COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF CIVIL AVIATION

H A N D B O O K

F O R

V.H.F. RECEIVER

RACK MOUNTING

D.C.A. TYPE NO. R32

HANDBOOK IDENT. NO.Y5/HB1052

VINTEN COMMUNICATION PRODUCTS PTY. LTD.
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VICTORIA, AUSTRALIA

I N D E X.

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1.0 BRIEF SPECIFICATION.

1.1 CLASSIFICATION.

Receiver Type R32 is designed to operate in the frequency band of 118 Mc./S. to 132 Mc./S. The unit operates from 240V 50 C.P.S. and is intended for rack mounting.

1.2 COMPOSITION AND TYPE NUMBER.

DCA Type R32 identification number Y5/813 Receiver Type R32 is complete with power supply on the one chassis and arranged for single sided Standard Rack mounting complete with panel and ventilated dust cover.

1.3 BRIEF DESCRIPTION.

The receiver is a double conversion super-heterodyne utilising one crystal for control. An efficient A.V.C curcuit, muting circuit and noise limiter are incorporated. The audio output is variable between 0 dbm and 15 dbm at an impedance of 600 ohms balanced. The mute and output level controls are pre set and mounted on the chassis; the AC on-off switch is mounted on the front panel.

1.4 POWER REQUIREMENTS. (Typical figures)

Phases	One
Voltage	190 - 270
Frequency	50 C.P.S.
Power consumed	50 watts

1.5 PERFORMANCE SPECIFICATION.

Tuning Range: 118-132 Mc./S. crystal controlled.

Signal Frequency Section: 1 stage at above frequencies.

First Intermediate Frequency Section: 16.44 Mc./S. - 14.88 Mc./S.

Second Intermediate Frequency Section: 2 Mc./S.

Crystal Frequency: 12.888 - 14.44 Mc./S.

Crystal Tolerance: 0.0035%

Sensitivity: Audio output + 15 dbm for 2 μv input modulated 30% at 1000 C.P.S.

Signal to Noise Ratio: Greater than 12 db for 1 μv input modulated 30% at 1000 C.P.S.

Audio Response:

300 C.P.S.	-3 db
1000 C.P.S.	0
2000 C.P.S.	-3 db

A.V.C. Output level does not vary by more than 5 db with an input variation of 5 μv to 100 mV.

Mute Control: May be set to operate at any R.F. input voltage between 0.5 μv and 10 μv. When the mute control is rotated fully anti-clockwise the mute circuit is inoperative.

Selectivity: 2nd I.F. Channel.

Bandwidth	Attenuation
± 25 Kc./S.	-4.5 db
± 70 Kc./S.	-63 db
± 100 Kc./S.	-120 db

Distortion: Not greater than 5% at an R.F. input of 100 μv and an audio output of ± 15 dbm.

1.6 ELECTRON TUBE AND CRYSTAL COMPLEMENT.

1.6.1 ELECTRON TUBE COMPLEMENT.

Type	Circuit Ref.	Function
6AK5	V1	R. F. Amplifier
6AK5	V2	1st Mixer
6BA6	V5	2nd Mixer
6BA6	V6	I.F. Amplifier
6BA6	V7	I.F. Amplifier
6AU6	V8	I.F. Amplifier
6AV6	V9	Audio and AVC Detector Audio Voltage Amplifier
6AU6	V10	Audio Output
6U8	V4	Crystal Oscillator Crystal Frequency Multip.
6AM6	V3	Frequency Multiplier
12AT7	V11	Mute Relay Control Tube
OA202	W1	Noise Limiter
OA202	W2	Noise Limiter
OA202	W3	Mute Circuit Noise Detector
OA202	W9	Mute Circuit Noise Detector
1N2096	W4 W5 W6 W7	H.T. Rectifiers

1.6.1 (Cont.) Total Quantity of each type:

Type	Number
6AK5	2
6AU6	2
6BA6	3
6AV6	1
6U8	1
6AM6	1
12AT7	1
OA202	3

1.6.2 CRYSTAL COMPLEMENT:

One crystal AT cut in HC6U Holder adjusted to 0.001% with a parallel capacity of 20 pf.

1.7 SPECIAL TOOLS:

Two special tuning tools are supplied with each receiver located in stowage clips on the chassis.

1. A nylon tool for capacitor adjustment.
2. A combination tool for use with I.F. transformers consisting of a core tuning tool and a core locking ring tool.

1.8 MECHANICAL CONSTRUCTION AND DIMENSIONS:

The chassis is constructed in 18 S.W.G. M.S. sheet, panels and dust covers in 20 S.W.G. M.S. sheet.

Finish to surfaces are as follows :

(a) Chassis - Cadmium plated and passivated prior to screen printing.

(b) Panels and Dust Covers - Painted to D.C.A. specifications.

(c) Fittings, Hardware, etc. Chrome, nickel or cadmium, according to end use.

The unit occupies 10½" of rack space (6 units)

Total weight including dust cover and panel 36 lbs.

2.0 TECHNICAL DESCRIPTION.

2.1 TECHNICAL DESCRIPTION.

To facilitate a circuit description, the major circuit components are tabulated below :-

Section	Component	Function
Signal Frequency	L1	Aerial Coil
" =	V1	6AK5 RF Amplifier
"	T1	RF Transformer to V2
"	V2	6AK5 RF mixer
14-16 Mc./S.	T3	IF Transformer to V5
"	V5	Second Mixer
2 Mc./S.	T6, 7	IF Transformer to V6
"	V6	6BA6 IF Amplifier
"	T8	IF Transformer to V7
"	V7	6BA6 IF Amplifier
"	T9	IF Transformer to V8
"	V8	6AU6 IF Amplifier
"	T10	IF Transformer to V9
"	V9	Double diode detector and audio amplifier
Audio	V10	6AU6 Output Triode
"	W1 W2	Noise Limiter
Mute	V11	Mute Relay, Control Tube
"	W3	Mute Noise Diode
RF Oscillator	V4	6U8 Oscillator and Doubler
"	T5	Tuned Oscillator Load for V4 Pentode
"	T4	Doubler Transformer to V3
"	V3	6AM6 Quadrupler
"	T2	Tuned Quadrupler Load for V3

2.1 (Cont.)

CRYSTAL OSCILLATOR.

The Receiver is a double conversion type using one crystal as the source for deriving both converter frequencies. The second mixer utilises the crystal frequency while the first mixer utilises eight times the crystal frequency.

The crystal oscillator is a Colpitts type using the screen grid of the pentode section of the 6U8 as an anode for the oscillator section and the plate of the pentode section as a point from which amplified oscillator voltage is obtained for the second mixer. T5 is a tuned load for the pentode. The grid anode connection prevents the crystal frequency changing due to detuning of any tuned circuit, normally present in other types of oscillator circuits. The crystal frequency is applied to the second mixer via C25. It is also applied via C21 to the grid of the triode section of the 6U8 which with T4 in the anode circuit doubles the crystal frequency. T4 also couples the doubled frequency to the grid of the 6AM6 quadrupler. T2 is the anode load of the 6AM6 and is tuned to eight times the crystal frequency. From the secondary of T2 this frequency is applied to the grid of the first mixer via C14.

T.P.2 is a test point for tuning T5 and T.P.3 permits the tuning of T4, using grid current in both cases as an indication.

R.F. and I.F. STAGES.

The aerial feeder is connected to the tapped coil L1. The R.F. input is then transferred to the grid of V1 via C2 where it is amplified before being applied to the first mixer via T1 and C13. In V2 the frequency is changed to that of the first I.F. (14.88 - 16.44 Mc./S.) and then applied to the second mixer via T3. In V5 the frequency is changed to that of the second I.F. (2 Mc./S.) The signal is then amplified in conventional manner in V6, V7 and V8 and applied to the double diode detector in V9.

The I.F. transformers T6, T7, T8, T9 and T10 are all identical and overcoupled to obtain a bandwidth of 25 Kc./S. at an attenuation of 4 db.

DETECTION AND AUDIO STAGES.

The I.F. frequency is applied to both diodes as in a conventional receiver. The A.V.C. diode (pin 6) does not conduct immediately but is delayed until the diode is at a potential more positive than the cathode of the triode which has cathode bias. The A.V.C. is filtered via R35, C54 and applied to V7, V6 and V1.

DETECTION AND AUDIO STAGES (Cont.)

Audio detection takes place at diode 2 of V9, the diode load being R30 and R31. At the junction of R30 and R31 the audio is taken off and applied to the diode limiter W, W2 and associated components R34, R33 and C59.

The junction of W2 and R34 is held at a negative voltage with respect to the cathode of V9 corresponding to the carrier level. Due to the time constant of R33, C59, this voltage cannot follow the audio impulse type noise.

When noise or any audio in excess of 100% modulation is received, the junction R30, R31, becomes more negative than the cathodes of the diodes W1, W2. The diodes cease to conduct under these conditions, thereby stopping the noise from reaching the audio amplifier.

The audio is fed from the junction of W2 and R34 via C61, R42 and R43 to the grid of V9. There it is amplified and fed to the audio output tube V10 for further amplification before being applied to the line.

MUTE CIRCUIT:

V11 is the mute relay control tube and the circuit is a simple form of codan. Audio signal, noise and a D.C. voltage proportional to the strength of the received signal is fed from terminal 4 of T10 via R32 to a network in the grid circuit of one triode of V11. C62 and R39 is a high pass filter which filters out both the D.C. voltage and the audio signal but lets the noise pass via C63 to the diode W3. R40 and C64 is a low pass filter which filters out the audio signal and noise and permits the negative D.C. voltage to be applied to the grid. Meanwhile the noise voltage is rectified by diode W3 so that a positive voltage is formed tending to buck the negative voltage already applied to the grid and this causes more plate current to flow.

An adjustable trigger level is provided by R60 in the cathode of the 1st section of V11. R49 is a HT bleed resistor which assists in stabilizing this voltage. The adjustment of R60 determines the level of the applied signal which will open the mute relay. In the anode circuit of the same triode is a resistor of high value (R48) to produce a large voltage difference for grid voltage changes. This anode voltage is applied directly to the grid of the second triode. Cathode resistor R51 and HT bleed resistor R52 provide bias which is substantially independent of plate current until the grid voltage rises to the appropriate value, when plate current rises sharply and the relay operates, opening the mute contacts.

2.1 (cont.)

MUTE CIRCUIT (Cont.)

In the no signal condition, the second triode is nearly cut off while the first triode is conducting. An R.F. signal produces the negative D.C. voltage which tends to cut off the first triode and the subsequent rise in plate voltage causes the second triode to conduct and operate the mute relay.

In the absence of a signal, noise pulses cause the positive voltage mentioned above. This causes the first triode plate current to increase which cuts off the second triode. Hence noise will not unmute the receiver but rather tends to hold it muted. The application of a weak noisy signal combines both these operations and it is not until a readable signal to noise ratio is obtained that the mute opens.

POWER SUPPLY:

The R32 power supply consists of a normal AC to DC supply. S1 is used in the primary of power transformer T12 for switching the receiver on and off. F1 protects the transformer against abnormally high currents and voltages.

The secondary of T12 consists of the following windings and functions:

(a) A 6.3 volt winding for the receiver heaters.

(b) A 6.3 volt winding for the panel pilot lamp.

(c) A 30 volt winding not used.

(d) A 50 volt winding not used.

(e) A 170 volt winding fed to a bridge connected rectifier circuit of silicon rectifiers. 220 Volts D.C. output is fed via a capacitance input filter to the receiver H.T. line.

3.1 TABLES OF VOLTAGES AND CURRENTS.

3.1.1 POWER SUPPLY VOLTAGES.

Operating Voltage	Heater Voltage	H.T. Volts
240V A.C	6.3	225

3.1.2 RECEIVER VOLTAGE TABLE.

Line level control	Fully anti-clockwise
Mute Control	Fully anti-clockwise
RF input	Zero
HT Supply	225
Heater Volts	6.3 volts

Meter. Measurements marked V.V. read with valve voltmeter. All others on instrument with 1000Ω/V sensitivity.

Valve No.	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
1	-	-	-	6.3	65	65	-	-	-
2	3 VV	-	6.3	-	85	85	-	-	-
3	43 VV	-	6.3	-	215	-	165	-	-
4	140	8.5 VV	60	6.3	-	80	-	-	10 VV
5	0.5 VV	-	6.3	-	125	125	4.8	-	-
6	0.5 VV	-	6.3	-	175	70	0.45	-	-
7	0.5 VV	-	6.3	-	210	80	0.5	-	-
8	-	3.5	6.3	-	225	165	3.5	-	-
9	10.5 VV	9.5	6.3	-	10 VV	-.35	162	-	-
10	0	225	6.3	-	225	225	4.5	-	-
11	155	45	90	6.3	6.3	45	6.5 VV	10.5 VV	0

3.1.3 RECEIVER TEST POINT READINGS.

Position	Meter	Current
TP1	50-0-50μA	+ 18μA
TP2	1 mA	.55mA
TP3	1 mA	.45mA
TP4	10 mA	7mA

3.2 MAINTENANCE ADJUSTMENTS AND ALIGNMENTS:

3.2.1 RECEIVER ALIGNMENT:

Test Equipment required -

(a) 50μA centre zero meter.

(b) Signal Generator covering 2 Mc./S.

(c) Signal Generator covering the range 118-132 Mc./S.

(d) Resistor 15K ohms with clips.

(e) 0-1 mA meter.

2 Mc./S. I.F. Alignment.

Plug the 50μ Amp meter into T.P.1 so that the meter deflects to the positive side of the scale with no signal. Connect the generator between Pin 1 of V8 and ground at 2 Mc./S. and full output. Using the special aligning tool provided, unlock the top and bottom slugs of T10 and tune for a maximum deflection on the meter. Ensure that the slugs are tuned to the first maximum when starting with the slugs at the outer position. Reduce the output of the generator till the deflection is -10μA. Retune each slug and lock, only very slight pressure on the locking ring is necessary to satisfactorily lock the slug.

Connect the generator to Pin 1 of V7 and earth. Connect the 15K loading resistor across terminals 1 and 2 of T9.

Using the same tuning technique as described above, tune both slugs of T9 for maximum deflection, reducing the output of the generator to give -10μA before giving the slugs a final tune and lock.

2 Mc./S. I.F. Alignment (cont.)

Connect the generator between Pin 1 of V6 and earth. Connect the 15K loading resistor between terminals 1 and 2 of T8. Tune both slugs of T8. Connect the generator between Pin 1 of V5 and earth. Connect the loading resistor between terminals 1 and 2 of T7. Tune both slugs of T7 as for T9. Connect the 15K loading resistor between terminals 1 and 2 of T6, tune both slugs of T6 as for T9. Disconnect the generator and resistor. The I.F. Alignment is now complete.

R.F. Alignment on Change of Frequency.

Select the crystal for the desired carrier frequency.

$$\text{Crystal Frequency} = \frac{\text{Carrier Freq. Mc./S.} - 2\ \text{Mc./S.}}{9}$$

Plug in the crystal. Plug in the 0-1 mA meter into TP2. Tune both slugs of T5. Tune the top slug first for a maximum on the meter. Then tune the bottom slug for a minimum. Lock both slugs after tuning. The meter reading should be approximately 0.5 mA. Shift the meter into TP3 and tune both slugs of T4 for a maximum, approximately 0.4 mA.

Connect the V.H.F. Signal Generator to the aerial socket and apply full output voltage (0.5 volts if available). Set the Signal Generator by the calibration to the approximate carrier frequency. Vary the frequency till a tuning indication is given on the 50μ Amp. meter in TP1. Tune the Signal Generator for maximum deflection.

Using the special tool provided, tune C1, C5, C6, C8 and C9 from the minimum capacity position for maximum meter deflection, taking care that the generator output is reduced at each tuning for a maximum meter deflection of + 10μA.

Having tuned the capacitors, check that the generator is exactly on the carrier frequency by tuning it for maximum deflection of the test meter. Retune C1, C5, C6, C8 and C9 if necessary again limiting the meter deflection to 10 μA by reducing generator output. Now tune both slugs of T3 for maximum deflection, reducing the output of the generator to keep the maximum meter deflection down to + 10μA.

The Receiver is now aligned and the generator output should be about 0.5μV. Give a final touch to the generator frequency, the slugs of T3, capacitors C1, C5, C8, C9 and C6 in that order. At this stage with the signal generator set to a maximum of 1.0μV set C6 to minimum capacity and readjust for maximum sensitivity ; repeat with C9, this ensures the correct tuning position of both these trimmer capacitors.

R.F. Alignment on Change of Frequency. (cont.)

C5 and C6 can tune to spurious responses when the generator is set to outputsgreater than 10µV and the original instruction to tune all condensers from the minimum capacity position should be adhered to.