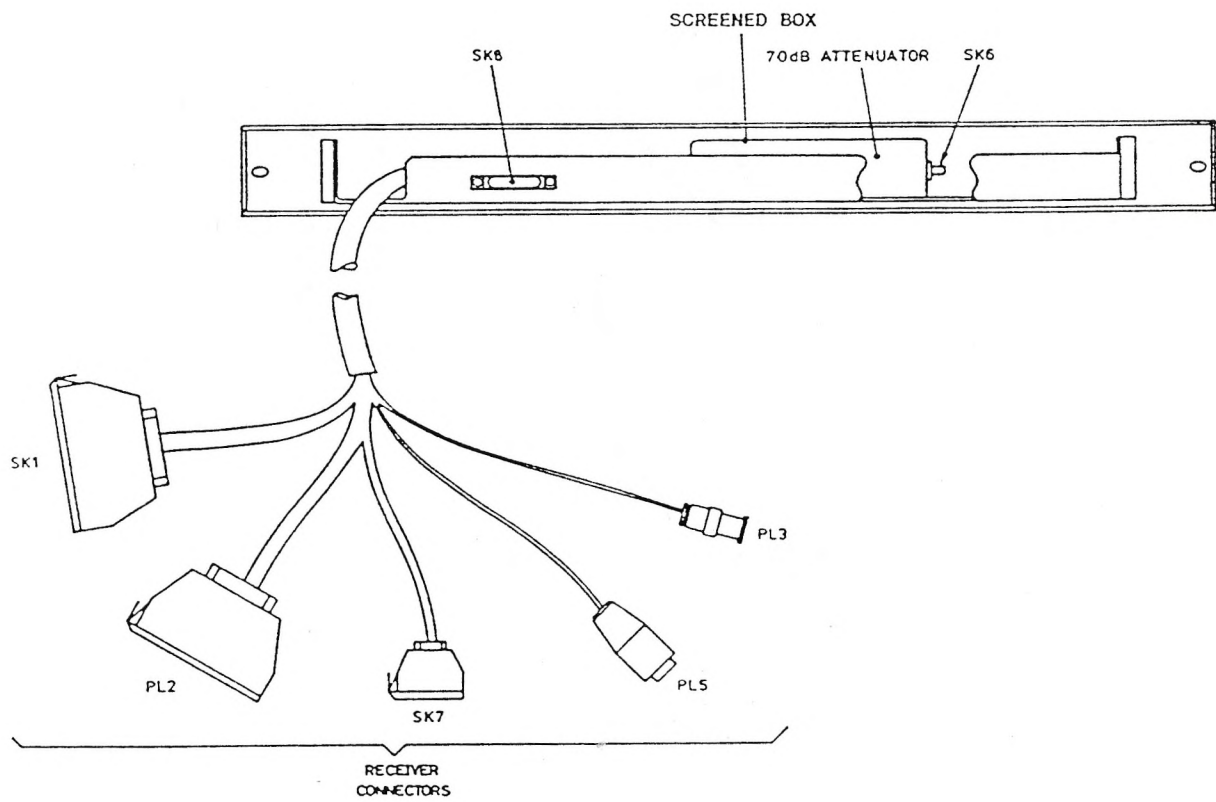
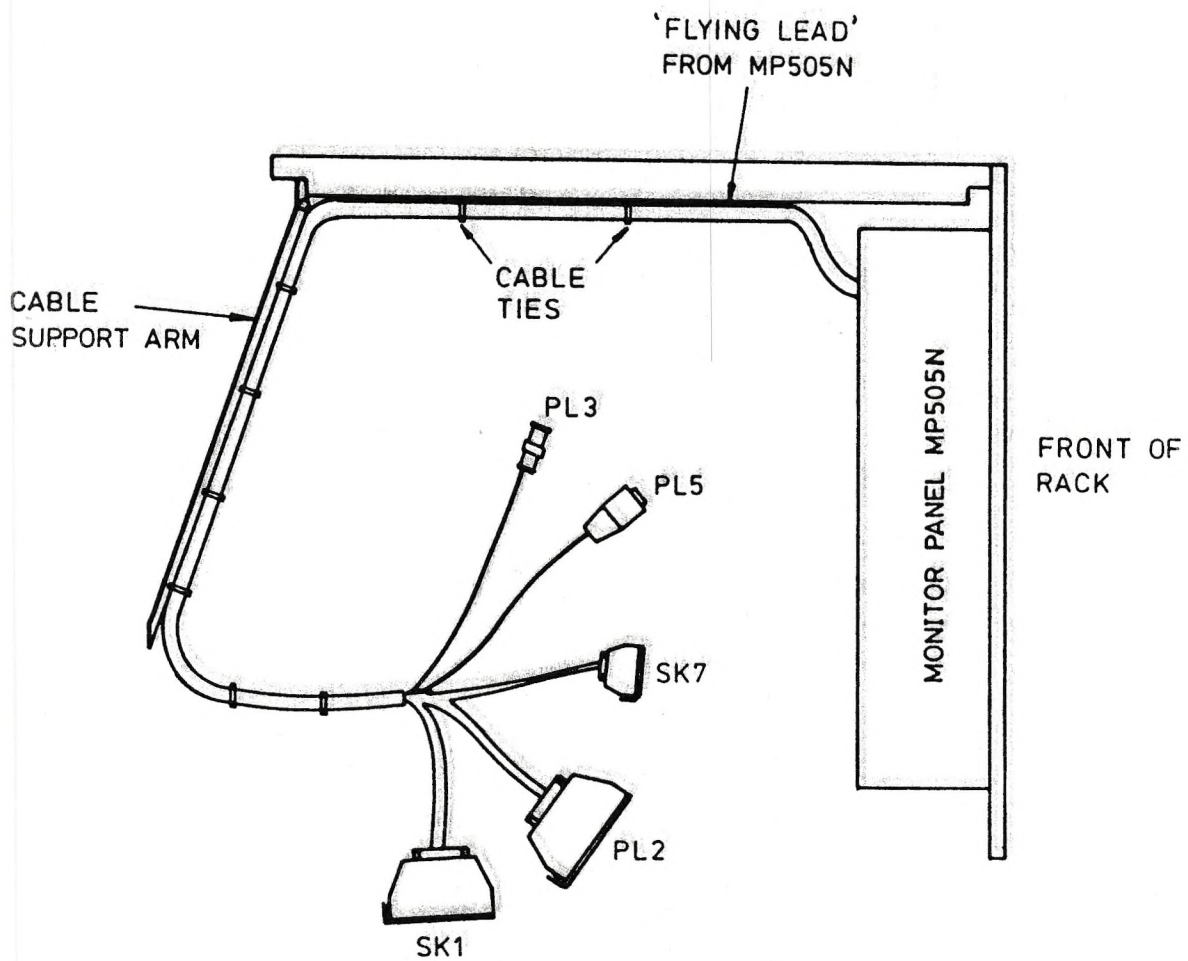


Fig. 6.2 Rear View



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Typical Cable Positioning

