

Technical Manual

RA. 1792 HF Receiver



RACAL
The Electronics Group

Racal Communications Limited Western Road, Bracknell, RG12 1RG England
Tel: Bracknell (0344) 3244 Telex: 848166 Grams: Racal Bracknell.
Prepared by Group Technical Handbooks Department, Racal Group Services Limited.
Printed in England Ref. TH 1496

Issue 4.3.81-500

LETHAL WARNING

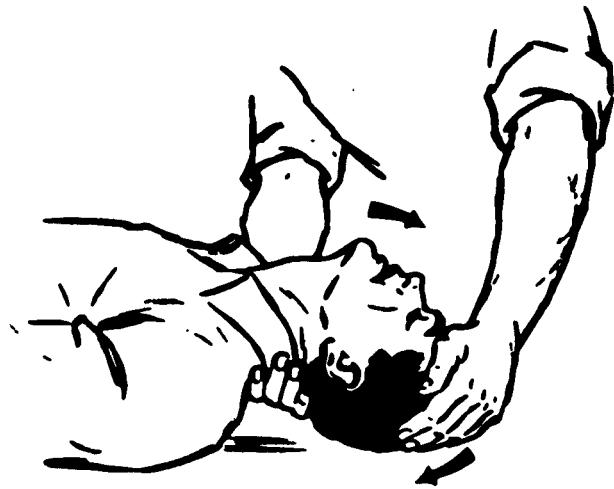
Voltages within this equipment are sufficiently high to endanger life.

Covers are NOT to be removed except by persons qualified and authorised to do so and these persons should always take extreme care once the covers have been removed.

Resuscitation instructions are given overleaf.

FIRST AID

in case of Electric Shock



1. Lay victim on his back.
2. Clear victim's mouth and throat.
3. Tilt victim's head back as far as possible and raise his head.



4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise. Note: Blow forcefully into adults, but gently into children.
7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at a rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible all the time.

Have someone else send for a Doctor
Keep patient warm and loosen his clothing

DO NOT Give liquids
until patient is conscious

HANDBOOK AMENDMENTS

Amendments to this handbook (if any), which are on coloured paper for ease of identification, will be found at the rear of the book. The action called for by the amendments should be carried out by hand as soon as possible.

'POZIDRIV' SCREWDRIVERS

Metric thread cross-head screws fitted to Racal equipment are of the 'Pozidriv' type. Phillips type and 'Pozidriv' type screwdrivers are not interchangeable, and the use of the wrong screwdriver will cause damage. POZIDRIV is a registered trade mark of G.K.N. Screws and Fasteners Limited. The 'Pozidriv' screwdrivers are manufactured by Stanley Tools Limited.

RA1792 - HF RECEIVER

CONTENTS

CHAPTER 1	GENERAL DESCRIPTION
CHAPTER 2	INSTALLATION
CHAPTER 3	OPERATION
CHAPTER 4	PRINCIPLES OF OPERATION
CHAPTER 5	FAULT FINDING PROCEDURES
CHAPTER 6	ALIGNMENT PROCEDURES
CHAPTER 7	PARTS LIST
CHAPTER 8	DIAGRAMS
APPENDIX 1	ISB IF/AF MODULE
APPENDIX 2	SCORE INTERFACE MODULE
APPENDIX 3	DC POWER SUPPLY MODULE
APPENDIX 4	FIRST LO SYNTHESIZER ST08545

CHAPTER 1

GENERAL DESCRIPTION

CONTENTS

<u>Para.</u>		<u>Page</u>
1	INTRODUCTION	1-1
6	FUNCTIONAL DESCRIPTION	1-2
14	MECHANICAL DESCRIPTION	1-3
16	REFERENCE DATA	1-4

TABLES

<u>Table No.</u>		<u>Page</u>
1	Reception Mode Codes	1-2
2	Receiver Module	1-4
3	Technical Specifications	1-5

ILLUSTRATIONS

<u>Fig. No.</u>	
1.1	Overall View, RA1792 Receiver
1.2	Functional Block Diagram

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

- 1 This manual contains detailed information on the installation, operation, and maintenance for the RA1792 Receiver. Chapter 1 contains general information and technical specifications. Chapter 2 contains installation data, and Chapter 3 contains detailed operating procedures. A detailed theory of operation is contained in Chapter 4, with Fault Finding and Maintenance data in Chapters 5 and 6. A complete parts list is contained in Chapter 7, with all circuit and wiring diagrams presented in Chapter 8.
- 2 The RA1792 receiver may be operated from a remote location through one of several different types of interfaces.
- 3 The RA1792 Receiver, shown in Figure 1-1, is a fully synthesized solid state receiver, suitable for all forms of reception and monitoring over the frequency range of 150 kHz to 30 MHz. Rapid and precise frequency selection in 10 Hz increments over the entire frequency range is achieved either through the use of a keypad or through the use of a single tuning control. The keypad permits instant selection of a new frequency regardless of the frequency the receiver is currently set to. The tuning control is an optically coupled device that provides a continuously variable tuning rate according to the speed at which it is turned. The receiver is also equipped with a 100 channel memory. Each channel may be preset to a particular frequency and operating mode through the front panel controls. When a particular channel is selected, the receiver will instantly tune to that frequency and mode. The receiver may also be set to a scan mode. In this mode the receiver will automatically scan 10 (or less) selected channels; stopping for a preset time interval (0.1 to 10 seconds) at each channel.
- 4 All receiver operating functions may be selected through the receiver front panel operating controls or through a remote device. Complete receiver status is shown through the liquid crystal display on the front panel.
- 5 The receiver provides reception capabilities for CW (A1), AM (A3), LSB/USB (A3J), FM (F3) and optionally ISB (A3B). Table 1-1 is an explanation of the international reception mode codes.

FUNCTIONAL DESCRIPTION

6 Figure 1-2 is an overall functional diagram of the RA1792 Receiver.

The input signal, in the range 150 kHz to 30 MHz, is fed through an RF amplifier stage and a 30 MHz low-pass filter to the first mixer. The amplifier stage may be bypassed if desired.

7 In the first mixer the received signal is combined with the output of the first local oscillator, a synthesizer covering the frequency range 40.605 MHz to 70.455 MHz in 10 Hz steps. This produces a first IF of 40.455 MHz which is fed through a crystal roofing filter of 16 kHz bandwidth and an AGC controlled amplifier to the second mixer. This roofing filter provides an additional selectivity option in the AM, CW, or FM modes.

TABLE 1-1. RECEPTION MODE CODES

Complete Designation Example:			
Bandwidth in kHz	2	A	2 H
	↑	↑	↑
	Type of Transmission	Purpose	Supplementary Characteristics
	A = AM	0 = No modulation	A = Single Sideband reduced carrier
	F = FM	1 = Telegraphy (on-off)	B = Two independant sidebands
	P = PCM	2 = Telegraphy (modulation)	C = Single sideband vestigial
		3 = Telephony	D = AM pulse
		4 = Facsimile	E = Pulse width modulation
		5 = Television	H = Single sideband, full carrier
		6 = Duplex Telegraphy	J = Single sideband, suppressed carrier
		7 = Multichannel Telegraphy	(None) = Double sideband, full carrier
		9 = None of the above	
Abbreviations:			
AM	= Amplitude Modulation		
CW	= Continuous Wave		
FM	= Frequency Modulation (or Phase)		
FSK	= Frequency Shift Keying		
ISB	= Independant Sideband		
LSB	= Lower Sideband		
MCW	= Modulated Continuous Wave		
PCM	= Pulse Coded Modulation		
SSB	= Single Sideband		
USB	= Upper Sideband		
DSB	= Double Sideband		

- 8 The 40.455 MHz first IF is combined with the fixed 40 MHz output from the second oscillator synthesizer to produce a 455 kHz second IF. After amplification, this second IF is routed to a bank of six 455 kHz filters which provide the main receiver selectivity. These are selected through front panel controls; or automatically, when a sideband mode is selected.
- 9 A second AGC-controlled amplifier follows before demodulation takes place. In the SSB/CW/AM modes a product/synchronous detector is used. The BFO synthesizer generates a fixed 455 kHz reinserted carrier for SSB detection, but in the CW mode this signal is either variable ± 8 kHz in 10 Hz steps or may be pre-programmed to provide a fixed offset BFO frequency. For AM reception the modulation is stripped off in the limiting amplifier and the resulting signal is applied to the carrier part of the product detector and mixed with the IF signal. For FM reception the 455 kHz second IF is brought through a limiting amplifier to a separate FM detector.
- 10 All three outputs from the synthesizers are referenced to an internal 5 MHz standard frequency source; or to external references of 1 MHz, 5 MHz, or 10 MHz.
- 11 The demodulated signal is fed through the audio crosspoint switch to separate AF amplifiers which provide outputs for a 600 ohm line, an internal loudspeaker and a headphone jack, and an external loudspeaker.
- 12 For LSB operation the optional ISB board provides the LSB signal path; while the receiver proper provides that for the USB. The LSB component of the 455 kHz second IF is processed through similar circuitry to that for the USB, with the common BFO synthesizer providing the reinserted carrier for demodulation. Two separate audio amplifiers provide 600 ohm line outputs for the two sidebands.
- 13 All command signals, whether from the front panel controls or from an extended remote operating position, are processed by the microprocessor assembly which is incorporated with non-volatile EAROMs located on the display assembly. These store pre-programmed frequency and mode information in each of 100 discrete channel locations for instant recall. Two separate buses carry control data and address information to/from the microprocessor/control assemblies. to the synthesizers for frequency selection, and to the appropriate switching circuits controlling the different operating modes.

MECHANICAL DESCRIPTION

- 14 A rigid, die-cast, full width chassis is used as the base for the main frame of the receiver. Mounted within compartments on the underside of this chassis are the mixer boards and the frequency generation system.
- 15 The input RF amplifier/low pass filter, main IF/AF, optional ISB IF/AF and power supply modules are located on the top surface of the cast chassis while the control and digital I/O modules are attached on the receiver main frame. All modules are accessible for maintenance and can be removed or replaced using simple hand tools without the use of a soldering iron.

REFERENCE DATA

16 Table 1-2 lists the different modules contained in the standard RA1792 receiver, the available optional modules, and the Racal part number for each module. The technical specification for the RA1792 is given in Table 1-3,

TABLE 1-2. RECEIVER MODULES

Designation	Module Name	Standard/Optional	Part No.
A1	Input RF Amplifier/Low Pass Filter	Standard	ST08233
A2	First Mixer	Standard	ST08184
A3	Second Mixer	Standard	ST08093
A4	Main IF/AF	Standard	ST08276
A6A2	Microprocessor	Standard	ST08203
*A7	First LO Synthesizer	Standard	ST80788
A8	Second LO/BFO Synthesizer	Standard	ST08283
A9A1	Front Panel Switch/Display	Standard	ST08198
A9A2	Front Panel Memory	Standard	ST08234
A5	ISB IF/AF	Optional	ST08109
A6A1	Remote Control SCORE Interface	Optional	ST08459
A10	AC Power Supply	Standard	ST 80734
A10	DC Power Supply	Optional	ST 80762
A11	Frequency Standard	Optional	ST08140

* Earlier Versions ST08545 (Appendix 4)

TABLE 1-3. TECHNICAL SPECIFICATION

Frequency Range	150 kHz to 30 MHz
Modes of Reception	USB/LSB (A3A, A3H, A3J, A2A, A2H, A2J) AM (A3) MCW (A2) CW (A1) ISB (A3B) optional FM (F3) Auxiliary - provides demodulated signal centred on optional fixed BFO offset frequency.
Tuning	Continuously tunable synthesizer in 10 Hz steps over the entire frequency range. Frequency setting either by numerical keypad or by single tuning knob with continuously variable tuning rate from 1 kHz per turn to approximately 20 kHz per turn, depending on the speed of rotation.
Pre-programmed Channels	EAROM memory unit may be programmed with up to 100 channel frequencies and mode which may be recalled by keypad or tuning control.
Channel Scanning	Automatic scanning of up to ten channels in any decade of the 100 stored channels. Dwell time on each channel variable in ten steps from 0.1 to 10 seconds; pre-selected by numeric keypad.
Frequency Stability	Dependant upon frequency standard used: 1. The following optional internal standard may be supplied: (a) Temperature Compensated Crystal Oscillator (TCXO): + 2 in 10^6 from -10°C to $+55^{\circ}\text{C}$. (b) Type 9442: (i) Temperature: ± 3 in $10^9/^{\circ}\text{C}$ (ii) Long term: ± 3 in 10^9 per day after 3 months continuous operation. 2. External standard input: 1 MHz, 5 MHz, or 10 MHz level 0 dBm into 50 ohms.
Antenna Input	(a) Wideband, 50 ohms to 75 ohms nominal. (b) The receiver will withstand without damage input signals of 50 V EMF continuously. (c) Re-radiation: (i) 0 to 30 MHz; not greater than 10 μV PD (ii) 30 to 100 MHz: not greater than 200 pW
Sensitivity	(a) CW and SSB (A1, A2H, A3A, A3H, A3J): In a 3 kHz bandwidth, signal-plus-noise to noise ratio is better than: 150 kHz to 1 MHz: 10 dB with 3 μV (EMF) input, 1 MHz to 30 MHz: 10 dB with 1 μV (EMF) input.

TABLE 1-3. TECHNICAL SPECIFICATION (Cont'd)

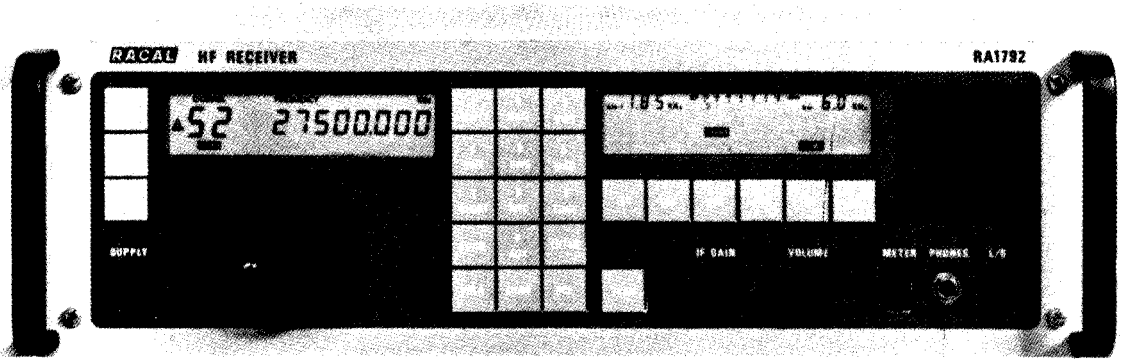
	(b) AM (A3): In a 6 kHz bandwidth, signal-to-noise to noise ratio is better than: 150 kHz to 1 MHz: 10 dB with 10 μ V (EMF) input, 70% modulated at 1 kHz, 1 MHz to 30 MHz: 10 dB with 3 μ V (EMF) input, 70% modulated at 1 kHz.
IF Selectivity	<p>USB: +250 Hz to +3.2 kHz at -6 dB AM1: > 3.2 kHz at -6 dB -400 Hz to +4.3 kHz at -60 dB < 12 kHz at -60 dB</p> <p>LSB: -250 Hz to -3.2 kHz at -6 dB AM2: > 6.0 kHz at -6 dB +400 Hz to -4.3 kHz at -60 dB < 20 kHz at -60 dB</p> <p>CW1: >300 Hz at -6 dB AM3: > 16 kHz at -6 dB < 3 kHz at -60 dB < 50 kHz at -60 dB</p> <p>CW2: >1 kHz at -6 dB < 6 kHz at -60 dB</p> <p>Note: A maximum of six filters may be installed, in addition to a 16 kHz bypass.</p>
Cross Modulation	With a wanted signal of 1 mV EMF in a 3 kHz bandwidth, an unwanted signal 30% modulated removed not less than 20 kHz, must be greater than 500 mV EMF to produce an output 20 dB below the output produced by the wanted signal.
Reciprocal Mixing	With a wanted signal of less than 100 μ V EMF in a 3 kHz bandwidth, and unwanted signal more than 20 kHz removed is generally greater than 70 dB above the wanted signal level to give a noise level 20 dB below the output produced by the wanted signal.
Blocking	With a wanted signal of 1 mV EMF, an unwanted signal more than 20 kHz removed must be greater than 1 V EMF to reduce the output by 3 dB.
Intermodulation Products	<p>(a) In band: Two 100 mV EMF signals within the IF passband will produce third order intermodulation products not greater than -50 dB at the IF output.</p> <p>(b) Out of band: With two 30 mV EMF signals, separated and removed from the wanted signal by not less than 25 kHz, the third order intermodulation products are not less than 90 dB below either of the interfering signals.</p>
Spurious Responses	(a) External (including image and IF rejection): External signals, removed more than 20 kHz from the wanted frequency, must be greater than +80 dB relative to 1 μ V EMF to produce an output equal to that produced by a 1 μ V EMF signal at the wanted frequency.

TABLE 1-3. TECHNICAL SPECIFICATION (Cont'd)

AGC	<p>(b) Internal: The presence of an internally generated spurious response generally will not degrade the specified receiver sensitivity by more than 3 dB.</p> <p>(a) Range: An increase in input of 110 dB above 2 μV EMF will produce an output change of less than 2 dB.</p> <p>(b) Time constants: Short, medium and long - preset to be automatically selected by mode switching, but can be set independantly by push-buttons. AGC lines are available at rear of receiver to permit remote control.</p>
IF Gain Control	<p>Control range 110 dB: Gain control may be switched either to manually set receiver gain or AGC threshold.</p>
BFO	<p>(a) Variable by main tuning control, ± 8 kHz, synthesized in 10 Hz steps.</p> <p>(b) Pre-selected fixed offsets may be selected for use with external demodulator.</p>
Pre-set Operating Conditions	<p>Bandwidth, AGC time constant, and BFO offset may be pre-set for each mode so that they are automatically recalled when the mode is selected.</p> <p>'Auxiliary' mode may be set up for any mode, bandwidth, AGC time constant and BFO offset.</p> <p>In the ISB mode, different AGC time constants may be stored for the two sidebands.</p>
IF Output	<p>455 kHz, nominal 100 mV into 50 ohms.</p>
Muting	<p>60 dB minimum by grounding rear panel connection.</p>
AF Output	<p>(a) Line output, 10 mW maximum into 600 ohms balanced, adjustable by internal preset level control.</p> <p>(b) Phone output, 1 mW maximum into 600 ohms unbalanced.</p> <p>(c) 200 mW maximum to internal loudspeaker which may be switched in or out of operation.</p> <p>(d) Connection for external loudspeaker, 200 mW into 16 ohms; 400 mW into 8 ohms.</p>
Metering	<p>Front panel display switched to indicate RF level or AF level output to line.</p>
Power Supply	<p>AC: Selections for 110, 120, 220, or 240V operation; +10% -15%. 45 to 65 Hz. DC: Receiver may also be operated from an 18 to 32 V dc source when receiver is equipped with optional dc power supply.</p>

TABLE 1-3. TECHNICAL SPECIFICATION (Cont'd)

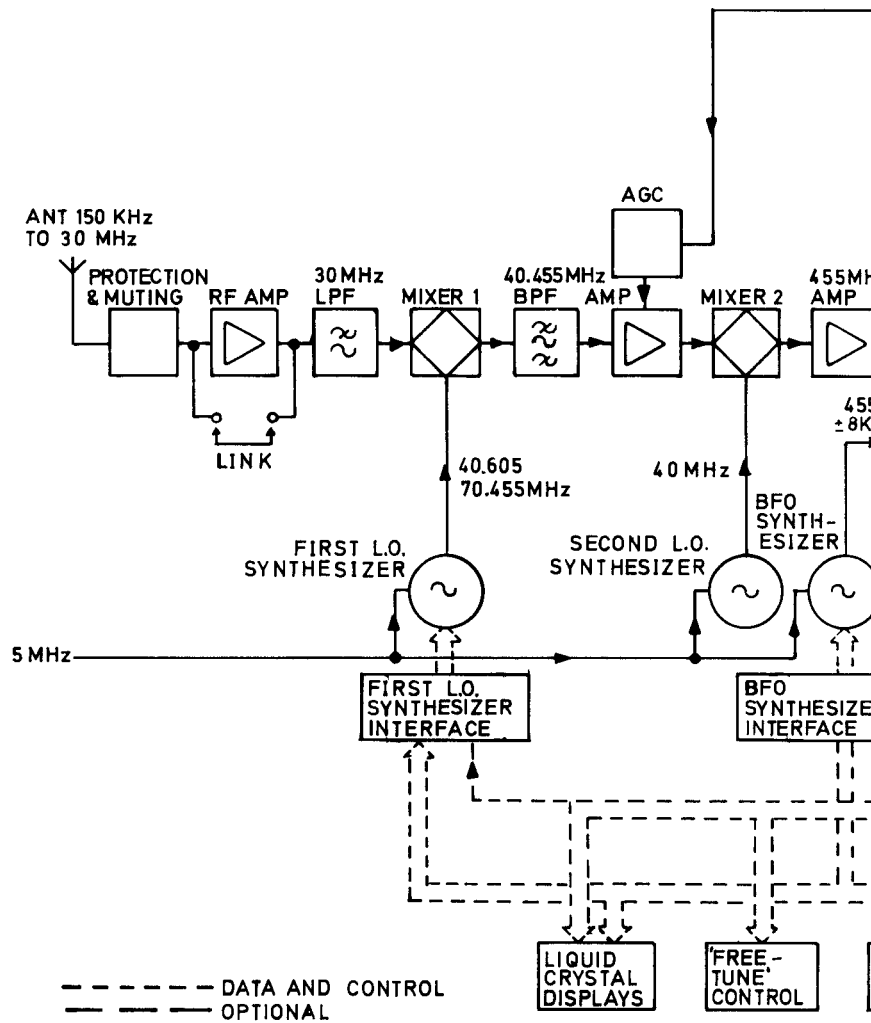
Power Consumption	Approximately 60 VA for ac operation; approximately 40 Watts for dc operation.
Environmental Conditions	(a) The equipment is designed to operate under the following climatic conditions: Operating temperature -10°C to $+55^{\circ}\text{C}$ Storage temperature -40°C to $+70^{\circ}\text{C}$ Relative humidity 95% at $+40^{\circ}\text{C}$ (b) The equipment is suitable for mobile operation. (c) The equipment is suitable for air transportation in unpressurized conditions and for operation up to altitudes of 3500 meters above sea level.
Dimensions	Height - 133 mm (5.25 in.) Width - 483 mm (19 in.) Depth - 458 mm (18 in.)
Weight	14 kg (31 lbs).

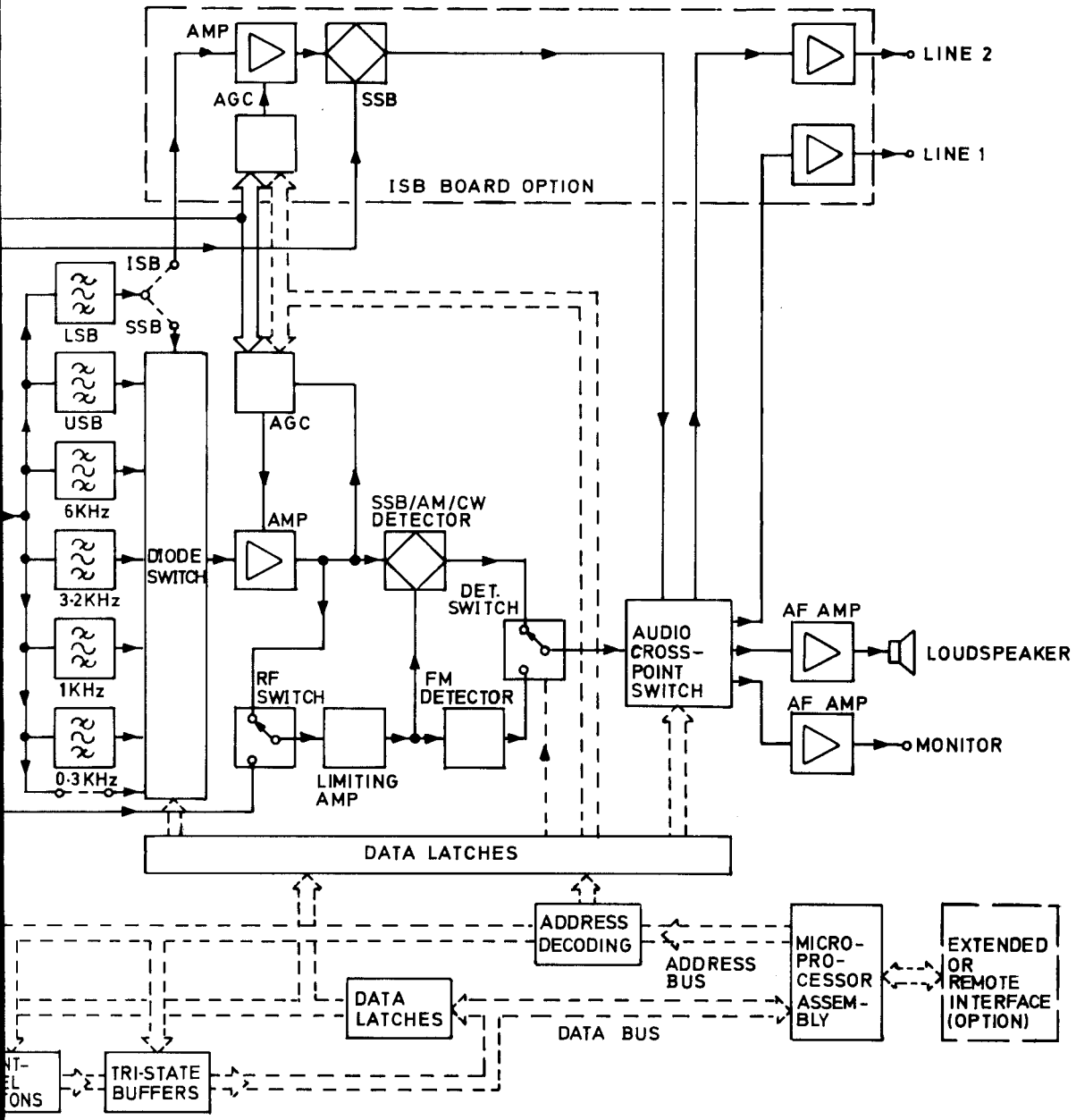


RACAL
TH1496

Overall View, RA1792 Receiver

Fig.1-1





Functional Block Diagram Fig.1.2