



**GENERAL PURPOSE
COMMUNICATION RECEIVER CR-6
SERIES C60600**

**HANDBOOK 60600R
(ISSUE 2)**

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
Engineering Products Division
422 LANE COVE ROAD, NORTH RYDE, N.S.W.

SUPPLEMENT No. 1
TO
HANDBOOK 60600R

1.—BRIEF DESCRIPTION

1.1 Classification

The A.W.A. Receiver CR-6B, type 2C60600, is similar to the CR-6A, type 1C60600, but covers a different range of frequencies. The R.F. Coil Unit type 2C60602 is used in place of type 1C60602 to provide coverage of the low frequency band 200 to 540 kc/s in addition to five high frequency ranges giving continuous coverage from 2 to 25 Mc/s. The low frequency range includes the marine calling and emergency band and certain fixed frequency services such as radio navigational aids and maritime beacons.

The unit is built into a main receiver chassis identical with that used in the CR-6A Receiver, described in Instruction Book 60600R. The receiver, with the inclusion of R.F. Coil Unit type 2C60602, becomes a CR-6B Receiver type 2C60600. Other variations from the basic CR-6A receiver include a dial drum scale calibrated for the ranges used and a different front panel escutcheon, with the appropriate frequency ranges stencilled around the range change switch.

1.2 Performance Specification

Frequency Coverage	(i) 200 to 540 kc/s (ii) 2 to 5 Mc/s (iii) 5 to 10 Mc/s (iv) 10 to 15 Mc/s (v) 15 to 20 Mc/s (vi) 20 to 25 Mc/s
Sensitivity and Signal to Noise Ratio 200 to 540 kc/s	With an output of 500 mW. for an input of 10 μ V. of a carrier modulated 30% at 1000 c/s, the signal to noise ratio is not less than 10 db.

2 to 25 Mc/s With an output of 500 mW. for an input of 3 μ V. of a carrier modulated 30% at 1000 c/s, the signal to noise ratio is not less than 10 db.

The other performance figures are as for the CR-6A receiver, as described in Instruction Book 60600R, sub-section 1.5.

1.3 R.F. Coil Unit Type 2C60602

The R.F. Coil Unit is very similar to that used in the CR-6A receiver. The differences are as follows:

- The new low frequency range is in position 1 of the range switch and all other ranges are moved up one position, the highest frequency range (25 to 30 Mc/s) being deleted.
- The anode load of the r.f. amplifier valve (V1) is a variable inductor (L11) and the first mixer grid inductor is replaced by a resistor (R11). Since L11 is in circuit on all ranges, it will be necessary to align the low frequency range 200 to 540 kc/s first, before proceeding with the alignment of the other ranges. (See sub-section 2.2.)
- On the low frequency range an extra resistor (R5) is switched into the cathode circuit of the r.f. valve (V1). This resistor is shorted out by the switch on the other ranges.
- The resistors in the voltage divider in the first mixer screen supply are of different values from those used in the CR-6A.

Apart from these variations, the coil unit is identical with that used in the CR-6A receiver. The remainder of the equipment is unchanged and the description of the receiver as a whole, as given in Instruction Book 60600R, applies equally to the CR-6B.

The component schedule for R.F. Coil Unit 2C60602 is included in the main handbook, sub-section 5.2.

2.—OPERATION AND MAINTENANCE

2.1 Operation

The low frequency (200 to 540 kc/s) range provides for the reception of radio navigational aids such as beacon transmitters, and the maritime emergency band between 490 and 510 kc/s.

The operation of the receiver is as described in sub-section 3.6 of the receiver handbook. Note, however, that only one calibration point (using the crystal calibrator) is available on the low frequency range, viz. 500 kc/s.

2.2 Maintenance

The care of the receiver and the maintenance and alignment procedures for the CR-6B receiver are identical with those given for the 6R-6A, with the following exception:

Paragraph 4.4.10 R.F. Alignment

The low frequency range (200 to 540 kc/s) must be aligned before proceeding with alignment of the

other ranges. Since the ends of the band cannot be calibrated by means of the crystal calibrator, this range must be aligned with the signal generator only. The signal generator should first be calibrated as accurately as possible, and the output impedance built out (if necessary) to 100 ohms with a non-inductive resistor.

Check that the scale calibration marks at 200 and 540 kc/s coincide with 2 and 26 on the log scale with the DIAL CORRECTOR set to the centre of its range. Then align the ends of the range as follows:

Range kc/s	Alignment Frequencies	Aerial	Adjustment	
			R.F.	Oscillator
200-	200 and	TR16,	L11,	TR17,
540	540 kc/s	C16	C32	C56

The other ranges are then aligned as in 4.4.10 in the receiver handbook.

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251067

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REVISION RECORD

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FOREWORD

The A.W.A. Receivers series CR-6 cover frequencies in the range 200 to 540 kc/s and 2 to 30 Mc/s.

Receiver type CR-6A gives continuous coverage from 2 to 30 Mc/s in six ranges, and this receiver is described in detail in this handbook.

Receiver type CR-6B is described in Supplement No. 1. It includes a low frequency range of 200 to 540 kc/s to cover the marine calling and emergency band and certain fixed frequency services. The high frequency range of 25 to 30 Mc/s is omitted from this receiver. The variations occur only in the R.F. Coil Unit series C60602, the calibrated dial scales and the range change switch. The circuitry of the main receiver chassis and the Crystal Oscillator Unit (when fitted) remain the same for all types.

The R.F. Coil Unit type 2C60602, used in Receiver CR-6B, is described in detail in Supplement No. 1 to the main handbook.

The types of receiver currently available are listed below.

Receiver	Type	R.F. Coil Unit	Frequency Coverage
CR-6A	1C60600	1C60602	2 Mc/s to 30 Mc/s.
CR-6B	2C60600	2C60602	200 kc/s to 540 kc/s, 2 Mc/s to 25 Mc/s.

60600R

(ii)

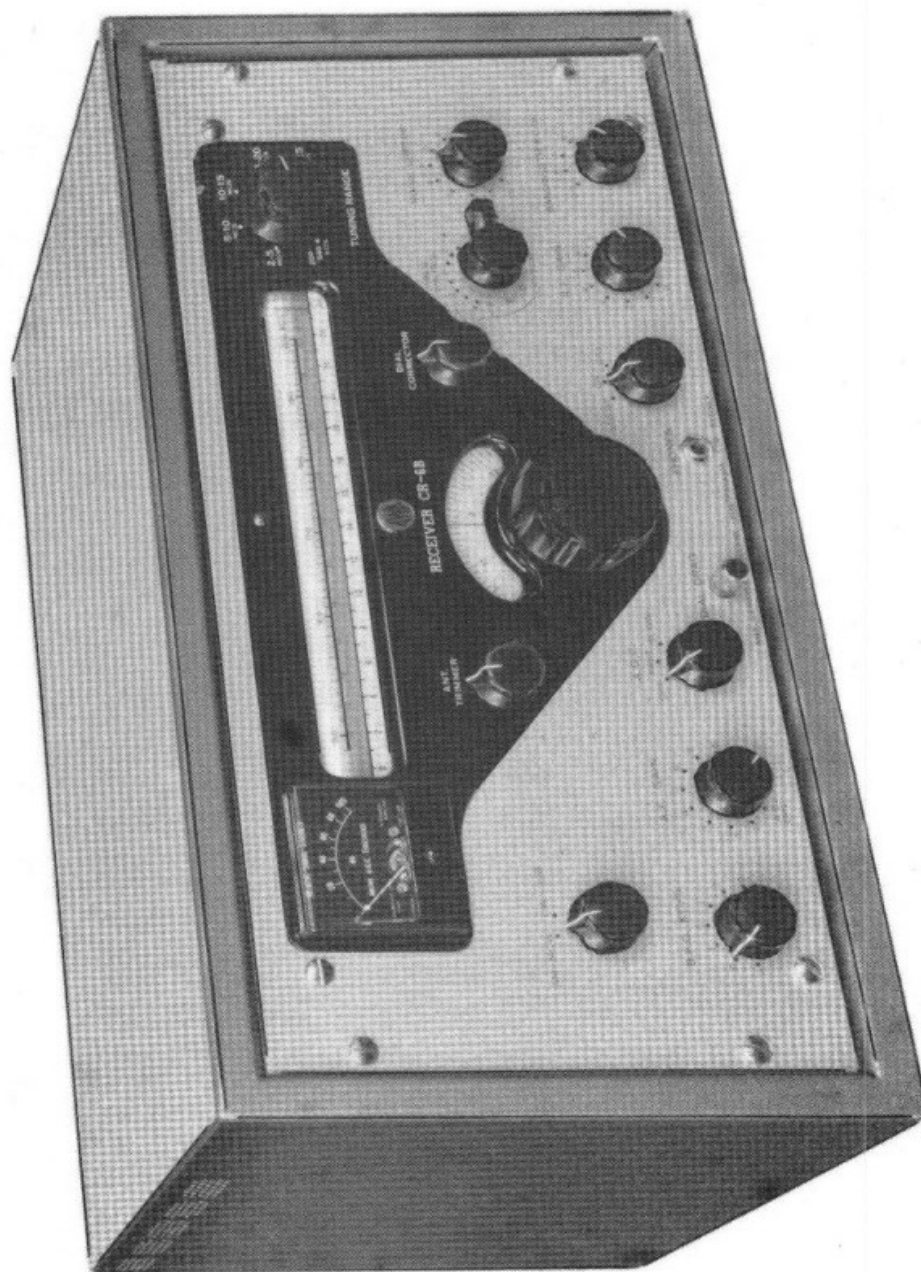
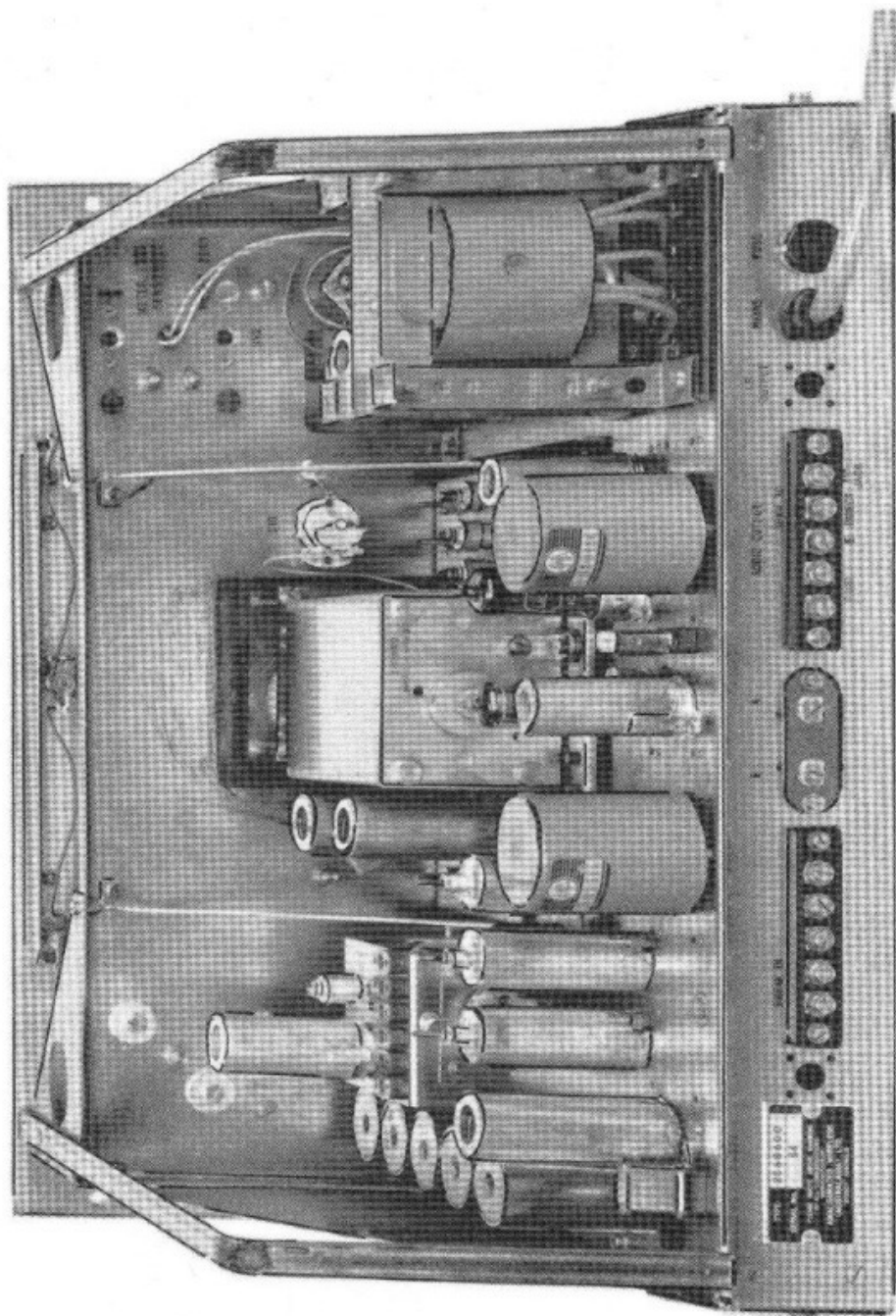


PLATE 1 RECEIVER CR-6 (Front View) IN CABINET

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60600R

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P.V.-526-0

PLATE 2 RECEIVER CR-6 (Rear View)

60600R

(iv)

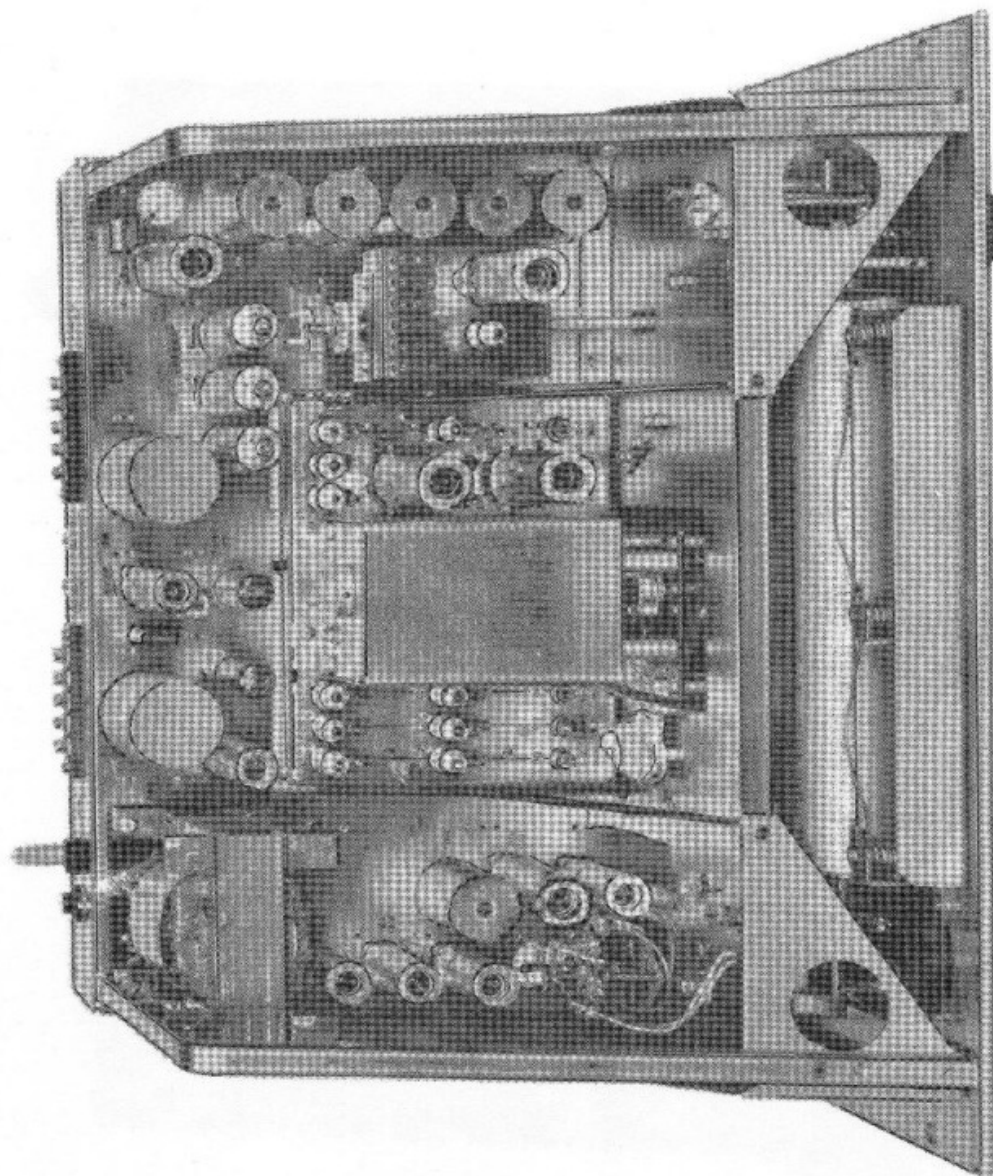


PLATE 3 RECEIVER CR-6 (Top View)

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60600R

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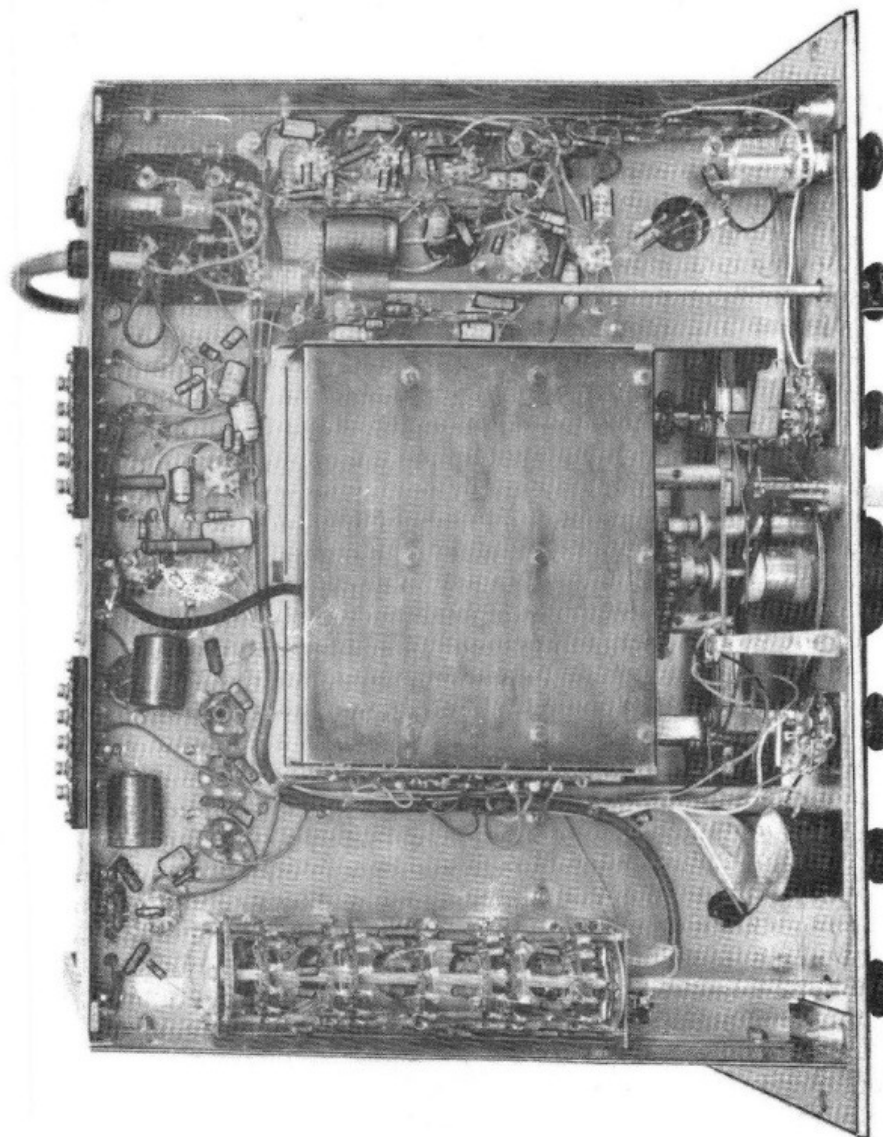


PLATE 4 RECEIVER CR-6 (Bottom View)

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Circuit	Drg. 60602C1
R.F. Coil Unit type 2C60602	
Circuit	Drg. 60602C2
Component Layout	Drg. 60602C3
100 kc/s Filter Unit type 1Q60603	
Circuit	Drg. 60603C1
Dial Cord Diagram	Drg. 60600C1
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1.—BRIEF DESCRIPTION

1.1 Classification

The CR-6A is a highly stable general purpose communication receiver covering the frequency range 2 to 30 Mc/s. It is compact and self contained, except for the loudspeaker, which is not supplied with the receiver.

The unit is suitable for mounting in a standard 19 inch carrier rack and occupies 8½ inches of panel space. Alternatively it may be supplied with an attractive case for desk-mounting use.

A loudspeaker styled to match the receiver in its case is also available.

The receiver operates from a 220 to 250V., 50 c/s power supply. The facilities provided include the following:

- Continuous frequency coverage from 2 to 30 Mc/s in six bands.
- Reception of CW, MCW, RT (AM) or SSB signals.
- Built-in crystal calibrator and dial correcting mechanism.
- Beat oscillator for CW and SSB reception.
- Variable bandwidth of 0.7, 1.5, 3 or 6 kc/s.
- A.G.C. off, fast or slow.
- Noise limiter.
- Signal strength meter.
- Provision for up to six crystal-locked frequencies within the range of the receiver, using the optional crystal oscillator unit described in the Appendix.

1.2 Composition and Type Numbers

Description	Type No.
Receiver CR-6A, including the following units	1C60600
One Tuning Unit	1C60601
One R.F. Coil Unit	1C60602
One 100 kc/s Filter Unit	1Q60603
One Case (when required)	1Z60605
One Speaker Unit (supplied separately when required)	1D60608
One Set of working valves and crystals	

For crystal locked operation the following may be supplied separately to order:

Description	Type No.
Crystal Oscillator Unit	1C60604
Crystals as specified	Type D

1.3 Brief Description

The unit is a double conversion superheterodyne covering the frequency range 2 to 30 Mc/s by means of switched coils and a three-gang variable capacitor. It comprises an r.f. stage, a first mixer oscillator which converts the signal to 1.8 Mc/s and a bandpass filter at the first intermediate frequency; a second mixer with a crystal controlled oscillator to convert the signal to 100 kc/s and a variable bandpass filter

centered on the second intermediate frequency. Three stages of i.f. amplification are used, followed by a diode detector for AM and MCW, or a product detector for CW or SSB signals.

A peak clipping noise limiter is provided. This limiter clips both positive and negative peaks and is effective on all types of reception.

A beat oscillator, tunable up to ± 3 kc/s about 100 kc/s is included for use in CW or SSB reception.

The a.g.c. is derived from a diode rectifier and is applied to the r.f. and i.f. stages. The signal strength meter operates from one of the a.g.c. controlled stages and is only operative when the a.g.c. is switched on.

The audio frequency circuits consist of a pentode voltage amplifier, resistance-capacitance coupled to a pentode power output stage which is in turn transformer coupled to a 600-ohm line output or an external loudspeaker and headphones.

A crystal-locked calibration oscillator provides harmonics at 500 kc/s points over the range of the receiver, for accurate calibration.

The power supply comprises a full wave circuit using a silicon bridge rectifier with a conventional "pi" network filter, and a gaseous regulator valve to stabilise the h.t. supply to the oscillator of the first mixer and the noise limiter.

The crystal oscillator unit, when fitted, takes the place of the first mixer oscillator and provides up to six fixed frequencies by means of switched crystals. This unit may be fitted to the receiver by mounting it in the holes provided and making a few simple wiring changes. The crystal oscillator unit and the method of adding it to an existing receiver are described in the Appendix, Instruction Book No. 60604R.

1.4 Power Requirements

Number of Phases	One
Voltage	220 to 250V. r.m.s.
Frequency	50 c/s to 60 c/s
Power Consumption	50 watts

1.5 Performance Specifications

- Frequency Range** 2 to 30 Mc/s, covered in six bands as follows:
 - 2 to 5 Mc/s
 - 5 to 10 Mc/s
 - 10 to 15 Mc/s
 - 15 to 20 Mc/s
 - 20 to 25 Mc/s
 - 25 to 30 Mc/s

Approximately 5% overlap is provided on all bands.
- Types of Reception**

A.M. radiotelephony	A3
Modulated C.W.	A2
C.W. telegraphy	A1
Single sideband	A3a

- (c) **Sensitivity and Signal-to-noise Ratio** With an output of 500 mW. for an input of 3 μ V. of any carrier modulated 30% at 1000 c/s, the signal-to-noise ratio is not less than 10 db.
- (d) **Selectivity** Four degrees of selectivity are provided by means of a switched 100 kc/s filter. The pass-bands are as follows:
- | Switch Pos'n. | 6 db. Points | 60 db. Points |
|---------------|--------------|---------------|
| 0.7 | 700 c/s | 3 kc/s |
| 1.5 | 1500 c/s | 6 kc/s |
| 3 | 3000 c/s | 10 kc/s |
| 6 | 6000 c/s | 18 kc/s |
- (e) **Image Rejection** Better than 36 db. at 30 Mc/s.
Better than 60 db. at 2 Mc/s.
- (f) **Audio Output and Distortion** With a 1000 μ V. carrier modulated 30% at 1000 c/s an output of one watt is available with a distortion of not more than 15%.
- (g) **Overall Frequency Response** Variation in level over the band 300 c/s to 3000 c/s is not greater than 6 db. Outside this band the attenuation is rapid.
- (h) **A.G.C. Characteristic** The audio output does not vary by more than 6 db. when the input is increased from 5 μ V. to 100 mV.
- (i) **Spurious Responses** All spurious responses other than images are at least 50 db. down.
- (j) **Input Impedance** Approximately 100 ohms unbalanced.
- (k) **Output Impedances** Two outputs are provided:
(1) 600 ohms for connecting to a standard telephone line or other equipment.
(2) 8 ohms for an external loudspeaker.
A jack for headphones is also provided.

1.6 Valve and Crystal Complement

(a) Valves and Semi-conductors

Circ. Ref.	Function	Type
V1	R.F. amplifier	6BY7
V2	1st mixer/oscillator	6AJ8
V101	Crystal calibrator	6AU6
V102	Voltage regulator	OB2
V103	2nd mixer/oscillator	6AJ8
V104	1st i.f. amplifier	6BA6
V105	2nd i.f. amplifier	6BA6
V106	3rd i.f. amplifier	6AU6
V107	B.F.O.	6AU6
V108	Product detector	12AU7
V109	Audio driver	6AU6
V110	Output amplifier	6AQ5
MR101 to MR104	H.T. rectifiers	1N1169
MR105	A.G.C. delay	OA202
MR106	A.G.C. rectifier	OA202
MR107	A.M. detector	OA202
MR108 & MR109	Noise limiters	OA202

(b) Total Valve and Semi-conductor Complement

Type	Quantity	Type	Quantity
6AJ8	2	12AU7	1
6AQ5	1	OB2	1
6AU6	4	OA202	5
6BA6	2	1N1169	4
6BY7	1		

(c) Crystals

Circ. Ref.	Function	Description
XL101	Crystal calibrator	Type D, 500 kc/s $\pm 0.005\%$ at 35°C. Adjusted for 30 μ F. shunt capacitance.
XL102	Local oscillator (2nd mixer)	Type D, 1700 kc/s $\pm 0.01\%$ between +10°C. and +60°C. Adjusted for 30 μ F. shunt capacitance.

1.7 Mechanical Construction and Dimensions

The receiver comprises two main sections, the R.F. Coil Unit and the main chassis. The R.F. Coil Unit is a self-contained, rigid assembly, and includes the three-gang variable tuning capacitor, the tuning mechanism and the six sets of tuning inductors together with the associated trimmer capacitors and the range change switch.

The main chassis is bolted to the front panel, the assembly being stiffened by side members. The R.F. unit is mounted in a cut-out in the chassis and rigidly secured to both chassis and front panel.

The main chassis, the R.F. coil assembly and the mounting brackets are of mild steel, cadmium-plated to resist corrosion. The front panel is of cadmium-plated steel and a black acrylic escutcheon surrounds the dial and main tuning controls.

All preset controls and adjustments are accessible from the top of the chassis and the layout is designed to facilitate servicing and maintenance.

The valves, i.f. filter inductors and transformers are mounted above the chassis, and the wiring and smaller components underneath. The tuning capacitor is protected by a clip-on dust cover and removable partitions and cover plates are provided to isolate the r.f. stages.

All input and output connections are on the rear apron of the chassis and are as follows, from left to right, viewed from the rear: Break-in connections, Earth, Aerial, Line and Speaker output, 100 kc/s i.f. output (when used), Mains Input Cable and Mains Fuse.

The dimensions of the receiver without the case are as follows:

Height: 8½in.

Width: 19in.

Depth (excluding controls): 12½in.

The case which is supplied when the receiver is used for desk mounting is of fabricated sheet steel with vents for air circulation at the top of the sides and back. A cut-out is provided for access to the input and output connectors at the rear.

The dimensions of the case are as follows:

Height: 10½in.

Width: 20½in.

Depth: 13in.

1.8 External Finish

The front panel of the receiver is finished in silver Hammertone enamel, with black engraved designations for the controls. The cases for the receiver and the speaker are finished in mid-blue Hammertone enamel.

2.—TECHNICAL DESCRIPTION

2.1 Tuning System

(a) Drive

The tuning elements consist of a high-grade three-gang variable capacitor and six sets of high-stability permeability-tuned inductors, the required set being selected by a six-position range change switch.

The tuning capacitor is driven through a gearbox assembly integral with the capacitor, and is adjusted by means of a heavy knob which also serves as a flywheel. The gearbox is a two-stage unit and gives a ratio of approximately 50 to 1. All three spindles in the gearbox are carried on ball bearings.

Backlash is practically eliminated by the use of spring-loaded double gear wheels and spring-loaded conical pivots on the spindles. A positive stop is provided at each end of the range to prevent damage to the tuning system by misuse of the tuning control.

As a further protection a friction clutch is incorporated in the main driving spindle. This takes the form of a flat spring disc, which is compressed just sufficiently to give a positive drive from the main tuning knob, but is still free enough to slip when the tuning mechanism is hard up against the end stops, or when the dial drag is fully locked.

The dial drag consists of a flat spring of phosphor bronze, adjusted by a lead screw to exert a variable pressure on a felt braking pad on the main driving spindle. When the lead screw is turned fully clockwise by the DIAL DRAG knob, the vernier dial scale is gripped between the lead screw carriage and the back of the dial drag mounting block and securely locked.

(b) Tuning Dial

The tuning dial consists of two parts; a drum which carries the six straight-line frequency calibration scales for the six bands, and which is operated by the range change switch to show the band in use, and a circular dial calibrated in 100 scale divisions. The circular scale is attached to the main tuning spindle and each scale division represents approximately 2 kc/s. The main scales carry special markings showing the frequency increment per vernier scale division at different points on the band. A fixed scale calibrated in 28 main divisions is also provided for logging as described below in sub-section 3.5 (a).

(c) Bandspread

Six sets of inductors are used in the bandspread system in this receiver, and a virtually constant tuning rate from 2 to 30 Mc/s is achieved. Each band is 5 Mc/s wide with the exception of the lowest band (2 to 5 Mc/s) which is 3 Mc/s wide, and the ease of tuning remains practically constant at all frequencies.

This system of bandspread has the great advantage that the stability of the receiver is automatically improved by the use of small, constant width increments of band coverage. Moreover, temperature compensation in the oscillator circuits becomes easier with a constant tuning rate, as compared with a constant frequency ratio between bands. This system also provides less variation of gain and selectivity

throughout the bands, simplifies tracking problems, and has a more constant input impedance.

2.2 R.F. Amplifier

The r.f. amplifier consists of a single type 6BY7 pentode stage with tuned grid circuits. A small variable capacitor designated ANT. TRIMMER is in circuit on all bands and is used to trim the input tuning. The anode of the r.f. valve is shunt fed via L8 and capacitively coupled to the r.f. tuned circuits L1 to L7, which are slug-tuned inductors with individual trimmer capacitors for each band. Individual paddler capacitors are also used on bands 2 to 6 to achieve the bandspread characteristics mentioned in 2.1 above.

The first mixer oscillator is a type 6AJ8 valve with the oscillator operating on the high side of the signal frequency on bands 1, 2 and 3, and on the low side on bands 4, 5 and 6. The anode of the oscillator (triode) section is shunt fed via L9 and capacitively coupled to the oscillator transformers TR8 to TR14 whose tuned secondaries are also provided with tuning slugs and individual trimmers. Each tuned circuit is connected by a separate paddler to the oscillator section of the main tuning capacitor.

In all cases, inductors adjacent to those in use are short-circuited by the range switch. An additional refinement involves switching different values of resistance in the voltage divider feeding the first mixer screen grid, to provide constant sensitivity over the full range of the receiver.

The output from the first mixer is at 1.8 Mc/s, and this is applied to the block filter in the input to the main receiver unit, as shown in Drg. 60600G2.

For crystal-locked fixed frequency application a Crystal Unit type 1C60604 (supplied separately as required) may be wired into the oscillator circuit. The crystal unit and the method of fitting it to the receiver are described in the Appendix, Instruction Book 60604R.

2.3 Second Mixer Stage and 100 kc/s Filter

The second mixer oscillator stage also uses a type 6AJ8 valve (V103). The input from the R.F. Coil Unit passes through a 1.8 Mc/s bandpass filter, which has a pass band of approximately 8 kc/s at the 3 db. points. The second oscillator (triode section of V103) is crystal controlled by XL102 (1.7 Mc/s) to give a second intermediate frequency of 100 kc/s. The signal is then fed to a 100 kc/s filter with a variable passband, as shown in Drg. 60603C1. This unit is a four-section filter with switched capacitors in both series and shunt elements, giving a choice of four different bandwidths of 0.7, 1.5, 3 and 6 kc/s, centred in each case on 100 kc/s.

2.4 I.F. Amplifiers

The i.f. amplifier comprises three stages of aperiodic amplification, with resistance-capacitance coupling, and is extremely stable. It will be noted that the functions of selectivity and gain are

separated and valve variations will not affect the selectivity characteristic.

The first two stages use type 6BA6 valves (V104, V105), with a.g.c. applied, the second stage being stabilized by a voltage divider for the screen supply. The third stage is a type 6AU6 (V106) transformer coupled to the detector circuits. Negative feedback is applied over the third stage (V106) to lower the output impedance and broaden the response of TR102.

2.5 Detector Circuits

Two different detector circuits are used, a diode rectifier for AM-MCW and a "product detector" for CW-SSB.

For AM and MCW the diode MR107 rectifies the positive-going signal pulses via the i.f. filter C154, R148, C162 and the diode load R149. Switch SWB connects the output to the noise limiter circuit. For CW and SSB reception a beat oscillator is used. This is a type 6AU6 (V107), tunable to 3 kc/s above and below 100 kc/s. The output is mixed with the 100 kc/s i.f. signal in the product detector V108 (type 12AU7) and the resultant is the difference frequency between the local "carrier" and the modulated i.f. signal. This method of detection provides far better reception of CW or SSB signals than that obtained with a diode detector.

Switch SWB connects the detector output to the noise limiter circuit and allows the beat oscillator to function by removing the earth connection from the oscillator screen supply when set to the CW-SSB position.

2.6 Noise Limiter

The noise limiter is common to both detector outputs, and may be switched in or out of circuit as required by a switch on the NOISE LIMITER control RV102/1SWC. The limiter is of the shunt type and clips both positive and negative peaks to a value determined by the setting of the noise limiter control. This control in turn derives a bias from the average amplitude of the modulation, and limiting is thus automatically adjusted for different modulation levels. The operation is as follows.

With the noise limiter switched on, a positive bias, derived from the full diode load (R148, R149) is applied to the junction of diodes MR108 and MR109 via the NOISE LIMITER control RV102 and resistors R153 and R154. This rectified voltage is smoothed by C163. Since R154 is a common impedance in both diode circuits, a.f. voltages across R152 will also appear across R157. Positive-going signals will be limited by the positive bias at the diode anodes and MR108 will cease conducting when the signal voltage equals the bias voltage. The negative-going signals will be limited by earth potential. The signal is thus limited to values between the threshold level as set by the noise limiter and earth or zero potential.

During CW or SSB reception the noise limiter control is switched by SWB to a fixed positive bias derived from voltage divider R141, R146. The bias applied to the diodes, and hence the degree of limiting, depends on the setting of the noise limiter control.

When the noise limiter is switched out of circuit by 1SWC the threshold voltage is raised to a high, fixed value derived from the stabilised h.t. supply.

2.7 A.G.C. and Signal Meter Circuits

The a.g.c. voltage is derived from the anode circuit of the third i.f. amplifier (V106) via C148. The diode MR105 is connected to a point on the voltage divider R142, R143, RV2, R147, to provide a delay bias of approximately +15V. Diode MR106 prevents the application of positive voltage to the a.g.c. line. When the signal exceeds a value of 15V. the positive-going peaks are clamped at +15V. by the diode MR105 and the average value of the rectified signal becomes negative, causing a negative a.g.c. voltage to be developed across R151 and applied to the r.f. stage and the first two i.f. stages.

The signal meter M101 is connected between a small positive voltage on the same voltage divider and the cathode of the second i.f. amplifier (V105), which is a.g.c. controlled. The voltage at the positive side of the meter is adjusted by RV2 to be equal to the cathode voltage of V105 at the threshold of a.g.c. operation. This control thus acts as a zero adjustment for the meter. The sensitivity of the meter is adjusted by RV1, which alters the effective series resistance. The procedure for setting up these two adjustments is given in the section on Maintenance, 4.4.15.

As the received signal rises above the threshold level, the a.g.c. voltage increases, biasing V105 negatively and causing the cathode current and hence the cathode potential to fall. The meter then gives a reading proportional to signal strength.

2.8 Crystal Calibrator

The calibrator circuit consists of a crystal controlled oscillator V101 (type 6AU6) operating on 500 kc/s. The circuit is untuned and is rich in harmonics which may be used to calibrate the dial accurately to any 500 kc/s point in the frequency range. The oscillator is energised by connecting the cathode to earth via the STD. BY/ON/CAL switch SWA in the CAL position. The output is fed to the receiver aerial by a 1 μ F. capacitor C106. A preset trimmer capacitor is provided to allow the calibrator to be adjusted against a frequency standard.

2.9 Beat Oscillator

The beat oscillator is a variable frequency oscillator tuned by the B.F.O. control C137. The output is coupled to the product detector V108, which is also fed from the signal circuit at the output of TR102. The b.f.o. is disabled during AM or MCW reception by earthing the screen grid of V107 via switch SWB. For CW or SSB reception the switch opens the earth connection and allows h.t. to be applied to the screen. The oscillator then operates and the output mixes with the signal in the product detector, as described above in sub-section 2.5. The b.f.o. frequency is variable over ± 3 kc/s about the centre frequency of 100 kc/s, so that the beat note (CW) or the sideband (SSB) may be tuned for best intelligibility and minimum interference.

2.10 Audio Amplifier

The audio circuit consists of voltage amplifier V109 with an A.F. GAIN control (RV103) in the input circuit, and a power amplifier V110 feeding the

loudspeaker or a 600 ohm line via step-down transformer TR103.

The first stage is a pentode amplifier type 6AU6, resistance-capacitance coupled to the power amplifier type 6AQ5, which is also pentode connected. Overall negative feedback is applied from the low impedance secondary winding on the output transformer to the cathode circuit of the input stage (V109).

The loudspeaker may be connected directly across TSC4,3 or via the headphone jack JKA from TSC4,5. With this latter connection the loudspeaker circuit is broken when headphones are plugged into the PHONES jack on the front panel.

2.11 Power Supply

The unit is powered from the 220 to 250V. 50-60 c/s mains supply by transformer TR101 and the silicon diode rectifiers MR101 to MR104 arranged in a full-wave bridge circuit. The 150V. h.t. supply is filtered by C108, L106, C109, and an additional supply of 105V. is provided by the gaseous regulator valve V102, type OB2, for the noise limiter and the triode oscillator of the first mixer (V2) in the R.F. Coil Unit. An additional winding on TR101 provides 6.3V. a.c. for the valve heaters and the dial lamps.

The mains input is switched by SWD, which is ganged to the A.F. GAIN control so that reducing the gain to minimum switches off the receiver. A mains fuse (FS1) is provided in the active line and this fuse is accessible at the rear of the chassis.

3.—INSTALLATION AND OPERATION

3.1 Unpacking and Installing the Receiver

The equipment should be carefully unpacked and all items checked against the packing slip. The case (if fitted) should be removed; if the unit is intended for rack mounting, defer the installation until the following checks have been made.

- (a) Make a thorough inspection of the equipment for mechanical damage and check the operation of all controls and switches, and in particular the operation of the main tuning dial and the range switch.
- (b) Clean thoroughly of all dust and packing material.
- (c) Check the mains fuse for presence and correct rating (0.5A, slow blow).
- (d) Replace all valves (if removed for packing) and check for correct types against the stencilled markings on the chassis.
- (e) Plug the crystals in the correct sockets.
- (f) Check the mains transformer tapplings and adjust if necessary to suit the local mains supply voltage.

3.2 Connections

The input and output connections are on the rear apron of the chassis. Reading from left to right, viewed from the rear, these are as follows:

TSB1,2	BREAK-IN connections. These tags should be bridged unless wired to a break-in relay or key in an associated transmitter.
E	Connect to the main station earth bus by a suitable earth lead (7/22 V.I.R. or equivalent).
A	Connect the aerial lead-in from an unbalanced aerial.
TSC1,2	Connect to 600 ohm line (if used).
TSC3,4	Connect an external 3 ohm loudspeaker to TSC4 (active) and TSC3 (earth) if a permanent connection is desired.
TSC3,5	Connect the loudspeaker to TSC5 (active) and TSC3 (earth) if it is desired that the loudspeaker be silenced when headphones are used. NOTE: For correct matching of TR103, either a 600 or a 3-ohm load should be used, but not both.
I.F. OUTPUT	Coaxial connector for 100 kc/s output (when used).
Power Cable	Connect to the 220 to 250V. mains supply, maintaining the correct polarity as shown by the colours of the connectors. Red—Active Black—Neutral Green—Earth
Fuse	Glass cartridge type 0.5A. slow blow.

3.3 Aerial

The aerial may be of any suitable type with an unbalanced feed. NOTE: Neither the STD.BY switch nor the BREAK-IN circuit provides any protection for the input circuits. If the receiver aerial is also used for transmitting, special arrangements must be made to prevent excessive voltages at the receiver input.

3.4 Preliminary Tests

The following preliminary test may now be carried out:

- (a) Switch on and allow the receiver to warm up for approximately 20 minutes. Check that the gaseous regulator valve is operating correctly, as indicated by the characteristic mauve glow.
- (b) Tune in a station of known frequency and check the operation of the controls.
- (c) Set the AM-MCW/CW-SSB switch to AM-MCW. Short-circuit the aerial to earth and adjust the ZERO ADJUST control (RV2) on the signal strength meter for zero reading.
- (d) The meter sensitivity has been preset by the manufacturer and will not normally require adjustment. For instructions on setting up the meter sensitivity refer to the chapter on Maintenance, paragraph 4.4.15.

3.5 Operating Controls

(a) Front Panel Controls.

Main Tuning Control

This control tunes the three-gang variable capacitor and is used on all bands. In addition to the frequency scales, changed by the TUNING RANGE switch, a fixed scale is fitted to the dial. This scale has 28 main divisions and each main division corresponds to 100 divisions on the circular vernier scale. Thus, any station may be logged by means of a four-digit reference number in conjunction with the frequency band.

ANT. TRIMMER

This control is effective on all bands and is used to peak the input circuits after the main tuning dial has been adjusted for the received frequency.

DIAL CORRECTOR

This control moves the scale drum to the right or the left over a small range to enable the dial to be set for exact calibration at any position in the range.

TUNING RANGE MC/S

Switches the required sets of inductors into circuit to cover the range indicated, and at the same time turns the dial drum to show the appropriate frequency scale.

AM-MCW/CW-SSB

In the AM-MCW position this switch connects the diode second detector into circuit and disables the b.f.o.

In the CW-SSB position it connects the product detector into circuit and energises the b.f.o.

NOISE LIMITER

In the OFF position (extreme counter clockwise) a switch disables the noise limiter circuit by raising the bias on the limiting diodes to a high, fixed value. When the control is rotated clockwise the switch connects the d.c. component of the detected signal to the limiter diodes for AM reception. The control then adjusts the limiting to be effective at a threshold value proportional to rotation of the control.

B.F.O. KC/S

This control tunes the b.f.o. frequency over approximately ± 3 kc/s about 100 kc/s, as shown on the calibrated scale.

A.C. OFF/A.F. GAIN

In the extreme counterclockwise position a switch opens the mains supply circuit. A small clockwise movement switches on the a.c. supply and the control then acts as an audio level control.

A.G.C. Switch OFF/FAST/SLOW

In the OFF position the a.g.c. line is earthed. In the FAST position connects the a.g.c. into circuit with a normal (fast) time constant. In the SLOW position a large capacitor (C153) is connected across the a.g.c. diode load to give a slow time constant.

DIAL DRAG

This control adjusts the friction on the main tuning dial. When the control is slackened, a fast, free-running action is obtained, owing to the flywheel action of the heavy tuning knob. For careful searching, the friction may be increased by turning the control clockwise; when fully tightened, the control locks the dial.

PHONES

This is a single circuit phone jack, with auxiliary contacts to open-circuit the speaker line when the phone plug is inserted.

STD.BY/ON/CAL

In the STD.BY position the switch opens the cathode circuits of the r.f. and the 1st i.f. amplifiers, and also disables the calibration oscillator by opening its cathode circuit. In the ON position the switch connects the r.f. and 1st i.f. amplifier cathodes to earth via the R.F. GAIN control, but keeps the calibration oscillator inoperative. In the CAL position the calibration oscillator cathode circuit is completed.

R.F. GAIN

This control varies the cathode resistance of the r.f. and 1st i.f. amplifiers, and hence their sensitivity.

BANDWIDTH

Switches the various sets of capacitors in the 100 kc/s bandpass filter to provide the four bandwidths indicated.

(b) Crystal Oscillator

The controls for fixed frequency operation are part of the Crystal Oscillator Unit type 1C60604. This unit (described in the Appendix) is fitted

only when required. However, the controls are described here for the sake of completeness.

FREQ. CONTROL

Operates a trimmer capacitor to provide fine control of crystal oscillator frequency. The trimmer is common to all crystal positions.

CRYSTAL

A lever (concentric with the FREQ. CONTROL knob) sets the receiver for manual operation or to any one of the six crystal-locked frequencies.

(c) Signal Strength Meter

The two preset controls for adjustment of the signal strength meter are mounted on a panel behind the meter.

ZERO ADJUST

This control is used to set the electrical zero as described in paragraph 4.4.15.

SENSITIVITY

This control adjusts the meter sensitivity as described in paragraph 4.4.15.

3.6 Operation

3.6.1. Calibration of Receiver

1. Switch the receiver on, select the range required and allow the receiver to warm up.
2. Set the controls as follows:
AM-MCW/CW-SSB to CW-SSB, B.F.O. KC/S to 0, STD.BY/ON/CAL to CAL, A.G.C. to FAST, R.F. GAIN near maximum, A.F. GAIN to maximum, BANDWIDTH to 3 KC/S and FREQ. CONTROL (if fitted) to MANUAL.
3. Tune the receiver to the calibration point (500 kc/s) nearest to the frequency of the transmission to be received, and adjust the tuning for zero beat.
4. Using the DIAL CORRECTOR, adjust the frequency scale until the calibration point on the dial scale is exactly underneath the pointer. The dial is now accurately calibrated in the vicinity of the desired signal.

3.6.2. Red Markings on Frequency Scales

Although all frequency ranges except the lowest one have the same frequency coverage, there is some variation in the tuning rate from end to end of each band. To facilitate setting to a frequency, or for measuring an unknown frequency, a KC/S PER DIVISION marking is given at a number of points over each scale. These markings are in red and indicate approximately the kc/s per vernier dial scale division in the frequency range indicated.

3.6.3 AM-MCW Signals

1. Set the TUNING RANGE to the correct range and set the other controls as follows:
STD.BY/ON/CAL to ON, AM-MCW/CW-SSB to AM-MCW, R.F. GAIN to maximum, A.G.C. to FAST, NOISE LIMITER to OFF and BANDWIDTH to 6 kc/s.
2. If necessary, calibrate the dial as described in 3.6.1 above, in the vicinity of the desired signal frequency.

3. Tune in the signal, adjusting the main tuning control for maximum reading on the signal strength meter.
4. Adjust the ANT. TRIMMER also for maximum reading on the signal strength meter.
5. Adjust the A.F. GAIN as required.
6. For MCW, decrease BANDWIDTH as required for minimum noise.

3.6.4 CW Signals

1. Set the TUNING RANGE as required.
2. Set the AM-MCW/CW-SSB switch to CW-SSB and the other controls as follows:
STD.BY/ON/CAL to ON, R.F. GAIN to maximum, A.G.C. to SLOW, B.F.O. to 0 and BANDWIDTH to 6 kc/s.
3. Tune in the signal and peak the main tuning and the ANT. TRIMMER as described above for maximum signal strength meter reading.
4. Adjust the pitch of the beat note by the B.F.O. control.
5. Reduce the BANDWIDTH to the minimum value sufficient to provide a useful signal.
6. Adjust the NOISE LIMITER according to prevalent noise.
7. Adjust the A.F. GAIN control for a suitable output level.

3.6.5 SSB Signals

The receiver may be used to receive single sideband suppressed carrier (SSBSC) using either upper or lower sideband. The controls are set up for the reception of CW signals. However, because of the necessity for maintaining the locally-inserted carrier (B.F.O.) within ± 50 c/s of the original suppressed carrier, tuning must be carried out very carefully. With tuning errors greater than 50 c/s the signal will become unintelligible.

The recommended tuning procedure is as follows:

1. Set the BANDWIDTH to 3 kc/s.
2. Set the AM-MCW/CW-SSB switch to CW-SSB.

3. Set the STD.BY/ON/CAL switch to ON and the A.G.C. to SLOW.
4. Set the B.F.O. to 1.5, clockwise or anti-clockwise depending on whether the transmitter is using lower or upper sideband.
5. Tune very carefully with the main dial through the signal and adjust the R.F. GAIN control so that the signal strength meter just starts to kick on signal peaks. Adjust the A.F. GAIN control as required.
6. Final tuning should be done with the B.F.O. to obtain maximum intelligibility. It is important, however, that the control be still in the vicinity of 1.5. If it is necessary to shift this control well away from 1.5 for intelligibility, set the B.F.O. back to 1.5 and readjust the main dial.
7. Should the signals appear distinct in quality but unintelligible it is probable that the other sideband is being used. In this case, set the B.F.O. to 1.5 kc/s on the other side of centre zero and repeat the tuning procedure.

If it is known which sideband is being received, the correct sense of the B.F.O. setting can be determined as follows:

Tuning Range Mc/s	B.F.O. Position	
	Upper Sideband	Lower Sideband
2 - 5	1.5 clockwise	1.5 anti-clockwise
5 - 10	1.5 clockwise	1.5 anti-clockwise
10 - 15	1.5 clockwise	1.5 anti-clockwise
15 - 20	1.5 anti-clockwise	1.5 clockwise
20 - 25	1.5 anti-clockwise	1.5 clockwise
25 - 30	1.5 anti-clockwise	1.5 clockwise

9. If a different bandwidth to 3 kc/s is used the B.F.O. setting will need to be changed from 1.5. The setting of this control will always be one half the bandwidth used. For example, with 6 kc/s bandwidth, set the B.F.O. to 3 kc/s.
10. If the Crystal Oscillator Unit 1C60604 is used for reception of SSB signals, the B.F.O. should be set to the correct position as described in steps (8) and (9) above, and fine tuning carried out with the crystal vernier control on the crystal unit.

NOTE: See Appendix 1, Book 60604R, for details of crystals required for SSB reception.

4.—MAINTENANCE

4.1 General

The CR-6A receiver has been carefully aligned and tested during manufacture, and the circuits and components have been chosen to ensure a high degree of stability and reliability. Indiscriminate adjustments to the preset controls and tuning adjustments should be avoided. If trouble occurs a proper testing routine should be undertaken to isolate the faulty circuit or component. After replacement of any frequency-determining component, re-adjustment of the stage concerned is normally quite sufficient. The complete alignment procedure is given in later sub-sections, and the procedure for adjustment of any particular stage may be extracted from it.

4.2 Valve Replacement

Care should be exercised in handling miniature glass-based valves. Do not attempt to force a valve

into its socket as this may result in bent pins or fracture of the glass envelope. Similarly, when removing a valve, ease it out carefully without excessive side movement. A combined tool is available for straightening bent pins and easing tight sockets.

4.3 Voltage Analysis

The readings given in the tabulation below are typical values and are intended mainly as a guide to correct operation. Actual values may vary due to commercial tolerances in valves and components, but should normally be within $\pm 25\%$ of the figures shown.

The meter readings were taken with respect to earth (chassis) using a Voltomyst with the controls set as in sub-section 4.4 and the receiver tuned to 7 Mc/s but with no input.

Valve socket pin numbers are shown in brackets.

TABLE A

Valve	Type	Anode	Screen	Cathode	Grid
V1	6BY7	150 (7)	50 (8)	1.2 (3)	
V2	6AJ8	182 (6)	91 (1)*	4.3 (3)	
V101§	6AU6	106 (8)			-6.8 (9) Osc. grid
V102	OB2	43 (5)	83 (6)	0 (7)	-11.4 (1)
V103	6AJ8	107 (1 or 5)	—	0 (2)	
		152 (6)	38 (1)	1.3 (3)	
		45 (8)			-12 (9) Osc. grid
V104	6BA6	130 (5)	68 (6)	3.9 (7)	
V105	6BA6	64 (5)	47 (6)	1.7 (7)	
V106	6AU6	141 (5)	85 (6)	1.3 (7)	
V107‡	6AU6	16 (5)	33 (6)	0 (7)	-4.6 (1)
V108‡	12AU7	75 (1)	—	5.3 (3 or 8)	
		142 (6)			
V109	6AU6	44 (5)	47 (6)	1.1 (7)	
V110	6AQ5	182 (5)	152 (6)	6.0 (2)	

Junction of R142/R143 15V. (A.G.C. Delay)

Junction of MR108/MR109 15V. (Noise Limiter OFF)

* This voltage varies between 50 and 100 depending on the range in use.

§ STD.BY/ON/CAL Switch in CAL position.

‡ AM-MCW/CW-SSB Switch in CW-SSB position.

4.4 General Alignment of Receiver

Unless otherwise stated, the alignment procedure should be carried out with the controls in the following positions:

AM-MCW/CW-SSB	to	AM-MCW
A.F. GAIN	to	maximum
R.F. GAIN	to	maximum
A.G.C.	to	OFF
STD.BY/ON/CAL	to	ON
BANDWIDTH	to	3 kc/s
B.F.O.	to	0
NOISE LIMITER	to	OFF
DIAL CORRECTOR	to	centre of range
ANT. TRIMMER	to	centre of range

4.4.1 Test Equipment Required

The following items of test equipment will be required for the complete alignment procedure.

- Signal Generator covering the r.f. ranges (2 to 30 Mc/s).
- Signal Generator covering the ranges 100 kc/s \pm 15 kc/s and 1.8 Mc/s.
- Output Meter, 600 ohms.
- Voltomyst or V.T.V.M.
- Microammeter, 0-100 μ A., 1000 ohms internal resistance.
- Low Distortion Audio Oscillator.
- Cathode Ray Oscilloscope.
- Noise and Distortion Meter.
- Harmonic Generator.

Item (d) may be used in place of Item (c) provided the output is properly terminated.

Items (e) to (i) are not absolutely essential, but will assist in accurate measurements and should be used if available.

4.4.2 Typical Stage Gain Levels

The following table is given for ready reference and will be of assistance in locating weak or defective stages. The figures given were taken on a typical receiver with the controls set as in 4.4 above.

TABLE B

Input Point	Frequency	Input Level	Output
Aerial (all ranges)		Less than 2 μ V.	3.5V. across C154
Aerial (CR-6B only)	0.2 to 0.54 Mc/s	Less than 10 μ V.	3.5V. across C154
V1 grid (2)	7 Mc/s	2.8 μ V.	3.5V. across C154
V2 grid (2)	7 Mc/s	62 μ V.	3.5V. across C154
V2 grid (2)	1.8 Mc/s	35 μ V.	3.5V. across C154
V103 grid (2)	1.8 Mc/s	250 μ V.	3.5V. across C154
V103 grid (2)	100 kc/s	200 μ V.	3.5V. across C154
V104 grid (1)	100 kc/s	380 μ V.	3.5V. across C154
V105 grid (1)	100 kc/s	8 mV.	3.5V. across C154
V106 grid (1)	100 kc/s	85 mV.	3.5V. across C154
Across C162	1000 c/s	0.08V.	500 mW. in 600 Ω
V109 grid (1)	1000 c/s	0.075V.	500 mW. in 600 Ω
V110 grid (1,7)	1000 c/s	1.6V.	500 mW. in 600 Ω

TSC
1,2

4.4.3 Typical Oscillator Voltages

When operating correctly, the oscillator voltages should be approximately as shown in the table. The voltages were measured with a Voltomyst, using the crystal probe.

TABLE C

Measuring Point	Conditions	Voltage
V101 grid (1)	Oscillating at 500 kc/s	7.5
V103 grid (9)	Oscillating at 1700 kc/s	10
V107 grid (1)	Oscillating at 100 kc/s	6
V108 grid (2)	Injection at 100 kc/s	2.3

4.4.4 Audio Tests

- Bridge terminals TSB4 and 5 and connect the 600 Ω output meter to terminals TSC1 and 2. If using a voltmeter, load the output by a 600 Ω resistor.
NOTE: The output transformer is properly terminated when loaded by 600 ohms at the line terminals, or by 3 ohms at the speaker terminals, but not both.
- Set the audio oscillator to 1000 c/s and check the audio gain according to Table B.
- Turn up the A.F. GAIN control and check that an output of one watt (24.5V.) can be obtained across the 600 Ω load.
- Remove the 600 Ω load and connect a 3 Ω resistor across terminals TSC3 and 4. Check that the full

output of one watt (1.73V.) can be obtained across the speaker terminals.

- Connect the 3 Ω load across terminals TSC3 and 5. Check for output as in step 4. Then plug a pair of headphones into the PHONE jack and check that the speaker circuit is broken and that the audio output is heard in the phones.

4.4.5 Second I.F. Alignment

- Set the signal generator to 100 kc/s, unmodulated and connect it via a capacitor of 0.1 μ F. to V106 grid (pin 1).
- Connect the v.t.v.m. across the diode load (C154) and adjust the input level for a reading of 3.5V. on the meter.
- Tune the slug of TR102 for maximum output, reducing the input level as required. The tuning will be reasonably broad.
- Check the gain of the i.f. stages. These should be as follows:

Input to	Input for 3.5V. at Diode Load
V106 grid (1)	85 mV.
V105 grid (1)	8 mV.
V104 grid (1)	380 μ V.

4.4.6 B.F.O. Adjustment

- Set the AM-MCW/CW-SSB switch to CW-SSB.

2. Connect the loudspeaker or plug in the headphones and connect a c.r.o. (or audio frequency meter if available) across the output.
3. Apply an accurate 100 kc/s signal (using the harmonic generator if available) to V106 grid (pin 1).
4. Set the B.F.O. control to 0 and adjust the slug in L105 for zero beat in the output.
5. Turn the B.F.O. control to +3 and check that the beat note is approximately 3 kc/s, using the frequency meter or the c.r.o. and audio oscillator.
6. Repeat step 5 for the -3 position of the B.F.O. control. If the beat notes are not equal, check that the variable capacitor (C137) is at half-mesh when the control is at 0.
7. The output should be approximately 1 W. at the ± 3 kc/s points for an input of 100 mV. to V106 grid.

4.4.7 100 kc/s Filter Alignment

1. Connect the signal generator to V103 grid and set the frequency as accurately as possible to 100 kc/s.
2. Set the BANDWIDTH switch to 0.7 kc/s and adjust the input level for a voltage of 3.5 across the diode load.
3. Tune the slugs of inductors L205, L204, L203, L202 and L201 in that order for maximum output as indicated on the v.t.v.m., reducing the input level as required.
4. Set the BANDWIDTH switch to 3 KC/S and check the stage gain. The input at V103 grid for 3.5V. at the diode load should be approximately 200 μ V.
5. Check the bandwidth as follows:
 - (a) Set the BANDWIDTH to 6 KC/S and adjust the input level (at 100 kc/s) for an output of 3.5V. Note the exact input level.
 - (b) Increase the input level by 6 db. (twice the voltage), and detune above and below the centre frequency to obtain the same output. The total bandwidth should be as shown in the table below.
 - (c) Increase the input level by 60 db. (1000 times voltage) and detune as before for centre frequency output.
 - (d) Repeat these tests at the 3, 1.5 and 0.7 positions of the BANDWIDTH switch.

BANDWIDTH Switch	Bandwidth at 6 db. Points	Bandwidth at 60 db. Points
6	6 kc/s	18 kc/s
3	3 kc/s	10 kc/s
1.5	1.5 kc/s	6 kc/s
0.7	0.7 kc/s	3 kc/s

4.4.8 1.8 Mc/s Filter Alignment

1. Set the signal generator to 1.8 Mc/s (unmodulated) and connect to V2 grid (pin 2). Adjust the input level for an output of 3.5V. at the diode load.
2. Tune the slugs of inductors L103, L102, and L101 in that order for maximum output, reducing the input level as required.
3. Check the stage gain. The input required for an output of 3.5V. at the diode load should be approximately 35 μ V.

4.4.9 Crystal Calibrator Alignment

1. Set the STD.BY/ON/CAL switch to CAL., AM-MCW/CW-SSB to CW-SSB and B.F.O. to 0.
2. Inject a signal into the aerial from a reliable frequency standard such as a harmonic generator or a standard frequency transmission (WWV). Keep the signal at a low level.
3. Tune the receiver to the standard frequency until a beat note is heard in the audio output.
4. Adjust capacitor C105 (concentric trimmer near crystal XL101) until zero beat is obtained in the audio output.

4.4.10 R.F. Alignment

1. Set the DIAL CORRECTOR in the centre of its range. Check that the ends of the bands (2 and 5, 5 and 10 etc.) correspond to 2 and 26 on the log scale.
2. Switch the controls to CW-SSB and CAL.
3. Connect the signal generator through a non-inductive series resistor (if necessary) so that it looks like a 100-ohm source.
4. Set the ANT. TRIMMER to the centre of its range and the B.F.O. to 0.
5. Connect the v.t.v.m. across the diode load.
6. Switch off the generator and calibrate the receiver by using the in-built crystal calibrator and adjusting the oscillator slugs (TR8 to TR14) at the low frequency ends of the bands and the trimmer capacitors (C49 to C56) at the high frequency ends, as shown in Table D.
7. Switch the STD.BY/ON/CAL switch to ON, the AM-MCW/CW-SSB switch to AM-MCW, and use the signal generator for adjustment of the r.f. and aerial circuits, aligning the low frequency ends of the bands by means of the slugs in the inductors and transformers, and the trimmer capacitors at the high frequency ends.
8. Repeat the complete alignment procedure until no further improvement is possible. It may be necessary to go over the alignment several times, as the adjustments are inter-dependent.

TABLE D

Range Mc/s	Alignment Frequencies	Adjustment					
		Aerial		R.F.		Oscillator	
2-5	2 and 5 Mc/s	TR1	C16	L1	C26	TR 8	C49
5-10	5 and 10	TR2	C16	L2	C27	TR 9	C51
10-15	10 and 15	TR3	C16	L3	C28	TR11	C52
15-20	15 and 20	TR4	C16	L4	C29	TR12	C53
20-25	20 and 25	TR6	C16	L6	C31	TR13	C54
25-30	25 and 30	TR7	C16	L7	C32	TR14	C56

4.4.11 R.F. Sensitivity and Signal-to-Noise Ratio

1. Inject into the aerial a signal of 3 μ V., modulated 30% at 1000 c/s at the test frequencies and adjust the A.F. GAIN control for an audio output of 500 mW. (17.3V. in 600 Ω).
2. Check the signal-to-noise ratio by switching off the modulation. The output should drop by at least 10 db., i.e., to 50 mW. or 5.5V. in 600 Ω .
3. Increase the A.F. GAIN. An input of 3 μ V., modulated 30% at 1000 c/s should produce an output of 1W. at all frequencies.

4.4.12 Rated Output and Distortion

1. Switch on the a.g.c. With an input signal of 1000 μ V. modulated 30% at 1000 c/s adjust the output to 1 watt.
2. The overall distortion should be less than 15%.

4.4.13 First Mixer-oscillator Injection

1. Plug the 0-100 μ A. meter into TJA (pin jacks at the rear of the R.F. Coil Unit) and check that the meter reading over each range is reasonably constant. Typical readings are as follows:

Range Mc/s	Meter Reading (Meter resistance 1000 Ω)
0.2 to 0.54	15 μ A.
2 to 5	20 μ A.
5 to 10	30 μ A.
10 to 15	35 μ A.
15 to 20	40 μ A.
20 to 25	35 μ A.
25 to 30	30 μ A.

4.4.14 A.G.C. Test

1. Set the A.G.C. switch to FAST.
2. Inject a signal of 5 μ V. at 7 Mc/s, modulated 30% at 1000 c/s and tune the receiver.
3. Adjust the A.F. GAIN for an output of 60 mW. (6.0V. in 600 Ω).
4. Increase the input from 5 μ V. to 100 mV. The output should not increase more than 6 db. (twice the voltage).

4.4.15 Adjustment of Signal Strength Meter

1. Set the A.G.C. switch to FAST and the R.F. GAIN to maximum.
2. With no signal input adjust the preset control RV2 (the lower one of the pair at the back of the meter) for zero reading on the meter.
3. Inject a signal into the aerial at 7 Mc/s and carefully tune the receiver.
4. Adjust the input level until the pointer just starts to lift from the zero mark. This indicates the threshold of a.g.c., and will normally occur at an input of approximately 1 μ V.
5. Increase the input by 100 db. or 100,000 times voltage.
6. Adjust the upper preset control RV1 for a reading of 100 db. on the meter.
7. Check the intermediate calibration points on the meter.

4.4.16 Noise Limiter

1. Feed a weak modulated signal into the receiver and connect a c.r.o. across the output. Set the BANDWIDTH switch to 6 kc/s.
2. Loosely couple a buzzer into the receiver and adjust the c.r.o. until the noise spikes can be seen.
3. Switch on the NOISE LIMITER and check that the noise spikes are clipped by the limiter action.

4.5 Care of Rotary Switches

Wafer type rotary switches should be cleaned and lubricated at approximately six-monthly intervals, or when noisy or uncertain operation is evident. The recommended solution for combined cleaning and lubrication consists of two ounces of pure lanoline dissolved in ten fluid ounces of dichlorethylene. The solution should be applied sparingly, with a fine-pointed soft brush to the contacts only: rotate the switch while the solvent evaporates to spread the lubricant evenly. Do not allow the solution to fall onto the wiring or other parts of the switch.

If the movement becomes stiff a drop of light machine oil may be applied to the spindle bearing and the clicker plate, taking care that the oil does not reach the contacts or wiring.

Care should be exercised when cleaning switches not to bend or otherwise damage the contacts. Attempts to straighten or re-align contacts on this type of switch are rarely successful and the preferred action when damaged contacts are discovered is to replace the complete wafer.

4.6 Pilot Lamps and Fuse

The pilot lamps are mounted on brackets below the dial, at the rear of the front panel, and are accessible from the underside. To replace, remove the receiver from the case or the rack. The lamp holders may then be pulled clear of the brackets and new lamps inserted.

The fuse is carried in a screw-in holder at the rear of the chassis. Before replacing a blown fuse, investigate the cause. When the trouble is cleared, replace with a fuse of the correct rating (0.5A., slow blow).

4.7 Dial Cord Replacement (Ref. Drg. 60600C1)

To replace the dial cord it will be necessary to remove the knobs, cover panel, front panel and the vernier dial scale. Remove these in the following order:

- (a) **Knobs.** These are each secured by two 4 BA Allen type screws, except for the range switch knob, where two 2 BA Allen type screws are used.
- (b) **Meter.** Unsolder the leads and unscrew the four holding nuts from the rear.
- (c) **Escutcheon.** Release the screw at the centre top.
- (d) **Dial Drag.** Release the split pin; the spindle may then be withdrawn by unscrewing.
- (e) **Phone Jack.** Unscrew the mounting nut at the front.

- (f) **Cover Panel.** Release the four 1/4in. screws at the corners of the panel. The cover panel may now be removed.
- (g) **Front Panel.** Withdraw the top three pilot lamp holders from the brackets. The front panel, complete with the log scale, may now be removed.
- (h) **Vernier Dial Scale.** This is secured by two 4 BA Allen type screws.

To replace the dial cord, follow the procedure given below and illustrated in the Dial Cord Diagram, Drg. 60600C1.

1. Set the DIAL CORRECTOR to the centre of its range.
2. Temporarily insert a pin in the 3/64-inch hole in the pointer slide bar and adjust the bar so that the pointer is over the special setting-up mark on the high frequency end of the lowest range, with the pointer bracket hard up against the pin. If the special setting-up mark is not on the scale, carefully measure 5/8in. from the outer edge of the high frequency calibration mark and adjust the bar to set the pointer over this mark.
3. Turn the main tuning spindle fully clockwise until it is checked by the stop in the gear box. Check that the drive pulley has a clearance of 1/32in. from the gear box and that the slot is in line with the lower edge of the main tuning spindle.
4. Tie the cord in the eye of the pointer, pass it one half turn around the jockey pulley ("E" in the diagram), over the top of the inner groove of the drive pulley "C" and wind 4½ turns in the grooves. Then pass the cord through the slot and bring it up over the pulley (about ¾ turn) and then around the second jockey pulley "F."
5. Keeping the cord taut, fit the spring into the eye of the pointer, loop the cord through the other end of the spring, pull the cord until the spring is extended to approximately twice its free length and then tie the cord.
6. Finally, DO NOT NEGLECT TO REMOVE THE PIN FROM THE SLIDE BAR.
7. Replace the vernier dial scale and adjust it so that when the main tuning spindle is turned to the extreme clockwise position the vernier scale reads six divisions. Then turn to the extreme anti-clockwise position and check that the vernier scale reads 94. If not, adjust the vernier scale

so that the over-run is equal at both ends of the range.

NOTE: When replacing the vernier dial, press it forward against the spring in the friction clutch. The spring must be compressed sufficiently to give a positive drive from the main tuning knob, but should be free enough to allow the knob to turn when the tuning mechanism is hard up against the stop at the end of its travel.

8. Check the calibration over the range and then replace the front panel, cover panel and other parts removed.
9. Replace the knobs, using the following procedure:
 - (a) **Switches.** Adjust the knobs so that the pointer is correctly aligned with the designations. This is best done by first turning the switch to the extreme anti-clockwise position and then setting the pointer to the appropriate designation.
 - (b) **Variable Resistors.** Set the controls to maximum anti-clockwise and then set the pointer to the anti-clockwise calibration point.
 - (c) **Variable Capacitors.**
 - (i) **B.F.O.** Set the pointer to -3 (9 o'clock) with the capacitor fully in mesh.
 - (ii) **ANT. TRIMMER.** Set the pointer to anti-clockwise horizontal position (9 o'clock) with the capacitor fully in mesh.
 - (iii) **FREQ. CONTROL** (when fitted). Set the pointer to F on the CRYSTAL range with the capacitor fully in mesh.
 - (d) **DIAL CORRECTOR.** Set the dial corrector to the centre of its range and set the pointer to the vertical position.

4.8 Lubrication

When necessary, the mechanical moving parts should be lubricated as follows:

1. **Spindle Bearings.** Use instrument oil or very light machine oil.
2. **Gears and Clicker Plates.** Apply a small quantity of light anti-freeze grease.
3. **Rotary Switches.** Clean and lubricate as described in sub-section 4.5.
4. **Range Switch Chain.** Brush lightly with the lubricant used for rotary switches (See 4.5).