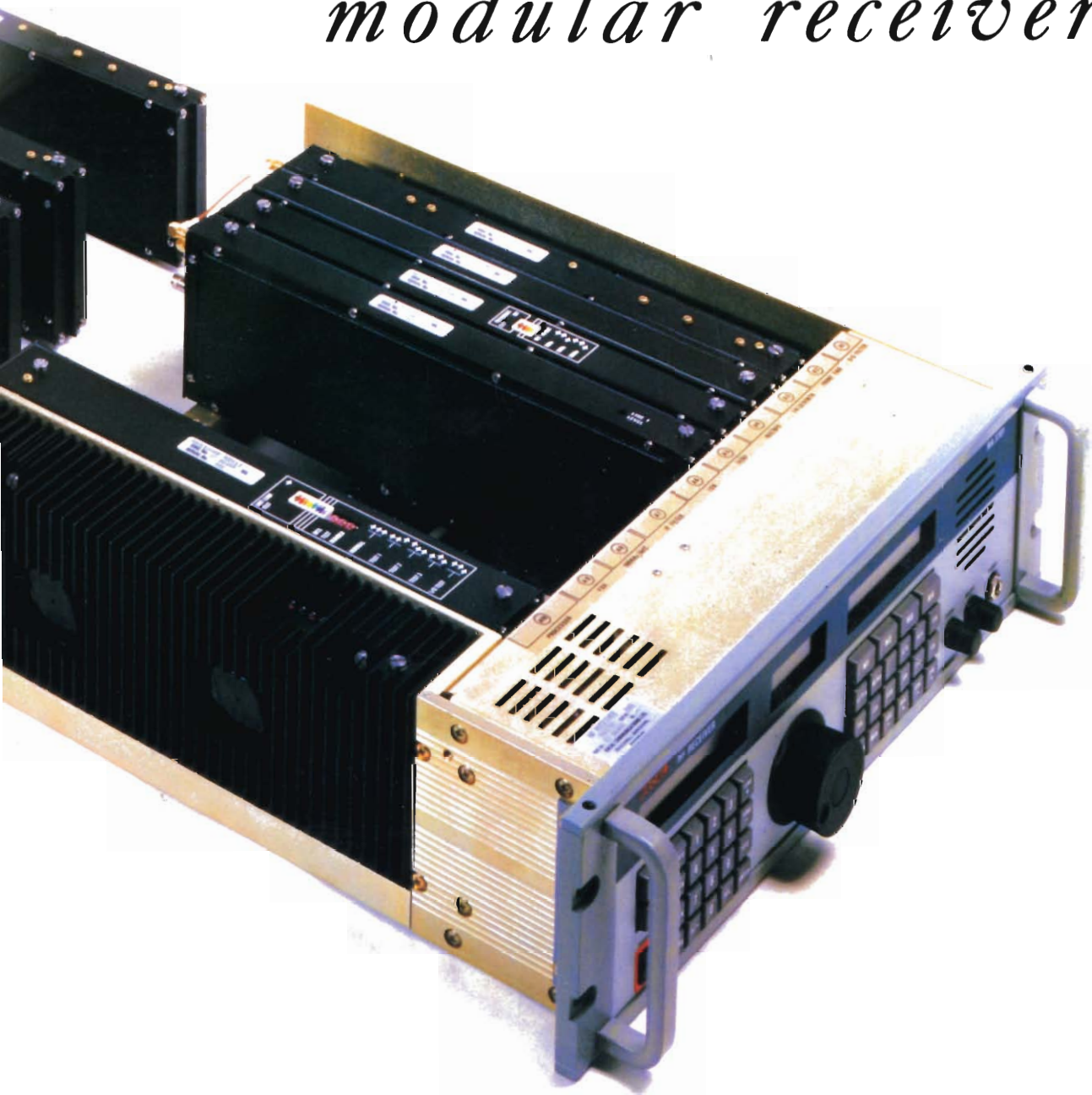




RA3700
S E R I E S

modular receivers



RACAL

R A C A L C O M M U N I C A T I O N S

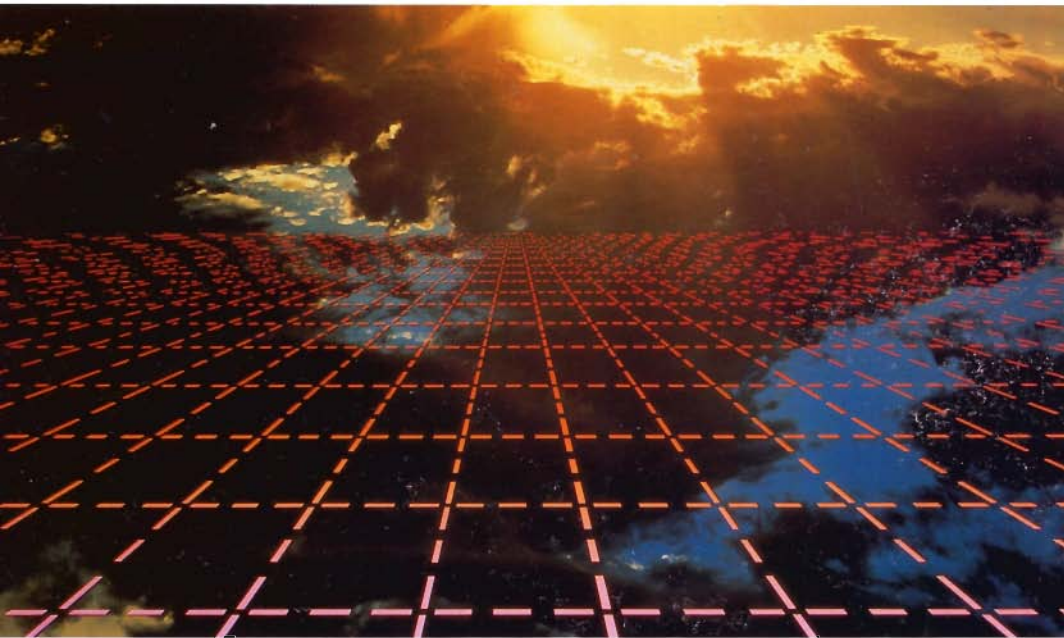
Racal is the international company which has grown from early successes in receiver design. The RA3700 Series of receivers is a product of these past achievements.

Employing a modular concept, the receivers are assembled to meet a variety of requirements from VLF to UHF, providing an economic, flexible solution with many logistic advantages.

Using the most modern design and construction techniques, the RA3700 Series of receivers meets a demanding set of performance specifications, enabling the equipments to be used in the widest range of applications.

This brochure provides information about the extensive range of facilities offered by the RA3700 Series of receivers.

a new generation



operational roles

- Point to Point Communications
- Radio Surveillance
- Direction Finding Systems
- Land, Sea or Air
- Fixed or Transportable
- Computer-Controlled Systems

applications

- Government Communications Agencies
- Defence Forces
- Special Forces
- Police Services
- Coastal and Offshore Operations
- PTT Organisations
- Broadcast
- Diplomatic Services
- Air Traffic Control
- Meteorological Systems
- News Agencies

a profile

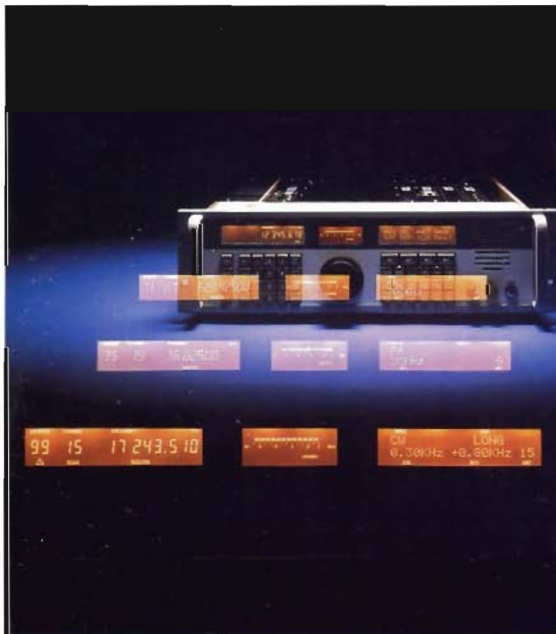
The Series comprises receivers covering the ranges VLF to UHF, receiver control units and a number of modules which enable extra facilities to be provided.

Dual receiver configurations within the same chassis are also available.

As well as independent operation, the units are provided with a multi-addressing capability.

Ease of operation is ensured by the well laid out front panel and careful design of controls. Single function buttons control the most commonly used operations and four keys control the receivers' many special facilities by means of a menu system.

Three display panels provide receiver status information, metering, and control messages to the operator. Many features appreciated by operators have been included, such as changing direction when sweeping or scanning by



a single key operation, changing receiver settings whilst sweeping, and a selection of tuning rates.

Test and repair facilities also feature strongly in the design of the receivers. The comprehensive built-in test equipment (BITE) may be operated locally or remotely and locates faults to module level. Module test and repair can be carried out to component level with the modules plugged into the receiver, thus eliminating the need for special-to-type test equipment. Modules can be changed on site by the operator; no realignment is needed, and Mean Time to Repair is exceptionally low.

Because of the demands of the VLF to HF environment, resources have been concentrated on applications within this range. Development continues to extend the Series into the VHF/UHF frequency bands.

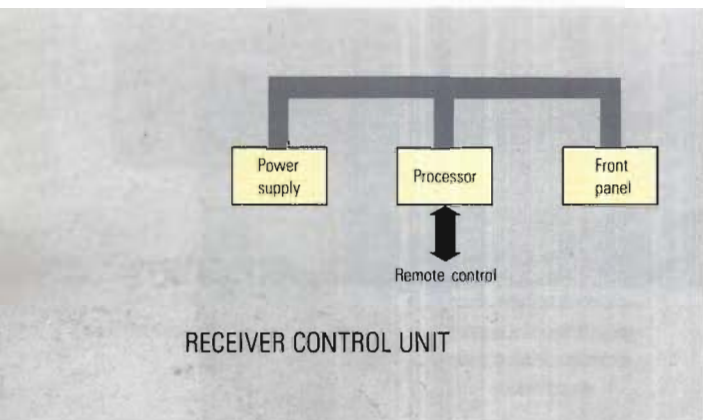
construction

An open frame arrangement is used to support the front panel, power supply unit and a number of plug-in, screened modules. This construction permits easy access and replacement of modules.



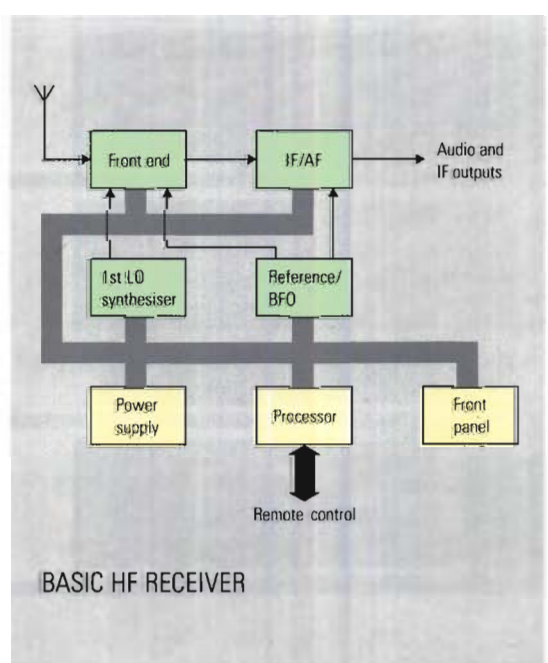
receiver control unit MA 3700

The receiver control unit comprises power supply, the processor module and the front panel assembly. In this configuration it can be used for remote or extended control of all receivers in the RA 3700 Series.



basic HF receiver RA 3701

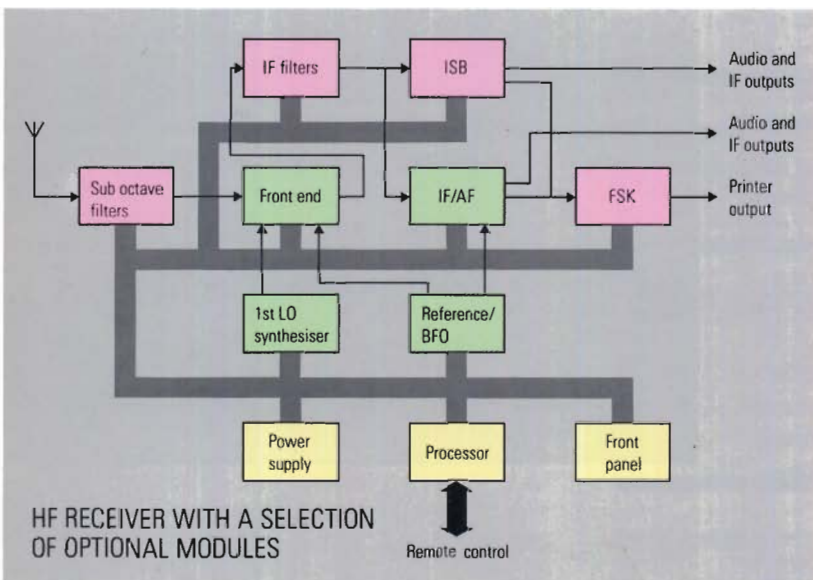
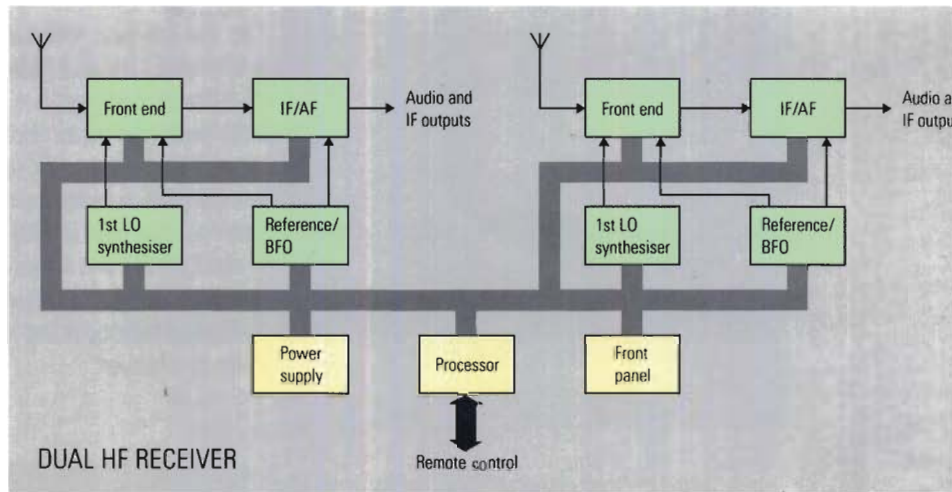
Four additional modules are added to form the RA 3701 basic receiver.



ar concept

dual HF receiver RA 3702

A further four modules are added to form the RA3702 dual HF receiver.



optional HF modules

In the basic receiver configuration there are five unused module positions which may be used to accommodate the range of optional modules, (shown on the right), and thereby enhance the facilities provided.

module options include

- Sub-octave RF Filter Module. Filters the antenna signal and improves intermodulation performance.
- IF Filter Module. 7 additional filters supplementing the 5 provided in the basic HF receiver.
- ISB Module. For demodulation of independent sideband signals.
- FSK Demodulator Module. For demodulation of frequency shift keyed signals.
- 100kHz IF Output Module. Converts standard 1.4MHz IF to 100kHz.
- Alternative Power Supply Module. Provides dc operation (18 to 32 volts).
- Frequency Standard. 3 separate built-in options to meet different stability requirements.

Product information is available in separate leaflets.

operating features

- Well laid out front panel.
- Logical control functions.
- Fast, easy operation.
- Basic receiver facilities selected by single function key operation.
- Menu System for special facilities.
- Keypad or knob tuning, with selectable tuning rates.
- Passband tuning for improved audibility.
- 100 User selected channels, storeable in non-volatile memory.
- Comprehensive sweep and channel scanning facilities with direction change.

left-hand keypad and tuning knob

The left-hand keypad and the tuning knob control the main operating functions. They are summarised below.

FREQ (Frequency) – Used to enter the frequency in conjunction with the numeric keys. Pressing ENTER tunes the receiver to the selected frequency.

CHAN (Channel) – Displays the last channel number selected and the settings for that channel. The channel number can be changed either using the numeric keys or the tuning knob. Pressing ENTER sets the receiver to the displayed settings.

SCAN – Stops/Restarts channel scan and bandsweep operation which are initiated using the menu system. Automatic stop on detection of a signal may also be selected. Up to 100 channels may be scanned with programmable start/stop channels and dwell time. Nominated channels may be inhibited. Bandsweep has programmable start/stop frequencies, step size and sweep rate.

STORE – Stores frequency, AGC, mode, bandwidth and BFO settings in up to 100 channels. Bulk erasure of the memory is possible from the front panel or remotely.

TUNE and **TUNE**

These keys have 2 functions:

- To select the tuning rate when the main knob is being used to tune the receiver. LOCK, SLOW, MEDIUM, FAST and VARIABLE tune rates are available.
- During scanning operation, to increase or decrease the dwell time.

front panel displays

displays

There are 3 back-lit liquid crystal display panels with adjustable brilliance and viewing angle.

- The left-hand display indicates Frequency, Channel Number, Receiver Address, and Receiver Status conditions.
- The central meter displays RF, AF, and a tuning scale for use with the FSK option. It also indicates the currently selected main tuning knob function.
- The right-hand display indicates Mode, Bandwidth, AGC, BFO, and Antenna Selection settings. It is also used in conjunction with the Menu System; status messages and instructions to the operator are displayed.



BFO – Enables the BFO frequency to be set in CW mode, either using the main tuning knob or the +/- key and numeric keys.

ENTER – Causes the receiver to operate on new setting of frequency, channel, or BFO frequency.

+/- – Controls direction of channel scan or frequency sweep during operation.

RCL (Recall) – Whenever pressed, recalls present receiver operating conditions to front panel.

remote control

The REM and ADDR (Remote and Address) keys on the left of the front panel are used to operate remote control facilities. The receiver can be used in a number of remote control configurations which are explained on page 8.

The ADDR button enables entry of the address of the remote receiver which is to be controlled, from the local front panel. The address is keyed in using the numeric pad. Displays indicate the remote receiver's settings. Receiver settings may be transferred ('hand-off') in either direction. While in control of a remote receiver, the local receiver continues to operate on its current setting.

The REM button may be used to return the unit to local control.



right-hand keypad and gain control knobs

M1, M2, M3, M4 – These keys control the menu system which is explained on Page 6.

METER – Selects RF and AF metering and tuning indicator. The tuning facility is only available when the optional FSK module is fitted.

MENU – Selects menu system levels.

L/S (Loudspeaker) – Internal loudspeaker ON/OFF.

AUX (Auxiliary) – Using this key a combination of mode, bandwidth, AGC and BFO settings may be preset using the menu system and recalled for use with auxiliary equipment.

FSK, ISB, LSB, USB, AM, CW, FM – Receiver mode selection. When a mode is selected, the AGC, bandwidth and BFO settings last used in that mode are set automatically and displayed.

SQLCH (Squelch) – Enables or disables squelch system. When enabled, 'SQ' is displayed and the IF gain control may be used to set the squelch threshold.

MAN (Manual) – Allows IF GAIN control knob to be used to set receiver gain, or AGC threshold in conjunction with AGC₊ and AGC₋ keys.

AGC₊, AGC₋ – Increases or decreases the AGC decay time.

BW₊, BW₋ – Increases or decreases the receiver bandwidth.

IF GAIN – Sets receiver gain, AGC threshold, and squelch level.

VOLUME – Sets audio output level of loudspeaker and headphones.

the menu system

The menu system uses four keys (M1, M2, M3, M4) to control special facilities. It is advanced through several levels using the MENU key. Pressing RCL returns the receiver to normal operation. At each level, four options may be selected, and the user is instructed how to proceed by messages in the display panel. The menu levels and options are summarised below.

LEVEL	OPTION			
	M1	M2	M3	M4
1	Frequency Sweep	Channel Scan	Antenna Select	Passband Tuning
2	Erase Channels	Set Modes	Spare	Spare
3	Unit Test	Select Test	Factory Test	Show Fault
4	Tune List	Bandwidth List	AGC List	Spare
5	Diversity Master	RF Amplifier	COR Select	Display
6	Bandwidths	Serial Ports	Frequency Resolution	Serial Number

The displays show a typical menu sequence to set-up Channel Scanning.

Select 'M2'.

FREQ SWEEP CHAN SCAN ANT SEL PBD TUNE

M1 M2 M3 M4

Use numeric keys to enter start channel.

Enter Start Channel
01

Enter Stop Channel
10

Enter dwell time
1.00 s

Select 'M1' or 'M2'.
Current selection marked by **

Stop on COR
ON OFF

M1 M2 M3 M4

Receiver now starts scanning the range set up.

CHANNEL 08 FREQUENCY 12 345.678 kHz
SCANNING



The unit has extremely comprehensive BITE facilities which may be controlled locally and remotely. It operates at five levels:

- Automatically at power-up, providing basic processor module and memory tests.
- Continuous monitoring of correct operation.
- Operator initiated confidence check, providing a complete automatic self-test of all modules. The receiver is out of service during this test.
- Fault finding, which calls up any of the automatic tests on request and includes signature analysis. Tests requiring manual intervention, such as remote control loop-back tests, are included at this level.
- Factory Test. The receiver cycles continuously through its automatic self-test.

Results of tests are displayed and faults can be investigated further using the BITE menu facilities, instructions being provided to the operator at each step.

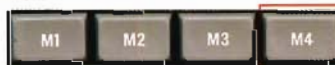
Fault indicated while receiver is being operated.

FREQUENCY MHz
12 345.678
FAULT

Select BITE menu.

Select 'M4' to SHOW FAULT.

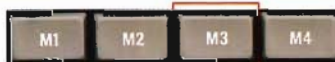
UNIT SEL FACT SHOW
TEST TEST TEST FAULT



Faulty module is indicated.

Select 'M3' for MORE information.

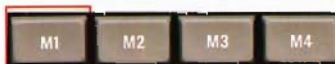
Front End (H)
INC MORE EXIT



2nd mixer drive level is incorrect.

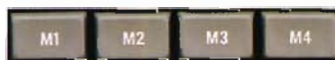
Select 'M1' to increment the display to the next fault.

2nd mix drive lvl
INC EXIT



There are no more faults.

No more faults
EXIT



8 *remote control operation*

configurations

The equipment may be used in a number of remote control configurations.

- **AS A REMOTE CONTROLLER.** Using its front panel built-in multi-address capability, up to 100 separately addressable remote receivers may be controlled. All front panel operating functions except power on/off switching can be controlled remotely. Where the controlling unit is also equipped as a receiver, the receiver continues to operate on its current settings while the front panel is being used for remote control purposes.
- **AS A REMOTE RECEIVER.** When the receiver is being remotely controlled, it displays its operating status. Alternatively, its front panel module may be replaced by a blank front panel.
- **IN DIVERSITY OPERATION.** Two separate receivers are controlled together from one front panel.

control

Remote control data is exchanged using ASCII serial data at speeds up to 9.6k baud. An RS423 (RS232 compatible) interface provides computer compatibility.

ease of repair

UNIT REPLACEMENT. Receiver BITE will identify a faulty unit.

MODULE REPLACEMENT. Receiver BITE will identify faults to a particular module and this can be replaced on site by simple exchange. No receiver realignment is needed.

REPAIR TO COMPONENT LEVEL. All fault finding to component level can be carried out with the modules plugged in, using the receiver as a test bed. Only standard proprietary workshop test equipment is required.

RA3701
RA3703

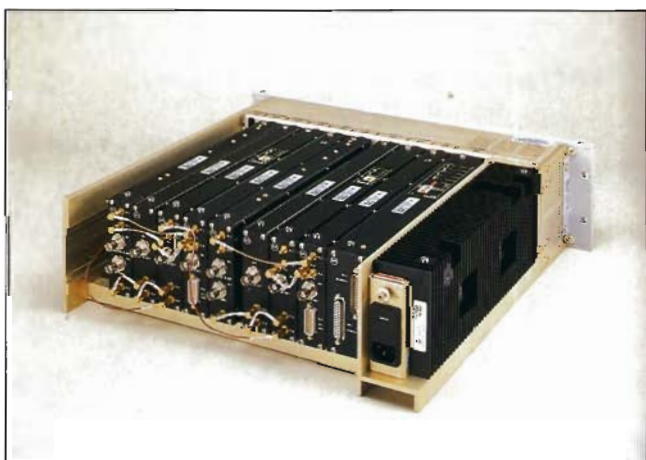
RA3702
RA3704

MODULAR HF RECEIVERS



KEY FEATURES

- Frequency range 15kHz to 30MHz.
- High RF performance.
- Modular construction.
- Wide range of optional modules.
- Automatic scanning of channels and frequency.
- Serial ASCII or IEEE 488 control.
- Controller of slave receivers.
- Simple to operate.
- Comprehensive BITE.



DESCRIPTION

This family of high performance HF receivers covers the frequency range 15kHz to 30MHz.

Using a highly modular design, the same frame and modules can be configured to assemble receivers to meet a variety of different applications.

The family includes single and dual receivers and a range of optional modules may be fitted to enhance the receiver facilities. The following receivers are available:-

RA3701 Single HF Receiver with front panel controls.

RA3702 Dual HF Receiver with front panel controls.

RA3703 Single, remotely controlled HF Receiver.

RA3704 Dual, remotely controlled HF Receiver.

Each of the receivers includes, as standard, a serial ASCII remote control interface with a built-in multi-addressing capability of up to 100 receivers. Alternatively, an IEEE 488 interface may be fitted. Slave receivers may be controlled in a number of ways: by computer; by using the MA3700 receiver control unit; or by the RA3701 and RA3702 receivers, which have built-in controller facilities. All front panel operating functions except power on/off switching can be controlled remotely.

Single function buttons control the most commonly used operations and four keys control the receivers' many special facilities by means of a menu system.

Comprehensive built-in test equipment (BITE), locates faults to module level and may be controlled remotely as well as locally from the front panel.

The RA3701 is a registered design in the UK (1033864) and the Federal Republic of Germany (URA1416/86).

The frequency synthesizer is patented in the UK (2026268) and the US (4204174).

RACAL COMMUNICATIONS

RA3701
RA3703

RA3702
RA3704

TECHNICAL SPECIFICATION

Frequency range

15kHz to 30MHz in 1Hz or 10Hz steps.

Tuning

By numeric keypad or single spinwheel tuning knob with selectable tune rate.

Modes of operation

CW	A1A
MCW	A2A
AM	A3E
FM	F3E
USB/LSB	R2A, H2A, J2A, R3E, H3E, J3E

Options:

ISB	B7E, B8E, B9E (RA3701, RA3703)
FSK	F1B

BFO

Tunable +/-9.99kHz in 10Hz steps using the main tuning knob or by keypad entry.

Channel Store

100 frequencies in non-volatile EEROM memory with associated mode, bandwidth, AGC and BFO settings. Bulk erasure of the memory is possible from the front panel or remotely.

Scan modes

- (a) Channel scan between designated channels with selected dwell time on each channel (0.1s to 9.99s).
- (b) Frequency sweep between any two frequencies with selected step size (from 0.1kHz to 999.9kHz) and sweep rate (from 10Hz/s to 999.99kHz/s).

In either mode scanning may be halted on detection of a signal above a threshold set at the front panel with the IF gain control.

Frequency stability

One of the following optional frequency standards may be fitted:-

- (a) **TCXO**
Accuracy ± 1.5 in 10^6
- (b) **9442 ovened oscillator***
Temperature stability ± 3 in 10^9 per °C.
Ageing
 ± 3 in 10^9 per day after 3 months continuous operation.
- (c) **9420 ovened oscillator***
Temperature stability ± 6 in 10^{10} per °C.
Ageing
 ± 5 in 10^{10} per day after 3 months continuous operation.

*Full details in *Racal Dana Publications 825-2 and 827-2.*

Sensitivity

For the frequency range 0.5 – 30MHz. SSB/CW: A signal of -113dBm (1 μ V emf) in a 2.7kHz bandwidth gives an S+N/N of 16dB [19dB] with the RF amplifier on and 10dB [13dB] with the RF amplifier off.

AM: A signal of -103dBm (3 μ V emf) 70% modulated at 1kHz, in a 6kHz bandwidth, gives an S+N/N of 16dB [19dB] with the RF amplifier on and 10dB [13dB] with the RF amplifier off.

Selectivity

The following bandwidths are standard:

USB	2.7kHz
LSB	2.7kHz
Symmetrical	300Hz
	1kHz
	2.7kHz
	6kHz
	12kHz

Other filters are available as options. A total of 5 filters (giving 7 bandwidths) are fitted in the basic receiver. The optional IF Filter Module allows a further 7 filters to be added.

Reciprocal mixing

With a wanted signal of -113dBm (1 μ V emf) in a 2.7kHz bandwidth, an unwanted signal 20kHz removed must be greater than 96dB [102dB] above the wanted signal to give a noise level equal to the output produced by the wanted signal. At 80kHz removed the difference in level must be greater than 106dB [115dB].

Out of band intermodulation products

RF amplifier on:

With two -13dBm (100mV emf) signals separated and removed from the wanted signal by 25kHz, the third order intermodulation products will be not less than 70dB [76dB] below either of the interfering signals. Third order intercept point not less than +22dBm [+25dBm].

RF amplifier off:

Third order intercept point typically not less than +32dBm.

In band intermodulation products

Two in band signals of -13dBm (100mV emf) with 600Hz spacing produce third order intermodulation products not greater than -50dB [-55dB] at the IF output and line output.

Blocking

With a wanted signal of -53dBm (1mV emf), an unwanted signal more than 20kHz removed must be greater than +7dBm [+13dBm] to reduce the output by 3dB.

Cross modulation

With a wanted signal of -53dBm (1mV emf) in a 2.7kHz bandwidth, an unwanted signal 30% modulated, more than 20kHz removed must be greater than +1dBm [+7dBm] to produce an output 20dB below the output produced by the wanted signal.

External spurious responses

Spurious response rejection not less than 80dB [90dB].

Image and IF rejection

Image and IF rejection not less than 90dB [100dB].

Internal spurious responses

Typically fewer than 5 internal spurious responses give an output more than 3dB above the receiver noise level in a 2.7kHz bandwidth. None give an output more than 6dB above the receiver noise level in a 2.7kHz bandwidth.

Antenna input

- (a) Input impedance 50 ohms nominal.
- (b) The receiver will withstand, without damage, input signals of up to 50V emf continuously.
- (c) Re-radiation from antenna input:
0–30MHz: Not greater than -87dBm (10 μ V pd).
30–100MHz: Not greater than -67dBm [-87dBm].

AGC

An increase in input of 120dB above -107dBm (2 μ V emf) produces an output change of less than 2dB.

Short, medium and long decay times may be selected from the front panel. When the mode is changed the receiver automatically selects the last time constant used in that mode.

IF gain control

The IF gain control may be used to set:

- (a) Receiver gain
(b) AGC threshold
(c) Squelch threshold
- The control range is 120dB.

Note

Figures in [] are typical values.

AF outputs

- (a) 200mW into the internal loudspeaker (RA3701, RA3702).
Adjustable using the front panel volume control. May be switched off from the front panel.
- (b) Rear panel connection for external loudspeaker (RA3701, RA3702). Level adjustable using the front panel volume control. Maximum output 1W into 8 ohms or 200mW into 16 ohms.
- (c) Front panel headphone output.
Adjustable using front panel volume control. Maximum output 200mW into 16 ohms or 1mW into 600 ohms. Plugging in headphones disables the internal loudspeaker.
- (d) Rear panel line output -20dBm to +10dBm into 600 ohms balanced. Level adjustable by means of a preset control mounted on top of the receiver.

IF outputs

- (a) **Narrow**
Centre frequency 1.4MHz.
Bandwidth determined by IF filter selected. Level -7dBm into 50 ohms.
(Optional modules provide 100kHz or 455kHz IF outputs).
- (b) **Wide**
Centre frequency 1.4MHz.
-3dB bandwidth not less than 12kHz.

Metering

The front panel bar-graph meter may be switched to meter either RF signal level or AF line level (RA3701, RA3702).

Remote Control

One of the following interfaces is fitted:-

- (a) Serial ASCII complying with CCITT recommendation V10 and EIA Standard RS423-A. Compatible with V28/RS232-C. Data rate may be preset in the range 50 baud to 9600 baud.
- (b) IEEE 488 complying with ANSI/IEEE Std 488-1978.

Power supply

100, 120, 220, 240V. 45-65Hz.
Operates to full specification over the range -15% to +10% relative to taps. Withstands a mains surge of $\pm 50\%$ for up to 1 second without damage. Power consumption approximately 60W for the basic RA3701 and RA3703 receivers. Power consumption approximately 90W for the RA3702 and RA3704 receivers.

Environmental

The full Environmental Specification is given in Racal Document ES20 (Issue 5.1) available on request. The equipment is suitable for operation in fixed or transportable installations.
Operating temperature -10°C to +55°C.
Storage temperature -40°C to +70°C.
Relative humidity 95% at 40°C.

Dimensions

Height 133mm (5.25 in)
Width 483mm (19 in)
Depth 450mm (17.7 in) behind front panel

Weight

Approximately 14 kg (31 lb) for the basic RA3701 and RA3703 receivers.
Approximately 20 kg (44 lb) for the RA3702 and RA3704 receivers.

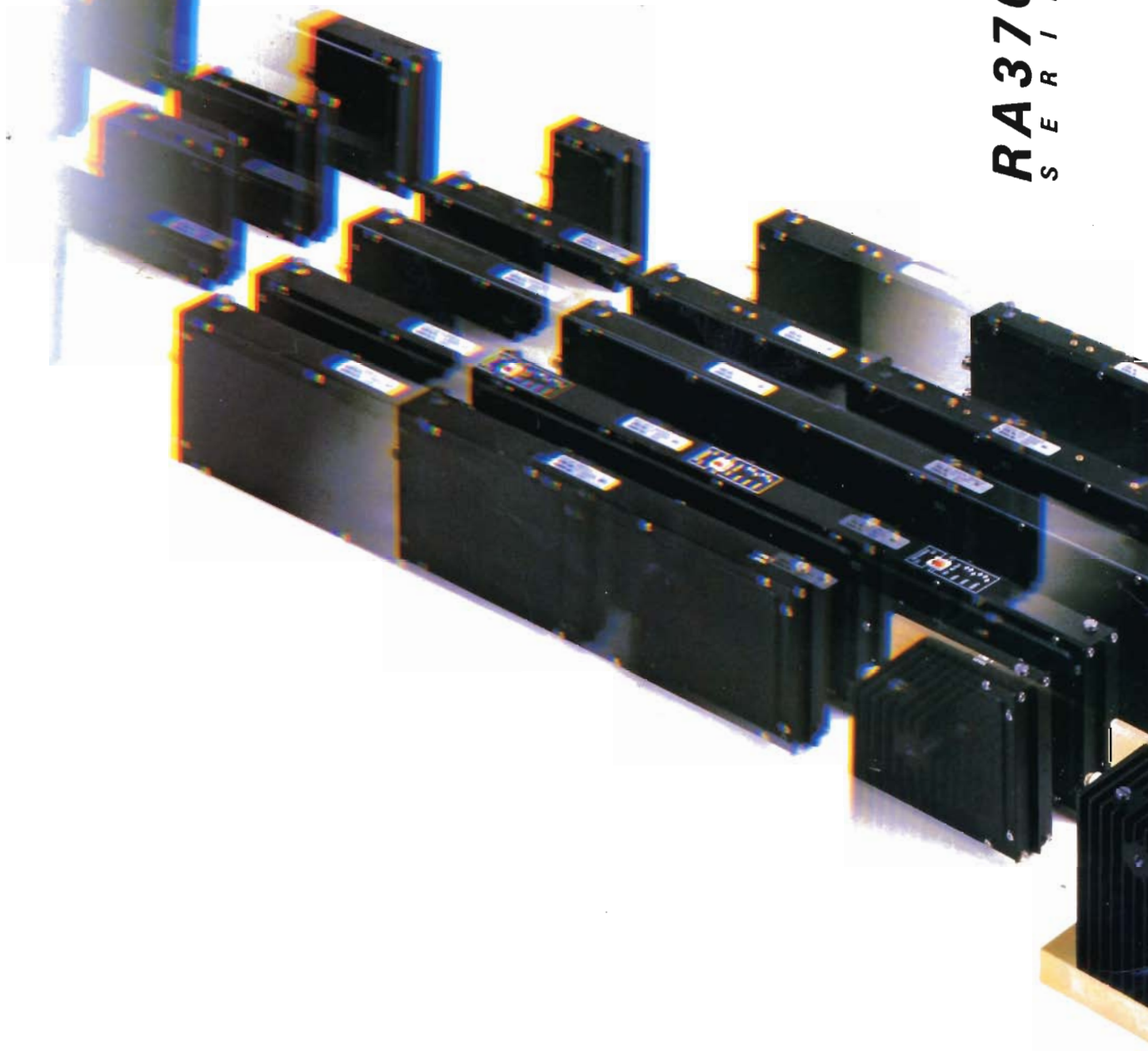
Optional modules

The RA3701 and RA3703 may be fitted with up to 5 plug-in optional modules. One plug-in optional module may be fitted to the RA3702 and RA3704. Please consult Racal for details of optional modules.

RACAL

RACAL COMMUNICATIONS

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RA3700
S E R I E S

R A C A L C O M M U N I C A T I O N S

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RACAL