Transistorized Military H.F. Communications Receiver

RA.329B

- F.S.K., T.S.K., S.S.B., F.M., Ph.M., D.S.B., C.W. RECEPTION
- TRANSPORTABLE AND SUITABLE FOR MOBILE USE
- HOUSED IN A MILITARY WATERPROOF TRANSIT CASE
- PROVISION FOR SYNTHESIZER CONTROL, AND USE OF PANORAMIC AND L.F. ADAPTORS
- UNIVERSAL A.C., D.C. POWER UNIT

The RACAL RA.329B is a compact, portable, fully-transistorized, high-stability receiver designed primarily for military use and housed in an approved type of field-transit case. The equipment is based on the new RACAL Transistorized H.F. Communications Receiver Type RA.217 and covers the frequency range 1 to 30 MHz.

RA.329B comprises the H.F. Communications Receiver Type RA.217D and the F.S.K./Loudspeaker Terminating Unit Type MA.323, both mounted on a frame assembly which can be installed in a 19 in. rack or housed in a Creeth Field-Transit Case with a sealed lid to prevent the ingress of dust and moisture during transportation.

The RA.217D uses the 'Wadley' drift-cancelling system of frequency-changing and selection, which provides excellent frequency-stability and great accuracy of tuning.

The RA.329B operates in the following modes: f.s.k., t.s.k., s.s.b., f.m., ph.m., d.s.b., and c.w. Separate re-insertion oscillators are provided for upper and lower sideband demodulation.

The F.S.K. Converter, located in the MA.323, provides facilities for reception of signals with frequency shifts between 85 Hz and 850 Hz, and speeds up to 150 bauds.

In addition to a built-in loudspeaker, there are three telephone output jacks on the front panels. Connections to the RA.329B are also brought out to the front on a connector panel which provides comprehensive facilities for the use of the receiver with adaptors or ancillary units.

The power unit for the RA.329B is contained in the RA.217D Receiver. The power source may be a.c. at either 200-250V or 100-125V 45-400 Hz, or a d.c. supply in the range 9-30V, with either positive or negative earth.

Provision is made for the display of receiver frequency on a remote digital counter unit.

The equipment is ruggedly constructed and plug-in modules are used extensively to facilitate maintenance. It is suitable for use under severe environmental conditions.

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Transistorized Military H.F. Communications Receiver. Type RA.329B

TECHNICAL DESCRIPTION

RA.217D Receiver

The RA.217D is a modified version of the RA.217 Receiver The r.f. stage is preceded by an attenuator network and optional double-tuned antenna-coupling circuits. The amplified input signal is first mixed with one output from a variable-frequency oscillator V.F.O.1 to produce a first i.f. centred on 40 MHz.

A second output from (V.F.O.1), and harmonics generated from a 1 MHz crystal oscillator, are also mixed in a harmonic mixer to produce a 37.5 MHz signal to mix with the first i.f. to obtain a wideband second i.f. from 2 to 3 MHz. In this way, variation in the first i.f. caused by frequency drift in the V.F.O.1 is exactly cancelled in the second i.f. and the stability of this frequency-changing system is that of the 1 MHz crystal.

The V.F.O.1 is set by the 'MHz' dial and acts as an electronic bandswitch, since all useful settings are limited to intervals of 1 MHz.

The second i.f. is fed to a conventional superheterodyne interpolation receiver, employing a final i.f. of 1.6 MHz, tuned by a second v.f.o. (kHz dial) tunable from 3.6 to 4.6 MHz. A 5-digit in-line mechanical counter indicates tuned frequency in units of 1 kHz, with interpolation calibration to 200 Hz. Thus the complete receiver is essentially tuned by varying the frequencies of the v.f.o.'s and no mechanical bandswitching is employed.

Four alternative i.f. bandwidths (13 kHz, 3 kHz, 1 kHz, 200 Hz) can be selected by a front panel switch. I.F. outputs of 100 kHz and 1.6 MHz are provided for use, respectively, in the f.s.k. converter and the f.m./ph.m. demodulator in the MA.323.

Separate demodulators are incorporated in the RA.217D for d.s.b. and for s.s.b. and c.w. For s.s.b. and c.w., a product detector is used with separate re-insertion oscillators for u.s.b. and l.s.b., and a variable b.f.o. for c.w. These are selected by a front-panel switch.

Two independent audio outputs are provided. 1 mW in 600 Ω for connection to line, with a preset level control 10 mW in 600 Ω at the headphone sockets, of which there are three in parallel. A detector output drives the loudspeaker amplifier in the MA.323.

The power unit is a transistorized unit operating from a.c. at either 200-250V or 100-125V, 45-400 Hz, or a d.c. supply in the range 9-30V, with either positive or negative earth. Precautions are taken to prevent damage due to inadvertent reversal of the supply polarity Fuse links to protect the power-supply inputs and outputs are located on the front panel.

MA.323 F.S.K./Loudspeaker Terminating Unit

This unit provides the following facilities

(i) F.S.K. or t.s.k. demodulation

(ii) A.F. amplification with built-in loudspeaker

(iii) F.M./Ph.M. demodulation

(iv) External connections

For f.s.k. the 100 kHz output from the RA.217D is taken to the product detector in the MA.323 which provides a two-tone audio-frequency output, the mean frequency of which is offset by 2550 Hz.

The two tones are subjected to limiting or amplification according to tone levels, and are then converted into a binary d.c. signal by a process of phase demodulation and re-shaping through a low-pass filter and Schmitt trigger circuit. The signal is then passed to a push-pull output stage which drives the windings of the telegraph relay.

The relay is a high-quality component characterized by low distortion, high speed, and virtually bounce-free operation. Interference and spark suppressors are fitted.

For t.s.k., a.f. is taken from the RA.217D in the form of two tones centred on 2550 Hz and fed direct to the f.s.k. demodulator.

A carrier-failure detector provides a 'mark hold' or 'space hold' facility in the event of a signal failure.

The f.m./ph.m. Demodulator receives the 1.6 MHz i.f. from the RA.217D Receiver An integrated high-gain amplifier/limiter circuit, which limits the amplitude of the 1.6 MHz i.f. signal, is followed by a Foster-Seeley discriminator circuit.

Tuning of the receiver is simplified by the provision of a front-panel meter, and a NORMAL/REVERSE polarity switch is incorporated. One control on the front panel gives gain control on loudspeaker and telephones, the former via a 50 mW amplifier in the MA.323 and the latter via a 10 mW amplifier in the RA.217D. Connectors for antenna, a.c. and d.c. supplies, and external adaptors are also brought out to the front panel.

Type RA.329B

TECHNICAL SPECIFICATION

Frequency Range 1 to 30 MHz.

Modes of Reception S.S.B. (U.S.B. or L.S.B.) D.S.B., M.C.W., C.W., F.S.K., Ph.M., F.M.

Tuning Digital presentation in units of 1 kHz. with interpolation calibration at 200 Hz. intervals.

Calibration Accuracy Better than ± 1 kHz referred to nearest 100 kHz calibration point.

Calibration A 100 kHz signal, derived from the 1 MHz crystal oscillator provides check points at 100 kHz intervals.

Frequency Stability After two hours from switch-on: ± 50 Hz over an eight hour period at constant ambient temperature and humidity.

Antenna Input Nominal 75 Ω impedance unbalanced into a wideband circuit, or tuned in five automatically selected bands:—

(i) 1 to 2 MHz. (iv) 8 to 16 MHz.
(ii) 2 to 4 MHz. (v) 16 to 30 MHz.
(iii) 4 to 8 MHz.

Sensitivity With tuned antenna input, and measured in a 3 kHz bandwidth, sensitivity figures are typically:
CW/SSB. 1 μV (e.m.f.) for 15dB signal-to-noise ratio.
MCW/DSB. (30% modulated at 400 Hz).
3 μV (e.m.f.) for 15dB signal-to-noise ratio.

Selectivity Four alternative I.F. bandwidths are selected by means of a front panel switch with nominal 3dB bandwidths:

1. 13 kHz
2. 3 kHz
3. 1 kHz
4. 0.2 kHz

Cross Modulation For a wanted signal level up to 1 mV and with appropriate use of the antenna attenuator an interfering signal, 20 kHz removed and modulated 30% at a level of 45dB above that of the wanted signal will, in general, produce a cross modulation of less than 3% in the tuned input mode.

Intermodulation To produce an equivalent 1 μV input, the level of two equal unwanted signals greater than 10% removed from the wanted frequency must be at least 80dB above 1 μV in the tuned input mode.

Blocking For level of wanted signal up to 1 mV and with appropriate use of the antenna attenuator, an interfering signal 20 kHz removed, must be 56dB above the level of the wanted signal to reduce its output by 3dB in the tuned input mode.

Spurious Response to External Signals To produce a response equivalent to 1μV signal, an external signal must, in general, be greater than 60dB above 1 μV

Spurious Responses Internally Generated Not greater than 3dB above noise level in a 3 kHz bandwidth.

Noise Factor Typically 10dB.

I.F. Output 100 kHz: 270 mV across 75 Ω (nominal). (A.G.C. on).

Automatic Gain Control

(a) Time Constants: (nominal)

	Charge	Discharge
(i) Short	10 mS	20 mS
(ii) Medium	50 mS	250 mS
(iii) Long	50 mS	4 S

(b) Output change (nominal)
An increase in input of 85dB above 2 μV will produce a change in output level not greater than 4dB.

B.F.O.

(a) Variable ± 3 kHz centred on +6, +3, 0, —3, and —6 kHz with respect to i.f. centre frequency
(b) Fixed: ± 1.5 kHz (U.S.B/L.S.B.) crystal controlled.

A.F. Output

(a) Headphone output: 10 mW into 600 Ω
(b) Line output 1 mW into 600 Ω
(c) 50 mW into internal loudspeaker

Overall A.F. Distortion Less than 5%

Overall A.F. Response With a selectivity bandpass of 13 kHz the audio frequency output level from 100 Hz to 6000 Hz will not vary more than 4dB from peak response.

Meter Indication

(a) 'S' Scale
(b) A.F. level to line
(c) F.S.K. demodulator: centre zero for mark space balance.

F.S.K. Demodulation

(a) Centred on 2550 Hz
(b) Frequency shift: 85 to 850 Hz
(c) Speed: up to 150 bauds
(d) Relay output: dry contact polar relay with spark-suppressed contacts giving Space, Tongue, Mark connections. Contact rating 500V 100 mA
(e) Bias adjustment: ± 10% by preset potentiometer
(g) Bias distortion: less than 3% (nominal)
(h) Carrier fail detector holds relay on space or mark in absence of adequate signal

F.M./Ph.M. Demodulation

(a) Linear range: ± 6 kHz
(b) Distortion (± 4 kHz deviation): less than 3% (nominal)
(c) Frequency response: within 3dB 100 to 4000 Hz

Power Supply By selection of the appropriate connections to the receiver power supply unit, operation from the following power sources is obtainable:—

(a) 100-125V a.c. 45-400 Hz single phase
(b) 200-250V a.c. 45-400 Hz single phase
(c) 9-30 V d.c. floating input

Power Consumption 15 VA approximately.

Controls

Receiver portions: (RA.217D).

(a) Meter Switch: A.F. level/carrier level
(b) Frequency Readout: in-line
(c) MHz Tuning
(d) kHz Tuning
(e) System Switch
(f) B.F.O. Variable and Detector Mode Selector
(g) R.F./I.F. Gain Control
(h) R.F. Tuning/W.B. Control
(i) Tuning Locks
(j) Calibrate-Fine Tune
(k) I.F. Bandwidth
(l) Antenna Attenuator
(m) Phone Socket

F.S.K. Demodulator and A.F. Amplifier portion (MA.323):

(a) Mode Switch
(b) A.F. Gain
(c) Loudspeaker ON/OFF Switch
(d) Second V.F.O. IN/OUT Selector.

External Connections (Front panel MA.323)

(a) Phone Jacks: two in parallel 10 mW in 600 Ω
(b) Coaxial Socket BNC 1 MHz Input
(c) Coaxial Socket BNC Adaptor connection
(d) Coaxial Socket BNC 100 kHz I.F.
(e) Coaxial Socket BNC 2nd V.F.O. In
(f) Coaxial Socket BNC 2nd V.F.O. Out
(g) Coaxial Socket BNC Antenna
(h) Power Supply Input Plug: Thorn 6-way
(i) Ancillary Socket: Thorn 19-way
(j) MHz Display Plug: Thorn 19-way
(k) F.S.K. Output Plug: Thorn 4-way
(l) A.C. Power Supply Fuse: 250 mA
(m) 16V H.T Fuse: 500 mA
(n) D.C. Power Supply Fuse: 3A

Dimensions

(a) In transit case with lid
10½ in. (27 cm) high x 20 in. (50 cm) wide x 19½ in. (49.5 cm) deep.
(b) For standard 19 in. rack mounting:
7 in. (17.5 cm) high x 19 in. (48.3 cm) wide x 15 in. (38 cm) deep

Weight

(a) Including transit case with lid.
70 lb. (31 kg) approximately.
(b) For rack mounting:
50 lb. (22 kg) approximately.

Environmental Conditions

Operating temperature —5°C to +55°C
Storage temperature —20°C to +70°C
Humidity 95% R.H. at 40°C
The receiver is designed to meet certain of the requirements of British Defence Specification DEF.133, Class L2, which include vibration and bump tests, and others appropriate to this class of equipment.

CONVERTERS AND ADAPTORS

Low Frequency Converter Type RA.337

The RA.337 is a fully transistorized unit which extends the lower frequency limit of the RA.217D to 3 kHz, subject to a minor modification to external connector wiring. The converter incorporates a double-tuned antenna circuit with a low-pass filter specially designed to combat interference from the broadcast frequency band. A full-vision tuning scale with slow-motion drive is incorporated to facilitate accurate tuning of the antenna circuit.

I.S.B./S.S.B. Adaptor Type RA.298

The RA.298 is a fully transistorized adaptor which provides for a wide range of requirements on both single and independent sideband modes of operation. It accepts a composite input signal at 100 kHz with a maximum bandwidth of ± 6 kHz and can provide a channel bandwidth of nominally 3 kHz or 6 kHz. A.F.C. and local carrier re-insertion facilities are incorporated for use with transmissions having pilot or suppressed carrier, respectively. The adaptor and receiver can be used in conjunction with a synthesizer to achieve stabilities of the order of ± 2 parts in 10^9 per day

Crystal Controlled Oscillator Type MA.358

The MA.358 replaces the first v.f.o. in the RA.217D Receiver to provide remote selection of the 'megahertz' range. Incorporating 29 crystals, it provides an output variable in 1 MHz increments from 41.5 to 69.5 MHz.

Panoramic Adaptor Type RA.366

The RA.366 is used in conjunction with the RA.217D Receiver to provide a panoramic display of received signals in a frequency spectrum up to 1 MHz wide. This enables radio transmissions throughout the h.f spectrum to be observed, making the receiver ideal for search, monitoring or bandwatching. Facilities are also incorporated for spectrum analysis in the 13 kHz band centred on the receiver tuned frequency

ANCILLARY UNITS

Pre-selection and Protection Unit Type MA.397

The MA.397 enables the RA.217D Receiver to be successfully operated in the close proximity of high-power transmitters and under similar adverse conditions, where it is essential not only to reduce breakthrough but also to prevent physical and electrical damage to the receiver Electronic valves are used, rather than semi-conductors, to provide the best possible performance under large-signal conditions. The unit operates over the frequency range 2-30 MHz.

Decade Frequency Generator Type MA.350B

The MA.350B is a fully transistorized synthesizer which enables highly stable and precise frequency settings to be obtained with the RA.217D Receiver It covers a frequency range of 1 MHz, from 3.6 to 4.6 MHz, in switched decade steps of 100 Hz and also incorporates an interpolation oscillator for continuous control calibrated in 1 Hz divisions.

RACAL

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