H.F. Communications Receiver | RA. 117

- **FREQUENCY RANGE 1 TO 30 MHz**
- **SUITABLE FOR SYNTHESIZER OR OTHER EXTERNAL CONTROL**
- **FACILITIES FOR DIVERSITY OPERATION**
- **RUGGEDLY BUILT ON CAST ALUMINIUM CHASSIS**

The RACAL RA.117 High-Stability H.F. Receiver, which has been developed from the world-famous RA.17, has facilities enabling it to be used with synthesizer or pre-set channel crystal-oscillator input, in addition to the continuously tunable v.f.o. It also incorporates facilities for diversity operation with a second RA.117 Receiver.

The RA.117 Receiver has a frequency range of 1 to 30 MHz with an outstandingly high degree of setting accuracy, sensitivity and stability. It utilizes the well-proven multiple frequency-changing technique used in the RA.17, but incorporates one further i.f. stage, thereby eliminating all variable tuned r.f. circuits, except aerial tuning. This, together with electronic bandswitching, renders it suitable for operation in conjunction with an external oscillator (such as the RACAL MA.143B Six-Channel Crystal Oscillator) giving six pre-set frequencies in addition to the continuous tuning facility; or a frequency synthesizer (such as the RACAL MA.350B Decade Frequency Generator) to provide precise frequency settings in increments of 100 Hz. This latter facility renders the receiver eminently suitable as the basis of s.s.b. and i.s.b. receiving terminals, where particularly high setting accuracy and stability are essential.

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H.F. Communications Receiver
Type RA.117

TECHNICAL DESCRIPTION

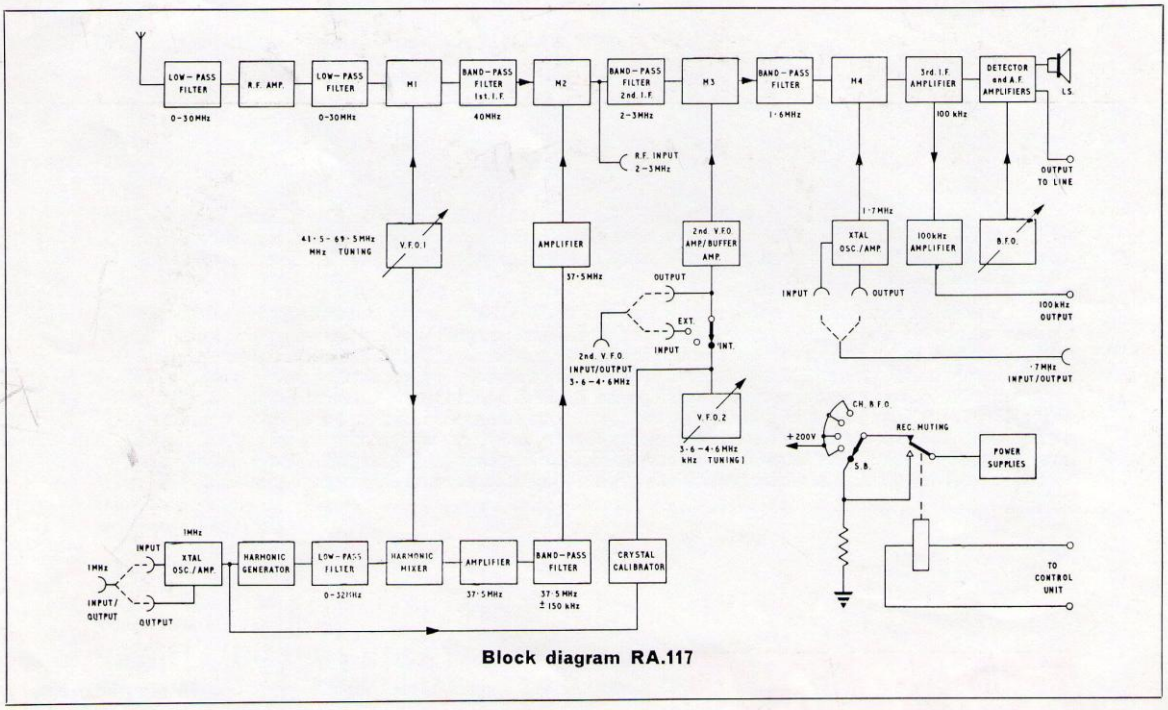
The RA.117 is designed and built to the same high standards which established such a world-wide reputation for the RA.17, and has been so constructed that one model is suitable both for European and North American use.

The receiver has been designed to operate with a range of specially designed adaptors and converters, many of which are equally suitable for use with the RA.17 A list of these units is shown elsewhere in this leaflet.

The aerial input circuit provides either double-tuned pre-selection or wideband operation. After amplification the signal is passed to the first mixer (M1) to be combined with the output from the first v.f.o. (VFO1). The frequency of this oscillator is varied (by the 'megahertz' control) between 41·5 and 69·5 MHz, only those frequencies at 1 MHz intervals being used. The first i.f. stage is tuned to accept frequencies within the range 40± 0·650 MHz. Thus when VFO1 is set to 41·5 MHz, for example, input signals in the range 1 to 2 MHz are accepted. In this way, the first v.f.o. selects any spectrum of signals 1 MHz wide within the range 1 to 30 MHz.

The output of VFO1 is also combined in the harmonic mixer with harmonics (up to the 32nd) derived from the 1 MHz crystal oscillator. The useful output of VFO1 is limited to frequencies spaced by 1 MHz intervals, that is, when the combination of VFO1 frequency and a harmonic of 1 MHz produces a resultant at 37·5 MHz. The 'gated' output is mixed with the first i.f. in M2 to produce a wideband second i.f. of 2 to 3 MHz. Thus if VFO1 drifts, causing a change in the first i.f., an equal change occurs in the 37·5 MHz input to M2 which cancels the initial drift. The frequency stability of this unique tuning system is therefore that of the 1 MHz crystal and the 'megahertz' tuning control functions as a 29-way electronic bandswitch. The second i.f. is fed via a bandpass filter to M3 where it is combined with the output of VFO2 in the range 3·6 to 4·6 MHz. VFO2 thus forms the basis of a conventional superheterodyne interpolation receiver, tunable over a band of 1 MHz by means of the 'kilohertz' control and employing a film-strip type of scale, 60 in. (152 cm.) long, calibrated at 1 kHz intervals. An external source, such as a synthesizer or crystal oscillator, may be used to provide the 'kilohertz' setting in place of VFO2.

The resultant output from M3 is the third i.f. of 1·6 MHz, which is then converted in M4 to the final i.f. of 100 kHz. Filters are incorporated in the final i.f. amplifier chain to give a choice of six different bandwidths. From this point the signal is detected and amplified in two separate audio amplifiers, with independent gain controls, to provide a number of outputs. In addition, the receiver incorporates a 100 kHz crystal calibrator referred back to the 1 MHz crystal standard, for checking and adjusting, if necessary, the setting of the film scale cursor. A b.f.o. variable over ±8 kHz, is also built into the receiver.



Block diagram RA.117

RA.117

TECHNICAL SPECIFICATION

Frequency Range 1–30 MHz.

Stability After warm-up time overall drift will be less than 50 Hz per hour under conditions of constant supply voltage and ambient temperature.

Input Impedance 75 ohms unbalanced.

Tuning Effective scale length of approximately 145 feet, i.e. 6 in. of scale length corresponds to 100 kHz. Frequency increments remain constant over the entire band.

Calibration A 100 kHz signal derived from a 1 MHz crystal oscillator having an accuracy of 5 parts in 10^6 provides check points at 100 kHz intervals.

Aerial Input
(a) Wideband, high impedance.
(b) Wideband, 75-ohm.
(c) Double-tuned in five bands
(i) 1–2 MHz (iv) 8–16 MHz
(ii) 2–4 MHz (v) 16–30 MHz
(iii) 4–8 MHz

Sensitivity
A1 reception (bandwidth 3 kHz):
1 μV for 18 dB signal/noise ratio.
A2 reception (30% modulated, bandwidth 3 kHz):
3 μV for 18 dB signal/noise ratio.

Cross Modulation For levels of wanted signal between 3 μV and 1 mV an interfering signal 10 kHz removed and modulated 30% must have a level greater than 50 dB above that of the wanted signal to produce a cross-modulation of 3%. The ratio of wanted to unwanted signal is improved up to 10% off tune, at the rate 3 dB/1%.

Intermodulation Better than 100 dB down for interfering signals at least 10% removed from the wanted signal.

Blocking With similar conditions to those for cross-modulation, an unwanted signal must be 60 dB greater before the audio output of the wanted signal is reduced by 3 dB due to blocking.

Selectivity Six alternative bandwidths are obtained by means of a selector switch. Filter details are:

	—6 dB	—66 dB (at I.F. Output)	—66 dB (at Detector)
(i)	13 kHz	35 kHz	28 kHz
(ii)	6.5 kHz	22 kHz	20 kHz
(iii)	3.0 kHz	15 kHz	15 kHz
(iv)	1.2 kHz	8 kHz	8 kHz
(v)	0.30 kHz	less than 2 kHz	less than 2 kHz
(vi)	0.10 kHz	less than 1.5 kHz	less than 1.5 kHz

Bandwidths (v) and (vi) are obtained with crystal-lattice filters. Differences in centre frequencies of these bandwidth settings do not exceed 50 Hz.

I.F. Output 100 kHz at 75 ohms impedance. Level 0.2V approx. with A.G.C. in operation. Two outlets in parallel are provided.

Image and Spurious Response With wideband or tuned input, external image signals are at least —80 dB, other spurious responses —60 dB. Internally generated spurious responses are not greater than 2 dB above receiver noise (3 kHz bandwidth and no aerial connected).

Noise Factor Less than 7 dB throughout entire range.

B.F.O. Range ±8 kHz.

B.F.O. Stability With constant ambient temperature and supply voltage, after warm-up time, drift does not exceed 50 Hz. For input level variations from 10 μV to 1 mV B.F.O. drift is negligible.

Automatic Volume Control A.V.C. is applied to the r.f. and the 1st 100 kHz i.f. stages only. An increase in signal level of 20 dB above 1 μV improves the signal/noise ratio by 18 dB.

An increase in signal level of 100 dB above 1 μV increases the a.f. output by less than 7 dB.

A.V.C. Time Constants
Short: Charge — 25 milliseconds.
Discharge — 200 milliseconds.
Long: Charge — 200 milliseconds.
Discharge — 1 second.

A.F. Outputs
(i) 2½ in. loudspeaker (1 watt) on front panel (switched).
(ii) Two headphone sockets in parallel on front panel (across one of 600 ohms 3 mW outlets).
(iii) Three independent outputs of 3 mW at 600 ohms at rear of chassis.
(iv) One output of 10 mW at 600 ohms. Pre-set level is independent of A.F. GAIN control setting.
(v) One output of 1 W, at 3 ohms.

Distortion Not greater than 5% at 10 mW output, 1000 Hz.
Not greater than 10% at 1.0 W output, 1000 Hz.

Hum Level With A.F. GAIN control at maximum, the hum level is never worse than 40 dB below rated output.

Noise Limiter A series noise limiter circuit can be switched into operation to provide limiting at modulation levels exceeding 30%.

Meter Indication A 3-position switch selects indication of signal carrier level, A.F. output level, 'S' Meter indication.

Controls

MHz Tuning	Aerial Tuning
Aerial Band Switch	Tuning Lock
Aerial Attenuator	I.F. Bandwidth
I.F. Gain	A.G.C. Time Constant
System Switch	B.F.O. Note
B.F.O. on/off	Line Output Level
A.F. Volume	Loudspeaker on/off
Limiter on/off	Meter Switch
Power on/off	2nd V.F.O. input
kHz Tuning	internal/external

External Connections
Mains Input
Aerial Input
2–3 MHz I.F. Input (for RA.237 L.F. Converter)
1 MHz Oscillator (input/output)
1.7 MHz Oscillator (input/output) for MA.161
100 kHz I.F. Output (two in parallel)
2nd V.F.O. input/output (3.6 to 4.6 MHz for diversity coupling or synthesizer/crystal controlled oscillator input)
A.G.C. Line
A.F. Outputs
H.T Supplies for L.F. Adaptor
Muting Relay
} Terminal Block

Power Supply 100–125 and 200–250 volts, 45–65 Hz a.c. single phase.
Power consumption 100 W approx.

Environmental Conditions Operating temperature range 0° to +55°C.
Storage temperature range —26° to +70°C.

Dimensions For rack mounting, complete with dust covers.
Width: Panel 19 in. (48.25 cm.). Chassis 16½ in. (42 cm.).
Depth: Chassis 18 in. (46 cm.). Before panel 2 in. (5.1 cm.).
Rear clearance for plugs ⅞ in. (2.2 cm.).
Height: 10½ in. (27.7 cm.).
In cabinet:
12 in. (30.5 cm.) high x 20½ in (52 cm.) wide x 21⅞ in. (55.6 cm.) deep.

Weight For rack mounting: 67 lb. (30.5 kg.).
In cabinet: 97 lb. (44 kg.).

Construction Cast chassis with ⅛ in. aluminium front panel, finished to highest durability and climatic specifications.

CONVERTERS AND ADAPTORS

Low Frequency Converter Type RA.237

The RA.237 Converter extends the frequency coverage of the RA.117 down to 10 kHz. The converter accepts the incoming signal from the aerial and mixes it with a local excitation of 2 MHz derived from the 1 MHz crystal in the RA.117 The resultant output between 2 and 3 MHz is then fed to the interpolation receiver part of the RA.117 The RA.237 has wideband or double-tuned input circuits and drum-type calibrated scale, switched sympathetically with the aerial band switch.

Single Sideband Adaptor Type RA.63

This adaptor, which operates from a 100 kHz i.f. output of the RA.117 Receiver, enables s.s.b. signals in the upper or lower sideband to be received. Vernier tuning of the local oscillator is provided for distortion-free reception. The unit, which has a pass-band from 500 to 3,000 Hz, can be used for suppressed or pilot carrier s.s.b. and for s.s.b. reception of d.s.b. signals.

Independent Sideband Adaptors Type RA.98 and RA.121

These adaptors are designed to simplify reception of independent sideband signals. The RA.98 includes a motor-driven automatic tuning device to maintain correct alignment even during long periods of fading. With the RA.121, after accurate tuning has been effected using a cathode-ray tube, a locking device holds the local oscillator exactly to the incoming pilot carrier The pass-band of both adaptors is 300 to 6,000 Hz.

Decade Frequency Generator Type MA.350B

Used in conjunction with the RA.117, the MA.350B provides a receiving system with an exceptionally high order of frequency stability and setting accuracy Rapid and precise selection of the 'kilohertz' portion of the desired frequency is achieved by means of four decadic controls in steps of 100 kHz, 10 kHz and 100 Hz. A variable interpolation oscillator provides adjustment between the discrete steps of the decadic frequency selectors, giving a setting accuracy of 1 Hz when tuning between the 100 Hz steps. The 'megahertz' part of the required frequency is tuned on the receiver in the usual way The frequency controlling element, incorporated within the unit, is a 1 MHz crystal with an aging rate of less than 2 parts in 10^9 per day after 30 days continuous use. If still higher stability is needed, provision is made for control from an external source.

Six-Channel Crystal Oscillator Unit Type MA.143B

This oscillator is designed to provide the RA.117 Receiver with the added facility of six pre-set channels within the frequency range 1–30 MHz. The output from the unit is between 3·6 and 4·6 MHz and thus replaces the second v.f.o. of the RA.117, the 'megahertz' part of the required frequency being set on the receiver in the normal manner

Receiver Pre-selection and Protection Unit Type MA.197B

This unit has been developed for use with the RA.117 (or RA.17) where the receiver is intended to work in close proximity to high power transmitters. It will provide 85–100 dB attenuation to unwanted signals 5% off-tune, without noticeable degradation of receiver performance.

Diversity Switching Unit Type MA.168B

This switching unit operates from the 100 kHz i.f. outputs of two RA.17 Receivers operating in diversity. The unit electronically selects the better signal which is passed either to a built-in detector and b.f.o. in the case of a.m., m.c.w and c.w signals, or to external adaptors in the case of f.s.k. or s.s.b. signals. The unit is fully transistorized.

RACAL

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