# LAYOUT OF A.P.2555 F

## RECEIVERS R.1392A, B, D and E

***Heavy type indicates the books being issued under this A.P. number; when issued, they will be listed in A.P.113***

RECEIVERS R.1392A, B, D and E

# LIST OF PARTS

**Note.**—*A list of chapters appears at the beginning of each part*

# LEADING PARTICULARS

## RECEIVERS, R1392 D and E

| | |
|---|---|
| **General** ... ... | *A 15-valve superheterodyne receiver, with crystal-controlled oscillator, designed to give R/T and CW communication and DF facilities over a frequency range of 100 to 156 Mc/s. AGC is provided for use when required.* |
| **Intermediate frequency** ... ... ... ... ... ... ... | *4·86 Mc/s.* |
| **Aerial input** ... ... ... ... ... ... | *100Ω co-axial feeder line* |
| **Output impedance** ... ... | *600Ω, for use with telephones of this impedance* |
| **Power supply** ... ... | *6·3 volts 4 amps., 240 to 250 volts at 80 mA supplied by power unit Type 234A. A power unit Type 138 may be used to operate the receiver from 6-volt DC supplies* |
| **Dimensions** ... ... ... ... ... ... ... | *19 in. x 10½ in. x 10 in.* |
| **Remarks** ... ... | *The R.1392D is the tropicalized version of this receiver, whilst R.1392E is non-tropicalized* |

## RECEIVERS, R1392 A and B

| | |
|---|---|
| **General** ... ... | *A receiver of exactly the same type as the R.1392 D or E but covering a frequency range of 100 to 150 Mc/s.* |
| **Remarks** ... ... ... | *In this case, the R.1392B is the tropicalized version* |

## POWER UNIT TYPE 234A

| | |
|---|---|
| **General** ... .. | *This power unit is designed to provide LT and HT voltages to a number of receivers including the R.1132A, R.1481 and R.1392A, B, D or E. It provides 6·3 volts at 4 amps. and an HT supply of from 180 to 270 volts as required* |
| **Power supply** ... ... ... ... ... | *AC mains, 230 volts, 40 to 60 c/s* |
| **Dimensions** ... ... ... ... ... ... ... | *19 in. x 7 in. x 10 in.* |
| **Remarks** ... ... | *The HT voltage required for any particular type of receiver amongst those named above are selected by a number of tapping points inside the power unit. Each tap is labelled with the type number of the appropriate receiver or receivers* |

AIR MINISTRY

RECEIVERS R.1392A, B, D and E

**This is Amendment List No. 5 to Air Publication 2555F (3), Volume I**

**Part I.** List of Chapters: *delete "(to be issued later)"* after the titles of Chapters 1 and 2 and *write "(A.L.5)"* in the outer margin against each deletion. *Insert these* Chapters 1 and 2 to follow the Part 1 marker card. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

SIGNALS

# Chapter I

# RECEIVERS R.1392D and E

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



**Introduction**

**1.** Receivers R.1392D and E have been designed for use over the range of frequencies 100 to 156 Mc/s, and provide DF and communication facilities within this range. They are most generally used in conjunction with transmitters T.1131K and J, and T.1540. The Types D and E differ only in the fact that R.1392D is a tropicalized version, and the description which follows applies equally to either type.

**2.** The receiver employs a 15-valve superheterodyne circuit designed for the reception of either CW or RT signals, and with or without automatic gain control as required. The power supplies necessary for the receiver are 6·3 volts at 4 amperes and 240 to 250 volts at 80 milliamperes; these are generally supplied from 200 to 250 volts single-phase AC mains by a power unit Type 234A. For 6·3 volt DC supplies a power unit Type 138 is used.

**3.** The unit is built on a chassis 10 in. × 17 in. having a 19 in. panel; it is designed for mounting in standard telephone racks or cabinets and is provided with a ventilated metal dust cover. The receiver is fitted into the rack by six fixing bolts; two large handles are fitted on the front panel for ease of handling.

### GENERAL DESCRIPTION

**4.** A front view of the receiver is shown in fig. 1 and in this illustration the various controls may be clearly seen. They are as follows:—

(1) TUNE OSC. This is the oscillator tuning control and is the four-ganged

variable condenser C3, C8, C9, C14. The scale is calibrated in Mc/s.

(2) TUNE SIGNAL. The tuning control of the RF amplifier stages, consisting of the three-gang condenser C2, C5, C11. This scale is also calibrated in Mc/s.

(3) METER SWITCH (S2, S3). A 3-position switch, which, being used in conjunction with the 0-1 milliammeter gives a visual tuning indication of the crystal chain, the amplifier stages, or AF output level, respectively.

(4) TONE FREQUENCY CONTROL. The condenser C16 tuning the beat frequency oscillator and giving control of the pitch of the beat note.

(5) TONE MAN. GC., MAN. GC., AGC. A 3-position system switch S1 in which the BFO is operative only in the first position, whilst AGC is switched in on the last-named position.

(6) RF GAIN. The manual gain control potentiometer VR1 which controls both RF and IF gain.

(7) LF GAIN. The manual gain control potentiometer VR2.

(8) MONITOR (J1). An attenuated output, for a pair of headphones, is provided by this jack; it is a means of checking receiver operation.

(9) LINE (J2). If a jack-plug is inserted in this socket the output of the receiver, which normally passes via a Jones plug to the remote control lines, is open circuited. This is to enable these lines to be changed if required.

**5.** The input to the receiver consists of an aerial input circuit capable of matching the receiver to a co-axial feeder of 100-ohm characteristic impedance. Following this input circuit are two stages of RF amplification (CV1136) using three tuned circuits. The signal output from these stages, together with the output of the heterodyne oscillator, are applied to the control grid of the mixer valve which is again a CV1136 type.

**6.** The heterodyne oscillator is crystal controlled and the desired oscillator frequency is obtained by using a crystal of one-eighteenth of this frequency, and then providing the required degree of multiplication. The oscillator itself is a pentode CV1065 in which the cathode, control grid and screen grid of the valve operates as a Pierce oscillator, the output being electron-coupled to the anode circuit which contains a tuned circuit resonating at the third harmonic of the crystal

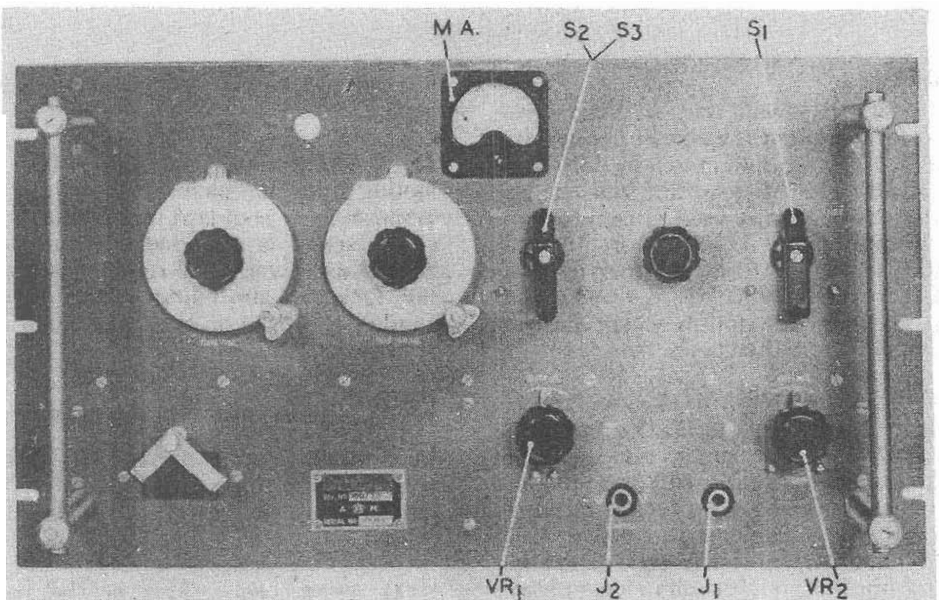


**Fig. 1. Front view, receiver R.1392A, B, D and E**

frequency. This trebled output is applied to a frequency multiplier stage (CV1136) which provides the remainder of the multiplication by having its anode circuit tuned to the eighteenth harmonic of the crystal. This output is fed to the control grid of the mixer valve via a buffer stage also using a CV1136 valve.

**7.** The IF amplifier chain, which has band-pass characteristics, consists of three stages in which valves of the CV1053 type are used. The IF output is applied to two separate circuits, both using a double-diode-triode valve, CV587. The first of these valves (with the diode anodes strapped to form a single diode) provides demodulation of the IF carrier in the diode section, the AF component then being amplified by the triode section of the valve before being passed to the grid of the output stage. By selecting suitable valves for the decoupling condenser of the cathode resistor of this valve, and for the coupling condenser to the grid of the output valve, attenuation of all frequencies below about 400 c/s is produced.

**8.** The second output from the IF amplifier is fed to the double-diode-triode which provides delayed amplified AGC. This operates at all frequencies covered by the receiver for signal input voltages of greater than 5μV. The RF amplifier stages and the first two stages of the IF amplifier are controlled by the AGC system.

**9.** A beat frequency oscillator is provided for the reception of CW signals, the working frequency being made variable by a small amount on either side of the intermediate frequency so that the beat note is adjustable.

**10.** The output of the final AF amplifier is matched to a line of 600-ohm characteristic impedance. A low-pass filter network is provided so that frequencies above some 3 kc/s are severely attenuated. The output from the secondary of the output transformer is taken to two contacts on a 6-pole Jones plug at the rear of the receiver. In addition, jacks are provided for line and monitoring facilities.

**11.** In the absence of a signal, extraneous site noises are reduced by including a muting circuit in the receiver. Additionally, a series diode limiter circuit gives some measure of protection against pulse transmissions or interference of a similar form.

## CIRCUIT DESCRIPTION

### Aerial input circuit and RF amplifiers

**12.** The signal input to the receiver is fed from the aerial system by a co-axial feeder of 100 ohms characteristic impedance. This is matched to the grid impedance of the first valve by an RF transformer L1, L18, the secondary of this transformer being tuned by condensers C1, C2 and C124.

**13.** The voltage developed by the signal across this tuned secondary is applied to the grid of V1 via condenser C19, and an amplified signal voltage will appear across the tuned circuit L2, C5, C6 which is shunt-connected to the valve by C36. This amplified signal is applied via C37 to the grid of an identical stage V2, where further amplification occurs. The signal is now applied to the control grid of the mixer valve V3.

**14.** The aerial input circuit, and the tuned circuits of the two RF stages are tuned by three variable, ganged, condensers C2, C5 and C11 respectively, each having a parallel connected trimmer condenser C1, 36 and C12.

**15.** When the receiver is operating in the MAN. GC condition the gain of the RF stages is controlled by varying the cathode potential of these two stages. This is effected by connecting the fixed cathode resistors (R9 and R16 respectively) to earth via the potentiometer VR1, so that variation of VR1 varies the effective cathode resistance of each valve. Under AGC conditions VR1 is short-circuited, R9 and R16 being connected to earth; the action of the switch at the same time breaks the earth connection of the junction of R48 and R69 allowing the AGC system to become operative. The AGC voltage developed across R50 is now applied to the control grids of V1 and V2 via R49 and HFC6.

### The heterodyne oscillator

**16.** In order to obtain a high degree of local oscillator stability, this receiver uses a crystal controlled local oscillator. The desired oscillator output frequency is obtained by using a crystal whose frequency is a sub-multiple of this, and then providing the necessary degree of multiplication. In this case the crystal frequency is one-eighteenth of the output frequency, and the heterodyne circuit consists of an oscillator trebler V4, a frequency multiplier V5, and a buffer stage V6.

**17.** The first stage V4 has a double function, being both oscillator and trebler. The screen grid, control grid and cathode of V4 form a modified type of Pierce oscillator, with the crystal connected in the grid circuit. Feedback occurs via the common cathode impedance formed by HFC2 and C22, the screen (which serves as the oscillator anode) being held at earth potential by condenser C25. The output from the oscillator section is electronically coupled (via the electron stream of the valve which passes through the screen grid) to the anode circuit of V4 which contains a tuned circuit L4, C3, C4; this circuit is tuned to the third harmonic of the crystal frequency. The frequency of the voltage applied to the grid of V5, via the condenser C27, is three times the crystal frequency.

**18.** The stage using the pentode V5 provides the remainder of the frequency multiplication, since its anode circuit L5, C7, C8, C43 (shunt-fed by C44) resonates at the eighteenth harmonic of the crystal (or, in other words, to the sixth harmonic of the signal being fed to its grid) and this is the desired oscillator frequency.

**19.** The anode tuned circuit of V5 is inductively coupled to another circuit L6, C9, C10, C45, tuned to the same frequency, in the grid circuit of valve V6. This stage serves as a buffer amplifier at the final oscillator frequency. Its anode circuit contains a shunt-fed tuned circuit L7, C14, C15, C66 and the voltage developed across this is fed by condenser C68 to the grid of the mixer valve.

**20.** The four condensers necessary for tuning the multiplying and amplifier stages C3, C8, C9 and C14 are ganged and controlled by the OSC TUNING knob on the front panel. Trimmer condensers C4, C7, C10 and C15 are connected in parallel with the respective variable condensers. All stages in the oscillator chain have automatic bias provided by the cathode resistors R4, R12 and R23 respectively.

### Mixer and IF amplifier circuits

**21.** The output from the RF amplifier section, at signal frequency, and the output from the oscillator section, are both applied to the grid of the mixer valve. The oscillator frequency is lower than the signal frequency by the amount of the IF, and after rectification by V3, which works with zero standing bias, sum and difference components of the two original frequencies are produced in the anode circuit of the valve. The primary of the first IF transformer is tuned to the difference frequency which is the desired IF of 4·86 Mc/s, whilst the higher frequency unwanted signal is by-passed to earth.

**22.** L8 and L9 are the primary and secondary of the first IF transformer, and the IF voltage developed across L8 is inductively coupled into the grid circuit of V7. The stages containing valves V7, V8 and V9 are identical and provide a high degree of amplification to the IF carrier wave. The IF transformers of each stage are fixed-tuned to the correct frequency by parallel condensers and adjustable iron-dust cored inductances; the coupling coefficient is adjusted so as to give a band-pass response of 6 db down at $\pm$ 25 kc/s.

**23.** Standing bias on V7 and V8 is provided by cathode resistors R30 and R41 respectively. When the receiver is operating in the MAN. GC condition, the gain of the first two stages (V7 and V8) is controlled by VR1, similar to the RF stages, by switching VR1 in series with the earth connection of R30 and R41. Independently of this, the gain of V9 can be adjusted by the pre-set potentiometer VR3, this being primarily for the adjustment of the muting circuit. Under AGC conditions the switching arrangements (*as in para.* 15) allow the AGC circuit to become operative, and the voltage developed across R48 and R50 is applied to the control grids of V7 and V8 via their respective decoupling resistors and the grid windings of the respective IF transformers.

### The beat frequency oscillator

**24.** This oscillator, which enables CW transmissions to be received, works at a centre frequency equal to the intermediate frequency. The circuit is a conventional one except that in this case the screen-grid of pentode V10 is used as the oscillator anode, it being maintained at earth potential as regards the operating frequency by the condenser C94. The frequency circuit determining circuit is L16, C95, C16 the last being variable in order that the oscillator frequency can be adjusted to some 1 kc/s on either side of the intermediate frequency. Feedback occurs from cathode to grid circuit via the coupling winding L17.

**25.** The oscillator output is coupled electronically to the anode circuit of V10 and the output voltage is developed across the load resistor R46, from whence it is injected via C98 into the primary L12 of the third IF transformer. Thus when the BFO is operating two voltages are combined in this circuit, that due to the signal, and that due to the BFO.

**26.** This oscillator operates only in the TONE MAN. GC position of switch S1 ; in all other positions of this switch the HT supply to V10 is open circuited.

#### The second detector and AF amplifier

**27.** The modulated IF carrier voltage developed across L14, the primary of the third IF transformer, is coupled inductively into the secondary winding L15 and is then applied to the diode section of V11. The two diode anodes of this valve are strapped together and work as a single diode. A rectified modulated carrier voltage appears across the diode anode load R54 and R55, the audio frequency component being passed via the diode V14 and condenser C107 to the potentiometer VR2. This is explained in more detail in para. 36, 37 and 38, covering the pulse limiter. A selected proportion of this voltage is applied to the grid of the triode section of V11, appearing in amplified form across the anode load of this section, R58. An HF filter is included in the anode circuit to remove any high-frequency carrier components which may remain.

**28.** The output from V11 is resistance-capacity coupled to the grid of the AF amplifier V13, the amplified AF voltage being developed across the primary of the output transformer T1. This transformer is designed to match the optimum load impedance of V13 to a balanced line of 600 ohms characteristic impedance. The secondary of T1 is connected to a closed-circuit jack J1, two contacts of

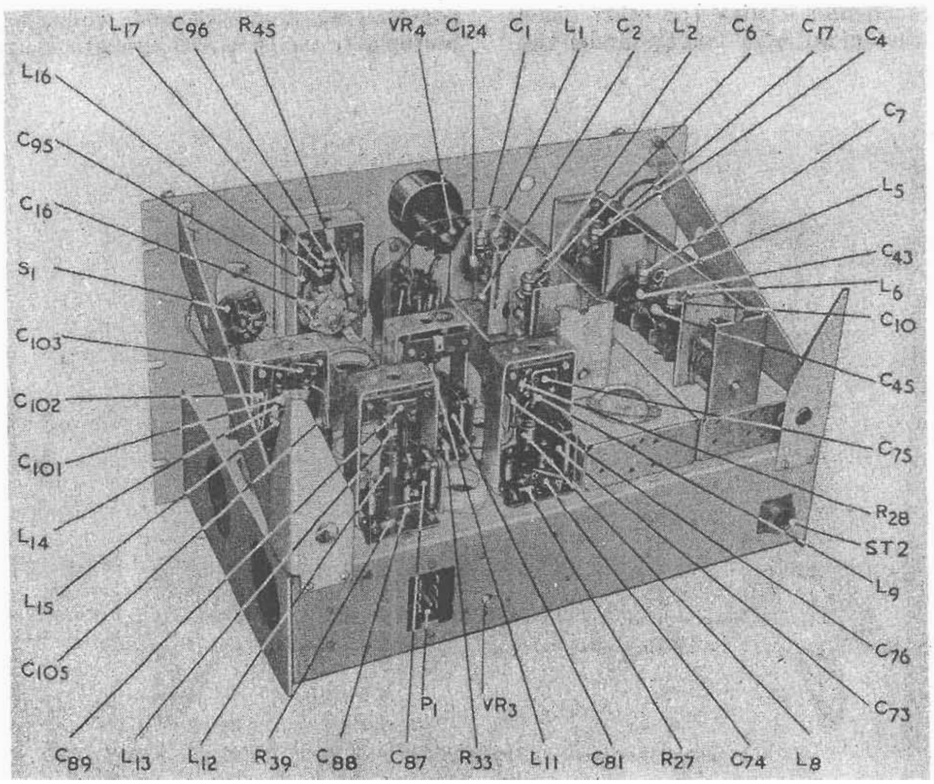


**Fig. 2 Rear view, receiver R.1392A, B, D and E, with screening covers removed**

which are taken away to pins 11 and 12 on the Jones plug P1. These are the connections to the external line, and when a jack plug is inserted into J1 the output from the receiver is disconnected from the line. Another jack J2 is connected in parallel with J1, output from the receiver appearing across it in attenuated form ; the attenuation is due to the inclusion of resistor R68.

**29.** The anode circuit of V13 also contains a filter network which in this case gives attenuation of the higher frequencies, particularly those above 3000 c/s. At the same time the value of the decoupling condenser of the cathode bias resistor R63 is so selected that degeneration occurs at the lower frequencies and more particularly at frequencies below 400 c/s. Thus the audio output of the receiver is restricted to a frequency range of between 400 c/s and 3000 c/s, which is adequate for communication purposes.

#### The AGC circuit

**30.** A double-diode-triode V12, is used for providing delayed, amplified AGC. The IF carrier is applied to one of the diode sections from the primary of the third IF transformer L14, via condenser C101. The other diode provides the actual AGC voltage under the control of the first diode. The triode portion of V12 is responsible for providing amplification of the AGC control voltages.

**31.** Under static conditions, with no signal input to the receiver, the following conditions apply. The HT current of all valves in the receiver passes through R67, which is connected between HT negative and earth, so that a voltage of some 50 volts negative to earth is set up across it. The triode grid of V12 is at almost cathode potential, whilst the anode has a high positive potential. This latter gives rise to a quite high value of anode current which will produce a voltage drop along R65 and make the cathode some 60 volts positive to earth. The resultant cathode potential is some 10 volts positive, and since the diode anode connected to R69 is at earth potential, it is held inoperative.

**32.** When a signal is received, a proportion of the IF carrier voltage is applied by C101 to the right-hand diode. During positive half cycles this diode will conduct, causing a current to flow through R64, and the diode anode becomes negative. The negative DC potential so produced, and which is proportional to the IF carrier strength, is applied

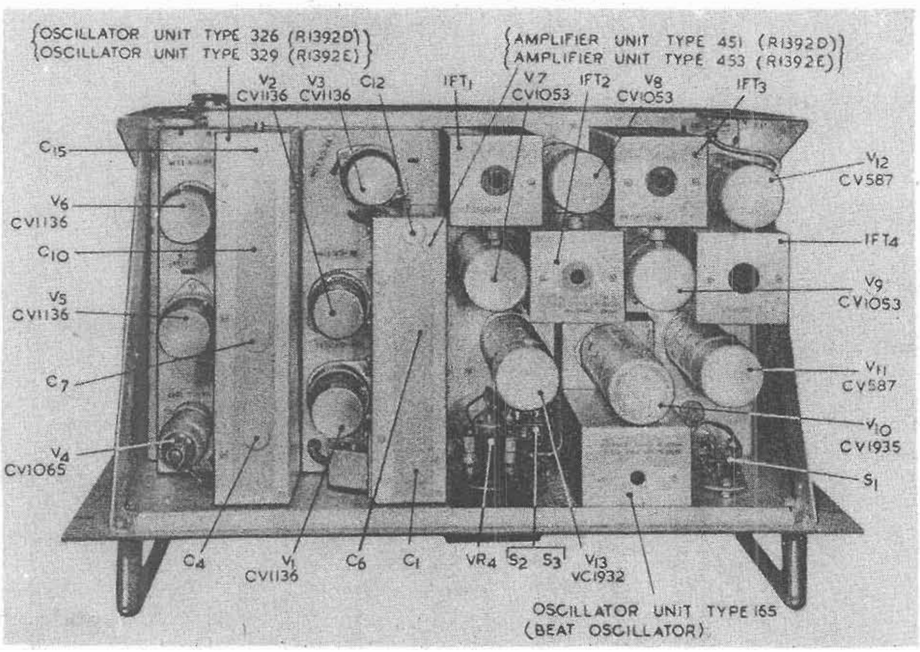


**Fig. 3. Top view of chassis, receiver Type 1392D and E**

to the triode grid via R62, stray IF components being by-passed by C114. The effect of the increase of negative grid potential is to cause a much larger change of anode voltage (due to the mutual conductance of the triode) and hence a large change of anode current. This amplified change causes the volts drop down R65 to decrease, and the cathode assumes a potential between +10 and —50 volts to earth, dependent upon signal strength.

**33.** For weak signals, therefore, the left-hand diode will remain inoperative, since the cathode will be above earth potential. For larger signals the delay voltage will be overcome and this diode will conduct, the diode potential above the cathode being proportional to the signal level. The current drawn by the diode, and hence the negative voltage across R48 and R50 must also, then, be proportional to the signal strength. These negative potentials are tapped off from R48 and R50 and fed to the grids of the controlled stages ; that across R50 to V1 and V2, and the voltage across R48 and R50 to V7 and V8.

#### The muting circuit

**34.** The diode V15 provides the receiver muting arrangement. Condenser C85 connects it directly across the potentiometer VR2, which is the audio input to the triode portion of V11. The anode of this diode is also connected via R71 to the cathode of V12. Under no-signal conditions, as has already been described in para. 31, this cathode is at a positive potential and hence the diode will be conductive. This shunts VR2 and consequently the input to V11 is cut off, or at least severely attenuated.

**35.** When a signal is received, the cathode of V11 takes up a negative potential, so that the anode of V15 also becomes negative. It ceases to conduct and the shunt-path across VR2 is now open circuited, allowing the audio frequency output from the second detector to be set up across VR2 without attenuation.

#### The pulse limiter

**36.** This circuit, using diode V14, limits pulse interferences whose amplitude is appreciably greater than that which corresponds to 100 per cent modulation of the carrier voltage being received. The diode section of V11 develops its output across the load resistance R54, R55, the centre point being connected to the anode of V14. The cathode of V14 is connected via a high resistance R70 and the filter circuit R44, C108, to the lo end of L15. Due to the slow time constant of R44 and C108, the potential due to the rectified IF carrier voltage is appreciably the same at the bottom of L15 and the cathode of V14.

**37.** When the modulation amplitude of the received signal is not greater than 100 per cent, the cathode potential of V14, and hence the audio output, follows the modulation envelope. This is due to the fact that since the instantaneous voltage at the diode anode is approximately one-half that of the bottom of L15 (due to the values of R54 and R55), while this point approximates the potential of the filter end of R70, the cathode is always more negative than the anode. Current flows through the diode, and since its anode resistance is much less than the high resistance of R44 and R70, the cathode potential will follow the anode potential, at the modulation frequencies. Under normal conditions then, the audio output from the second detector is passed through the relatively low resistance cathode-anode path of V14, developing an audio-frequency voltage across R70, C126, which has a time constant adjusted to follow the modulation frequencies. The AF output is then coupled by C107 to VR2.

**38.** As soon as a pulse interference peak exceeds the 100 per cent modulation level, the potential of V14 anode becomes more negative than the left-hand end of R70 and the diode ceases to conduct. The audio frequency output thus fails to reproduce the excess negative voltage, since the AF path is open circuited for the period of the pulse. These pulses are therefore suppressed.

#### Meter switching

**39.** The selector switch S2, S3 performs the following functions :—

(1) Switches the 0-1 milliammeter in parallel with a shunt resistor R10 in the anode to the mixer valve V3. The magnitude of the IF voltage in the anode circuit of this stage is indicated by the magnitude of the fall of observed anode current in the meter.

(2) Switches the meter in parallel with a shunt resistor R57 in the anode circuit of the first IF valve, V7. The fall of anode current in the meter is an indication of the magnitude

of the AGC control voltage, which is itself directly proportional to signal strength. Whenever possible, the receiver should be tuned by the indication of the meter in this position.

(3) Switches the meter into a bridge rectifier circuit which is connected across the 600-ohm audio output of the receiver, thus giving an indication of the receiver output level.

(4) A fourth position, indicated on the circuit diagram fig. 4, gives an indication of the anode current of the AGC amplifier V12 by switching the meter in parallel with R20. This position is no longer used and the panel stops are arranged to prevent selection.

### RECEIVER TUNING

**40.** To operate the R.1392A, B, D or E, with aerial connected and the receiver switched on, the following procedure should be used :—

(1) Insert a suitable crystal for the channel required, namely

$$f\ crystal = \frac{(f\ signal - 4{\cdot}86)\ Mc/s}{18}$$

the receiver crystal frequency being 0·27 Mc/s lower than the transmitter crystal.

(2) Set the meter switch to OSC.

(3) Set the system switch to AGC.

(4) Set the TUNE OSC. and TUNE SIGNAL dials to the required signal frequency as indicated by the calibration.

(5) Find the dip in the reading of the tuning meter which occurs when the TUNE OSC. dial is moved about ± 3 Mc/s from the frequency required. Adjust the TUNE OSC. dial to give maximum dip. The crystal oscillator harmonic selector will then be correctly tuned for the required channel.

(6) Set the meter switch to SIGNAL.

(7) Using a test signal of the desired frequency, or the actual desired incoming signal, find the dip in the reading of the tuning meter which occurs when the TUNE SIGNAL dial is moved about ± 3 Mc/s from the frequency required. Adjust the TUNE SIGNAL dial to give maximum dip. The signal amplifier is then correctly tuned for the required channel.

**41.** With very weak signals (less than some 5μV) it may not be possible to tune the signal amplifier in this way, since the signal will, in all probability, be too weak to operate the AGC system. If this is so, the alternative procedure is as follows :—

(1) Set the meter switch to AUDIO.

(2) Set the LF gain control to maximum (and the RF gain control to maximum under MAN. GC conditions) and adjust TUNE SIGNAL dial to provide the maximum signal output as indicated in the meter.

(3) If no signal is available, plug headphones into the MONITOR jack and adjust the TUNE SIGNAL dial for maximum background noise, keeping within ± 3 Mc/s of the frequency required.

**42.** When working on MAN. GC, always set the AF gain control to some three-quarters of maximum for high audio levels, and adjust the overall gain of the receiver by means of the RF gain control. For lower audio levels the AF control should be adjusted to give a reasonable output.

**43.** When using the receiver for the reception of CW signals, it should be tuned in the usual manner, as already described, and the following procedure carried out :—

(1) Set the system switch to TONE MAN. GC.

(2) Adjust the beat frequency oscillator control to give the desired audio beat note in the headphones.

### CONSTRUCTIONAL DETAILS

**44.** The R.1392 series are all constructed with a 17 in. by 10 in. silver-plated chassis which is bolted to a front panel of dimensions 19 in. by 10½ in. To strengthen the unit the chassis is also supported by a pair of brackets bolted to the front panel. The receiver is designed for mounting in a standard 19 in. rack, six slots being provided in the front panel to take the fixing bolts. In addition two large vertical handles are fitted on the panel. A large metal dust cover, with louvres to allow of good ventilation, gives protection to the interior of the receiver; it is locked in position by two wing nuts (Dzus fasteners) at the rear of the cover. The general construction is clearly seen from fig. 2 and 5.

**Sub-assemblies**

**45.** Mounted on the upper side of the main chassis are a number of self-contained and completely screened sub-assemblies (*fig.* 3). The units used for the tropicalized R.1392D and the non-tropicalized R.1392E have different serial numbers and these are given where necessary. The sub-assemblies are as follows:—

(1) Oscillator unit (Type 326, 10V/640 for R.1392D and Type 329, 10V/641 for R.1392E). This is a self-contained unit, with its own chassis, and contains the valves and components of the crystal oscillator and the crystal harmonic amplifier (V4, V5 and V6).

(2) Amplifier unit (Type 451, 10V/16580 for R.1392D and Type 453, 10V/16' for R.1392E). Another self-contained unit, with its own chassis, which carries the valves and components of the signal frequency amplifier stages V1, V2 and the mixer stage V3.

(3) Transformer unit Type 91 (10K/1689) IFT1.

(4) Transformer unit Type 92 (10K/1690) IFT2.

(5) Transformer unit Type 93 (10K/1691) IFT3.

(6) Transformer unit Type 94 (10K/1692) IFT4.

(7) Oscillator unit Type 165 (10V/585). Again this is a self-contained sub-chassis

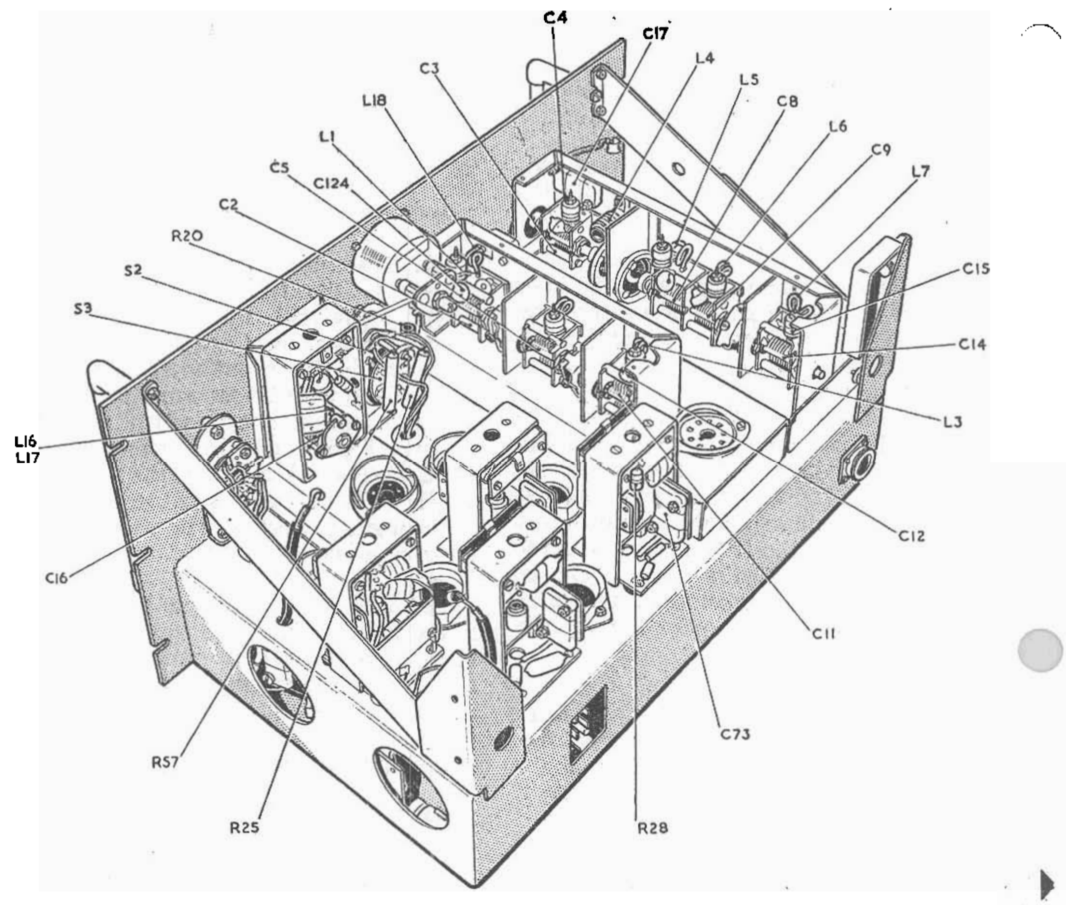


**Fig. 5 Rear view, receiver R.1392A, B, D and E**

which carries the single valve (V10) and the components of the beat frequency oscillator stage.

**46.** In fig. 2 and 5 the receiver is shown from the rear with the screening boxes and the valves removed. On the extreme right of the main chassis is the oscillator unit, and in these illustrations the removal of the screens shows the three separate compartments each containing the variable tuning condensers and coils of the tuned circuits of V4, V5 and V6 respectively; the oscillator anode condenser is C3, that nearest the front panel. It should be noted that the middle compartment has a twin-section condenser C8, C9, this being the tuning of the RF transformer coupling V5 to V6. The variable condensers are ganged together by flexible couplers and each has a pre-set trimmer condenser mounted on it and connected in parallel.

**47.** The amplifier unit, situated adjacent to, and to the left of, the oscillator unit is very similar in appearance. This has a screened three-section metal box which contains the variable condensers, trimmers and coils of the aerial input circuit and the tuned anode circuits of the two RF amplifiers V1 and V2. The three valves mounted on this sub-assembly are V1, V2 and the mixer valve V3. The variable condensers are ganged by flexible couplers.

**48.** The right-hand rear portion of the main chassis (*fig.* 3) has mounted upon it the three IF valves V7, V8 and V9, the second detector and AF amplifier V12 and the IF transformers associated with these valves. These transformers are completely screened, holes being provided for access to the iron-dust cores used for adjusting the inductance of the IF tuned circuits. The valves are completely screened by removable metal screening cans. The connections from the IF transformers to the valve top-caps pass through screwed metal connectors which are joined to the IF screening cover and to the top of the valve screening can.

**49.** The internal construction of the IF transformers is shown in fig. 5. They are built up on a U-shaped metal frame, the primary and secondary windings being mounted co-axially and each being tuned by an iron-dust core. The tuning condensers for primary and secondary windings are silver-mica fixed condensers; also mounted inside the screening cover are the anode decoupling resistor and condenser for the respective stages.

**50.** The beat-frequency oscillator unit is located toward the left-hand edge of the main chassis, mounted very near to the front panel (*fig.* 5). On its small sub-chassis are mounted the base of the valve V10 and a screened box closely resembling the IF transformer covers. In fig. 5 the cover of this box is removed; the main components it contains are the two coils L16 and L17 which are the grid winding and the coupling winding of the oscillator respectively, the main tuning condenser C16, and the fixed condenser C95 which is in parallel with it. The shaft of condenser C16 is taken through the screen of the sub-unit and the front panel, so that it is accessible from the front of the receiver. This is the TONE FREQUENCY control.

### Main chassis

**51.** On the rear of the main chassis are two sockets P1 and ST2. P1 is the male portion of the Jones plug which carries the connections to the power supply unit and to the external line. The other socket ST2 is the low-loss connector into which the plug on the co-axial feeder from the aerial system is fitted. It should be noted that on each side of the chassis two large circular holes have been cut to give additional access to the components mounted on the underside.

**52.** Two switches are mounted on brackets bolted to the front panel; they are the system switch S1, mounted at the extreme left of the panel (*fig.* 5), and the meter switch S2, S3 mounted adjacent to the meter itself. A small sub-assembly is fitted to the meter terminals consisting of a triangular-shaped piece of insulating material on the back of which is mounted the potentiometer VR4. The shaft of this potentiometer passes through the insulating strip and permits VR4 to be adjusted from the rear of the receiver.

**53.** Fig. 6 and 7 illustrate the underside of the main chassis where the majority of the small components are mounted. It will be seen that on the right-hand side of the main chassis are six square-shaped holes; these allow access to the underside of the oscillator and amplifier sub-assembly chassis.

**54.** The small components of these sub-assembly units, both resistors and condensers are mounted on tag panels close to their respective valve bases. Components which are connected from pins on the valve base to

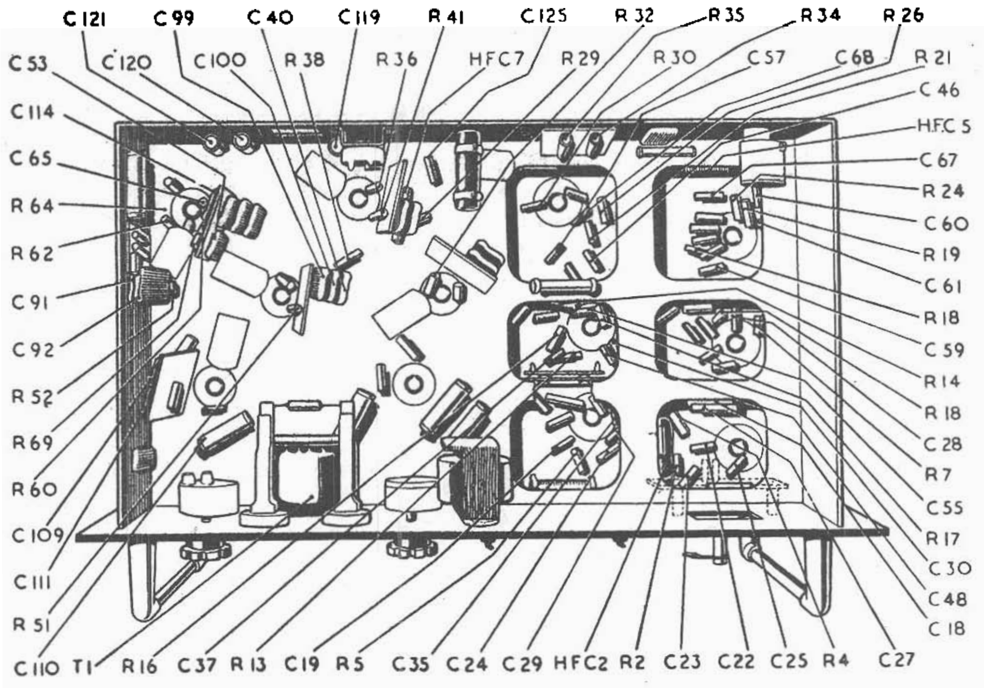


**Fig. 6. Receiver Type R.1392D and E, underside view**

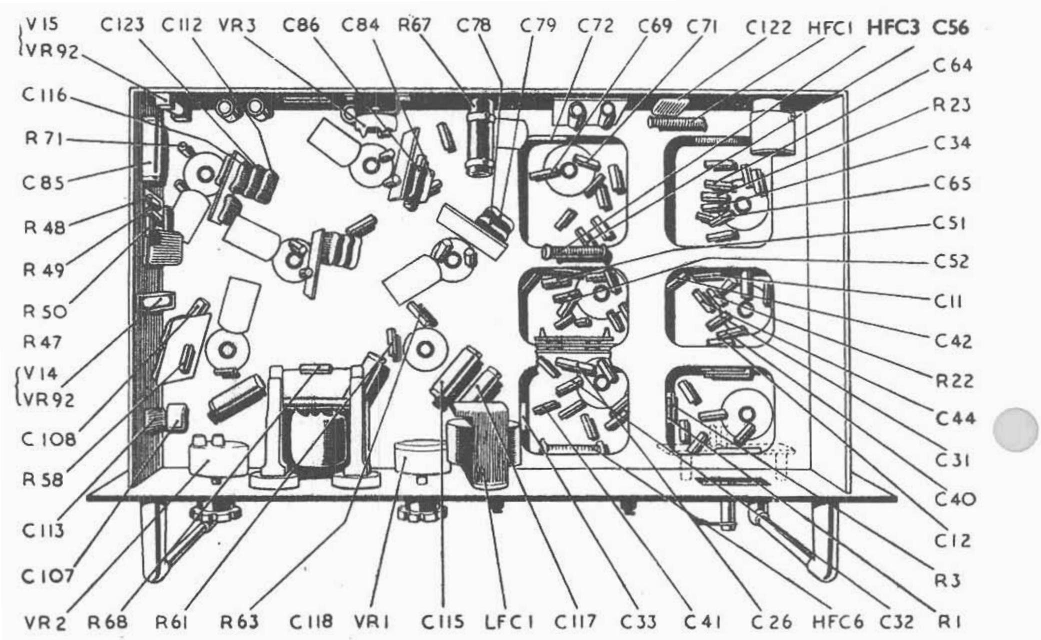


**Fig. 7. Receiver Type R.1392D and E, underside view**

the chassis, such as decoupling condensers, are connected to earth tags arranged as closely as possible to the valve base itself. Thus all wiring is kept short and rigid, and the possibility of stray capacity effects is minimized. All the condensers used in these sub-units are of the ceramic type.

**55.** On the underside of the main chassis proper, shown on the left of fig. 6 and 7, are the valve bases of V7, V8, V9, V10 and V11. Condensers and resistors associated with each stage are mounted on rectangular tag boards which are mounted vertically over the valve base itself. The front panel carries some of the heavier components such as the choke LFC1 and transformer T1, together with potentiometer VR1 and VR2. On the rear edge of the chassis are mounted various components on small tag strips, the vitreous resistor R67 and the potentiometer VR3. This component is mounted on a metal bracket so that its shaft is accessible through a small hole cut in the chassis edge.

# Chapter 2

# RECEIVERS R.1392A and B

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## LIST OF ILLUSTRATIONS



### Introduction

**1.** The R.1392A and B receivers are the original models of this series in Service use, and it is intended that they will be superseded in time by the R.1392D and E. The R.1392D, which is a tropicalized version of the R.1392E, is to be the ultimate type in use.

**2.** The differences between the two categories of receiver (Types A and B, and Types D and E) are due to changes made in order to extend the frequency coverage of the R.1392D and E to be 100 to 156 Mc/s. The heterodyne oscillator and frequency multiplier stages are slightly modified, but the remainder of the circuit is unchanged. In this description of the R.1392A and B, it will only be necessary to cover the parts of the circuit which differ from the R.1392D and E. The remainder of the circuit is unchanged and the circuit description of Chap. 1 applies equally to the R.1392A and B.

**3.** Very small changes in the constructional details occur in the two categories, but these are of a minor nature and are shown in the respective illustrations of this chapter and Chap. 1. The dial of the R.1392D and E has, of course, an additional calibration mark at 156 Mc/s.

**4.** Receiver R.1392A and B (B being the tropicalized version) is a 15-valve superheterodyne receiver designed for the reception of CW and R/T signals in the frequency range 100 to 150 Mc/s. Automatic or manual gain control may be used, and the receiver includes a muting circuit and a pulse interference limiter. As with the R.1392D and E, the power supplies are derived from a power unit Type 234A.

## CIRCUIT DESCRIPTION

### RF amplifier stages

**5.** The operation of these stages is covered already in Chap. 1 and need not be repeated. One small change in the circuit diagram should, however, be noted. The interstage coupling condensers C36 and C56 are of a slightly larger value in the R.1392A and B, being 50 pF instead of 47 pF, as in the D and E types.

### The heterodyne oscillator

**6.** The circuit of the heterodyne oscillator V4 (*fig.* 1) shows that a slightly different oscillator circuit is used in the R.1392A and B. It is basically the same as the oscillator used in the R.1392D and E, being a modified -ce circuit, but the higher frequencies required in the R.1392D and E have necessitated some changes. These can be seen in Chap. 1, fig. 4.

**7.** Referring again to fig. 1 of this chapter it will be seen that the screen-grid, control grid and cathode form a triode oscillator, the screen serving as oscillator anode. The crystal is connected in the grid circuit of the valve, feedback occurring across the common cathode impedance HFC2 and C22. The screen-grid is tied to the cathode via C25, whilst a small condenser C23 provides additional feedback from cathode to grid circuits. The output from the oscillator section is coupled into the anode circuit through the electron stream of the valve. The tuned circuit in the anode of V4 is tuned to the third harmonic of the crystal frequency so that the output from this stage is at three times the crystal frequency.

**8.** The operation of the remainder of the heterodyne oscillator chain is identical with that described in para. 18, 19 and 20 of Chap. 1, but there are some small differences in component values. These are mainly in the values of the interstage coupling condensers and are most easily seen from a comparison of the respective circuit diagrams.

#### General

**9.** The whole of the remainder of the circuit is identical with that of the R.1392D and E, so that the description already given for these types applies equally well to R.1392A and B.

## CONSTRUCTIONAL DETAILS

#### Introduction

**10.** The variation in the constructional details of the different types of the R.1392 are small, and do not affect the main structural or layout arrangements of the receiver. The description of the method of construction given in Chap. 1, together with fig. 1, 2 and 5 of that chapter, may be taken as applying to R.1392A, B, D or E.

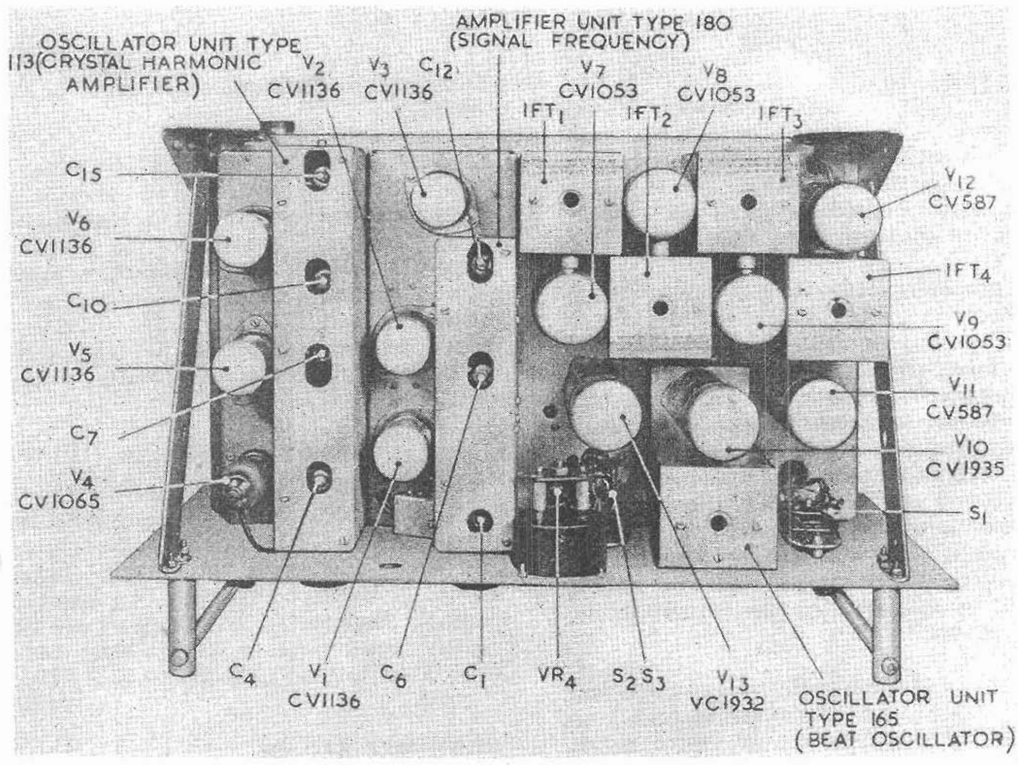


**Fig. 2. Top view of chassis, receiver Type R.1392A and B**

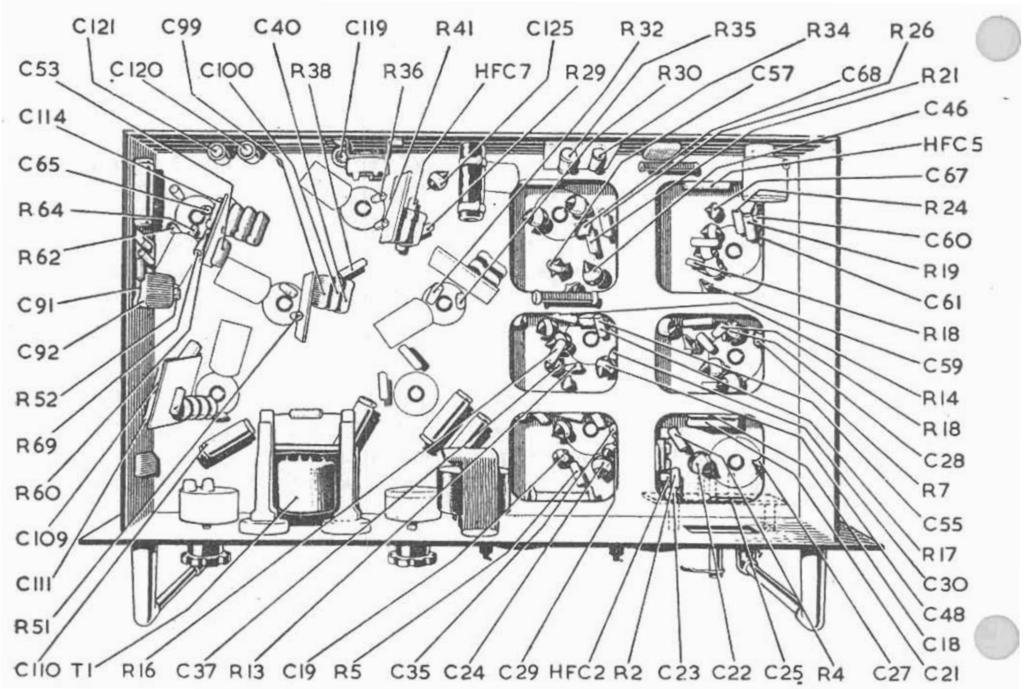


**Fig. 3. Receiver R.1392A and B, underside view**

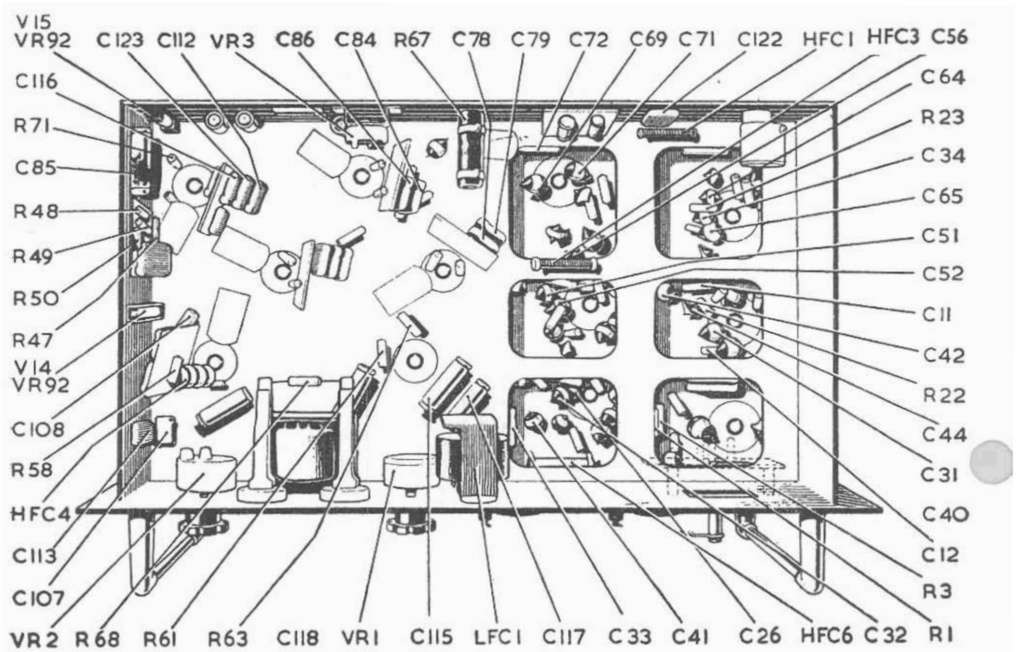


**Fig. 4. Receiver R.1392A and B, underside view**

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**Sub-assemblies**

**11.** The changes of components which occur in the R.1392D and E are in the RF amplifier and heterodyne oscillator portions of the receiver. These two sections of the receiver are built into sub-assemblies which are mounted on the main chassis, and since the sub-assembly for each type is slightly different, they are known by different type and reference numbers. Fig. 2 shows the top view of the R.1392A and B with these units in position, the sub-assemblies being in this case oscillator unit Type 113 and amplifier unit Type 180.

**Main chassis**

**12.** The underside of the receiver main chassis is illustrated in fig. 3 and 4. On the right-hand side, six square holes are cut in the main chassis so that the underside of the oscillator unit and amplifier unit are accessible. The components of these units are grouped on tag panels close to their respective valve bases so that the wiring may be kept as short as possible.

**13.** The same procedure is used on the main chassis and in fig. 3 and 4 the valve bases of V7, V8, V9, V10 and V11 may be seen, with the tag panel carrying the small components mounted close beside them. The front panel carries some of the heavier components, such as the choke LFC1 and output transformer T1, together with the potentiometer VR1 and VR2. The position of the crystal holder is shown by dotted lines.

**14.** As before, the differences between R.1392A and B, and R.1392D and E are very small and may be seen by comparing fig. 3 and 4 with fig. 6 and 7 of Chap. 1.

AIR MINISTRY

RECEIVERS R.1392A, B, D and E
**This is Amendment List No. 1 to Air Publication 2555F(3), Volume I, Part I.** *Insert* this Chapter 3 to follow the Part I marker card. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

SIGNALS

# Chapter 3

# POWER UNIT TYPE 234A

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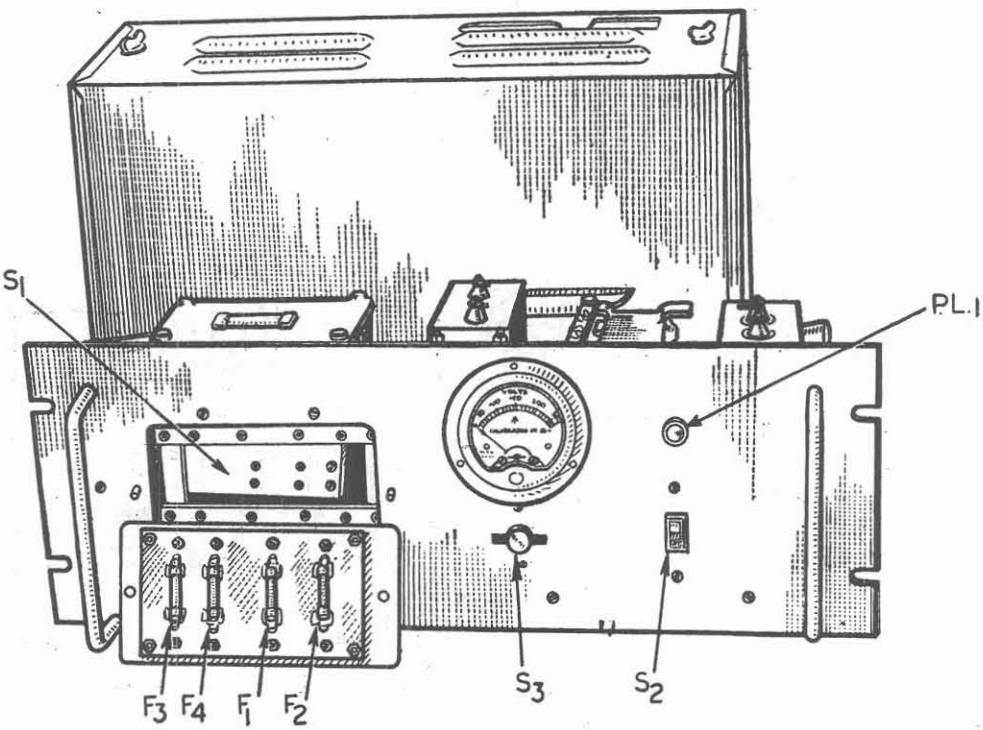


**Fig. 1. Power unit Type 234A, front view, fuses exposed**

**Introduction**

**1.** This power unit is designed to supply both HT and LT voltages to a number of receivers, including the R.1132A, R.1481 and R.1382A, B, D or E. It is built on a 17 in. × 10 in. chassis, with a front panel 19 in. × 7 in. intended for mounting in a standard 19 in. rack assembly. A dust cover is provided for the unit, with louvres to give adequate ventilation.

**2.** The output voltage of the power unit may be varied for the particular type of receiver being used by a pre-set switch which varies the primary tappings of the mains transformer. In addition, a tapping switch S4 in the secondary of this transformer gives a high-voltage input to the rectifier when maximum HT output is required. The range of voltages obtained from the unit is of the order of 180 to 270 volts. A moving-iron meter on the front panel normally reads the AC input to the unit, but by means of a lever switch S3 (marked PRESS TO READ HT) it may be switched to read the smoothed HT output.

**Circuit description**

The circuit diagram of the power unit is given in fig. 2 and it will be seen that it is basically a conventional full-wave rectifier circuit with a condenser-input smoothing filter. The 230 volts 50 c/s input is applied to the primary of the mains transformer T1 via the mains on-off switch S2, double-pole fuses F1 and F2, and the tapping switch S1. The secondary of T1 has three windings; the centre-tapped HT winding feeds the anodes of the full-wave rectifier V1. The other two windings provide, respectively, 5 volts at 2 amps for the heater of V1, and 6·5 volts at 4·3 amps for the heaters of the valves in the receiver. The latter winding is connected to pins 7 and 8 on the output socket P2, whilst connected directly across the winding are the resistor R1 and the indicator lamp PL1. The output voltage of 6·5 is intended to give 6·3 volts at the receiver after making allowance for the voltage drop along the line connecting power unit and receiver.

**4.** The HT winding of T1 is provided with a tapping switch S4. In the position shown in fig. 2 only a part of the secondary turns are in use and the input to the rectifier is reduced. When S4 is set to the left-hand position the secondary input voltage to the rectifier is increased, due to the increased number of turns, and, consequently the HT output from V1 is correspondingly increased. The HT negative line from the centre-tap of this winding, which is not earthed, is connected to the smoothing network and also to pin 9 on socket P2 via the fuse F3.

**5.** The HT positive line from the cathode of V1 is connected to the choke L1 of the smoothing network. This is a two-section filter comprising L1, L2 and the condensers

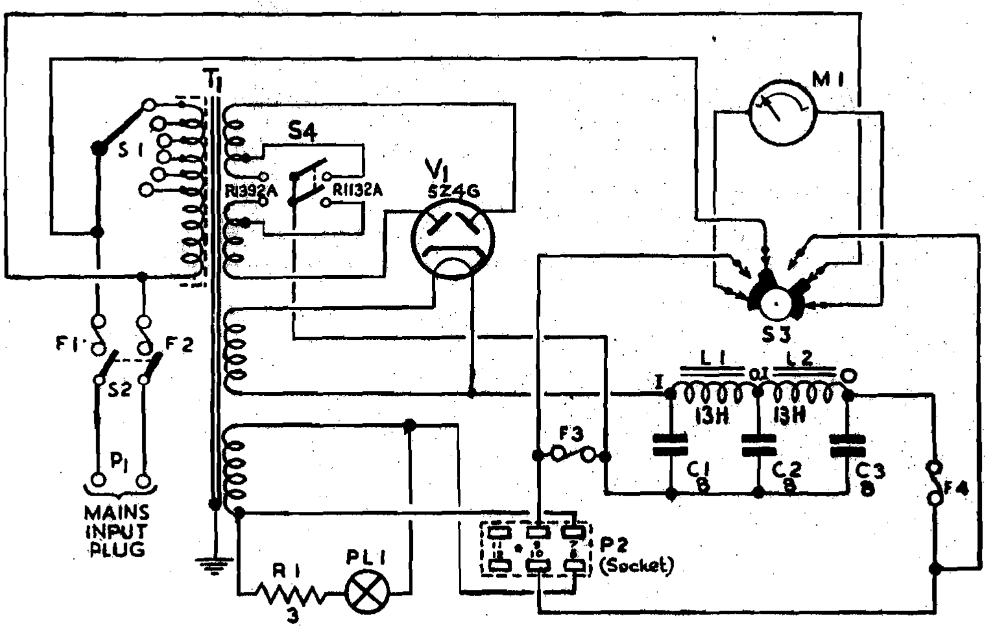


**Fig. 2. Power unit Type 234A, circuit**

C1, C2 and C3 and its efficiency is such that the HT ripple is of the order of 0·01 per cent. The output from the filter is connected to pin 10 on the socket P2 via the HT fuse F4.

**6.** Switch S3 is the meter selector switch previously mentioned. The meter* itself is a moving-iron type having a range of 0–300 volts and in the position shown in the diagram it is connected directly across the primary of the mains transformer. In the other position of the switch, the meter is connected directly across the HT output of the unit.

AL9

#### Constructional details

**7.** The general layout of the unit may be seen from fig. 1 and 3. The front view (*fig.* 1) gives the location of the controls on the front panel, including the meter M1 and the PRESS TO READ HT switch S3. The fuse panel is shown removed from the unit to illustrate the method of mounting of the fuses; they are held in clips on an insulated panel mounted on the rear of the outside metal panel, each clip being connected to a metal pin. Inside the unit are two insulated strips carrying sockets to which the circuit connections are made. When the fuse panel is in position, the metal pins plug into these sockets and connect the fuses into circuit, the panel then being locked in position by two wing-nuts. The primary tapping switch S1 is a link plug fitting into the sockets indicated in fig. 1.

**8.** Fig. 3 gives a view of the power unit from the rear and shows the mechanical construction. The metal chassis carrying the heavy components is strengthened by bracing it to the front panel by two brackets at either side.

**9.** The wiring of the unit, except for the smoothing circuit components and the valve base, is by a cableform, all leads except the LT supply using Unicel 4c. The heavier requirements of the LT circuits are met by using Unicel 19.

#### Operation of power unit

**10.** Before use it is advisable to check the unit for superficial damage. The tappings

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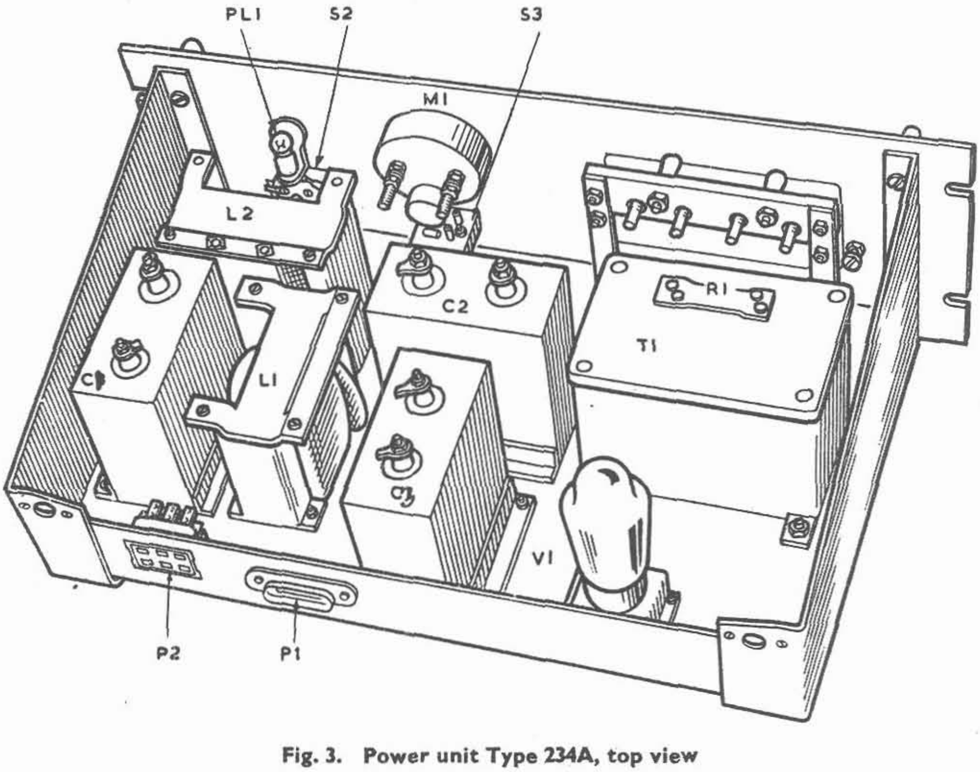


**Fig. 3. Power unit Type 234A, top view**

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* But see Vol 2 leaflet 5.

on the mains transformer should then be adjusted and to do this it is necessary to remove the fuse panel. When this has been done the primary tappings and the link-plug will be seen and the link switch can be set to the correct voltage by pulling it out and plugging it into the appropriate position. The output adjustment S4 should be set in the position "R.1392A" when used with receivers R.1392A, B, D or E.

11. Prior to replacing the fuse cover, examine the fuses located upon it and check that they are of the correct value. The mains input fuses should be of 1 amp rating and the fuses in the HT positive and negative lines of 150mA.

# Chapter 4

# RECEIVER 62 H

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## LIST OF ILLUSTRATIONS



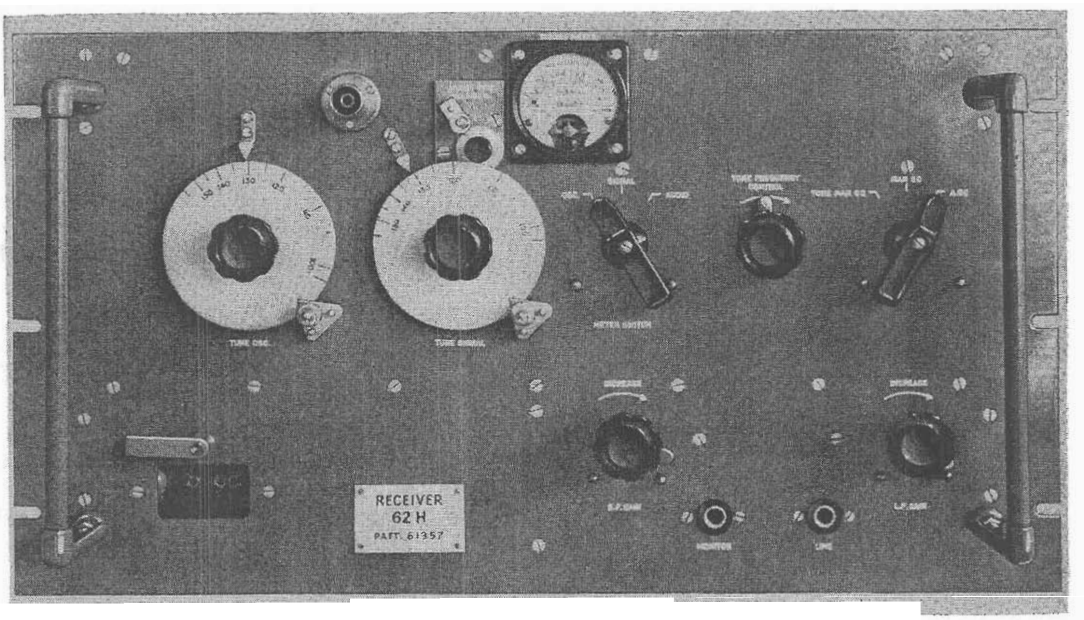


**Fig. 1. Receiver 62H**

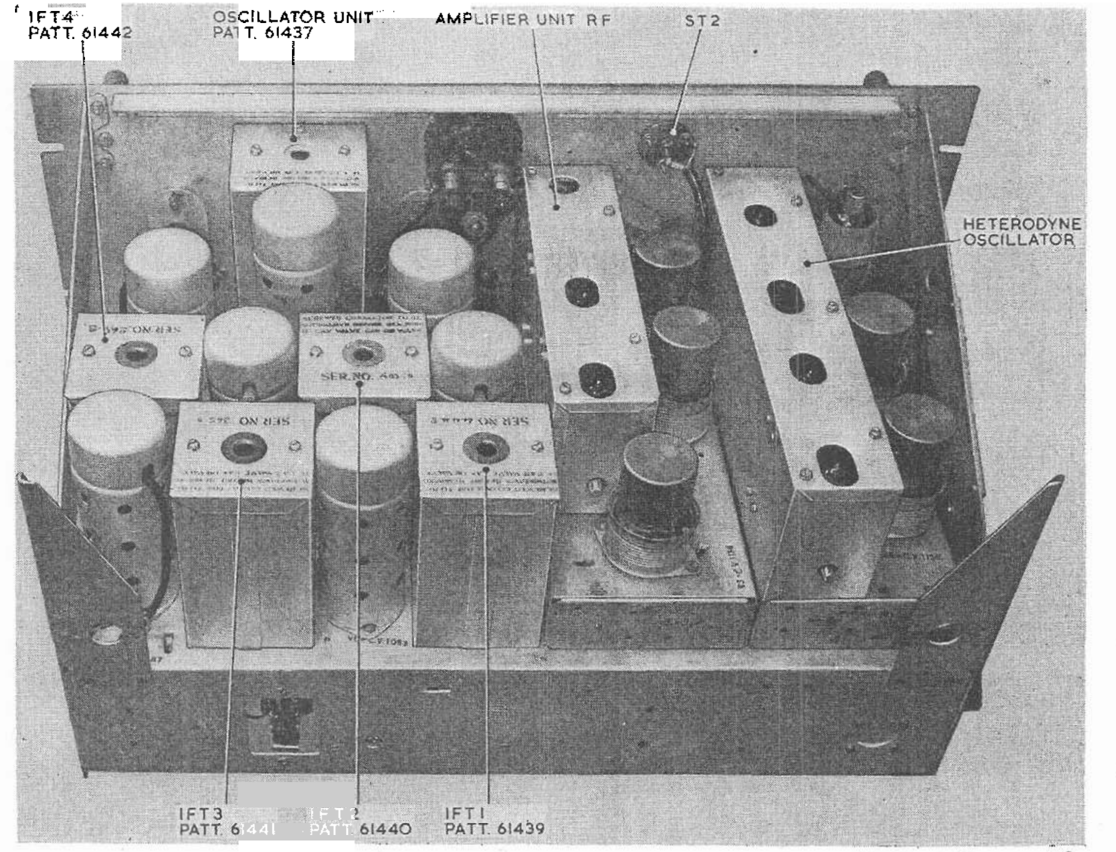


**Fig. 2. Top view of chassis**

#### Introduction

**1.** The Receiver 62H is a VHF ship-borne and ground station VHF receiver, designed for the reception of R/T and CW signals, in the frequency range 100 to 156 Mc/s. The equipment obtains its voltage supplies from power unit Pattern W8356A, which operates from single phase AC supply of 230 volts 50 c/s. The power unit provides 260 volts DC for HT and 6·3 volts at 4·3 amps AC for LT. The power consumption is approximately 60 watts.

**2.** Receiver 62H is a 15 valve superheterodyne receiver designed for reception in the frequency range 100 to 156 Mc/s. Automatic or manual gain control may be used, and the receiver includes a muting circuit and pulse interference limiter.

#### Circuit description

*Input circuit*

**3.** The input circuit is designed for connection to an unbalanced co-axial feeder cable having a surge impedance of 75 ohms.

*Signal frequency amplifier*

**4.** The input circuit is followed by two stages of signal frequency amplification embodying 3 tuned circuits.

*Mixer stage*

**5.** Frequency changing is effected by control grid modulation of the mixer valve. The heterodyne oscillator is crystal controlled, the crystal frequency being 1/18th of the desired output frequency less the IF ($F_{XTL} = \frac{F_s - IF}{\phantom{18}}$). Frequency multiplication is obtained as follows:—

(1) Crystal oscillator and frequency trebler circuit.

(2) Frequency amplifier stage selecting the 18th harmonic of the crystal frequency at the anode.

(3) A tuned amplifier stage, the output of which is applied to the control grid of the mixer valve.

*Intermediate frequency amplifier*

**6.** The intermediate frequency amplifier consists of three amplifying stages. Intermediate circuits have band-pass characteristics and are tuned to a mid-band frequency of 9·72 Mc/s and a nominal bandwidth of 80 kc/s at 6dB down.

*Second detector and audio stages*

**7.** Rectification at the output of the IF amplifier is provided by the use of double diode triode valve. The audio frequency component of the rectified current is amplified first by the triode portion of the above valve and then by the output valve. Resistance capacity inter-valve coupling is employed. The output of the amplifier is designed for connection to balanced lines having a surge impedance of 600 ohms. The 600-ohm output of the receiver is jack terminated, provision being made for line and monitoring facilities.

*Automatic gain control*

**8.** Delayed amplified automatic gain control is provided using a second double diode triode valve, capacity coupled to the final IF amplifier. The control is designed to be fully operative with an input signal voltage of the order of 10μV at frequencies between 100 to 156 Mc/s. Gain control is provided in the form of additional negative bias to the control grids and the two frequency amplifying valves, and the first and second stages of the IF amplifier.

*Beat oscillator*

**9.** A beat oscillator is provided for the reception of unmodulated incoming signals, provision being made for tone adjustment.

*Muting circuit*

**10.** A muting or noise suppressor circuit is provided whose function is to mute the receiver in the absence of an incoming carrier. In the presence of an incoming carrier, the muting is automatically removed by the suppressor circuit and the receiver becomes operational. The maximum signal level required to remove the muting is not greater than 6μV.

*Pulse limiter circuit*

**11.** For action of this circuit see Part 1, Chapter 1, para. 36. The whole of the remainder of the circuits are identical with that of R.1392D/E.

**Constructional details**

**12.** The receiver chassis is of dimensions 19 in. × 12 in. × 10½ in. weighing 35 lbs. The following units replace those detailed in receiver R.1392D in Part 1, Chapter 1, para. 45, in order to increase the intermediate frequency from 4·86 to 9·72 Mc/s.

(1) Amplifier unit R/F 43D Pattern 61436

(2) Oscillator unit Design 7 Pattern 61437

(3) Transformer unit I/F Design 23 Oscillator Pattern 61438

(4) Transformer I/F Design 24 Pattern 61439

(5) Transformer unit I/F Design 25 Pattern 61440

(6) Transformer unit I/F Design 26 Pattern 61441

(7) Transformer unit I/F Design 27 Pattern 61442

**13.** The following alterations have also been made:—

(1) The fitting of an aerial trimmer, capable of manual control, on the front of the equipment.

(2) The re-positioning of the aerial socket ST2 on the front panel instead of the rear.

(3) The coil HFC4 in the anode circuit of V11, is replaced by a 10K, ¾ watt resistor.

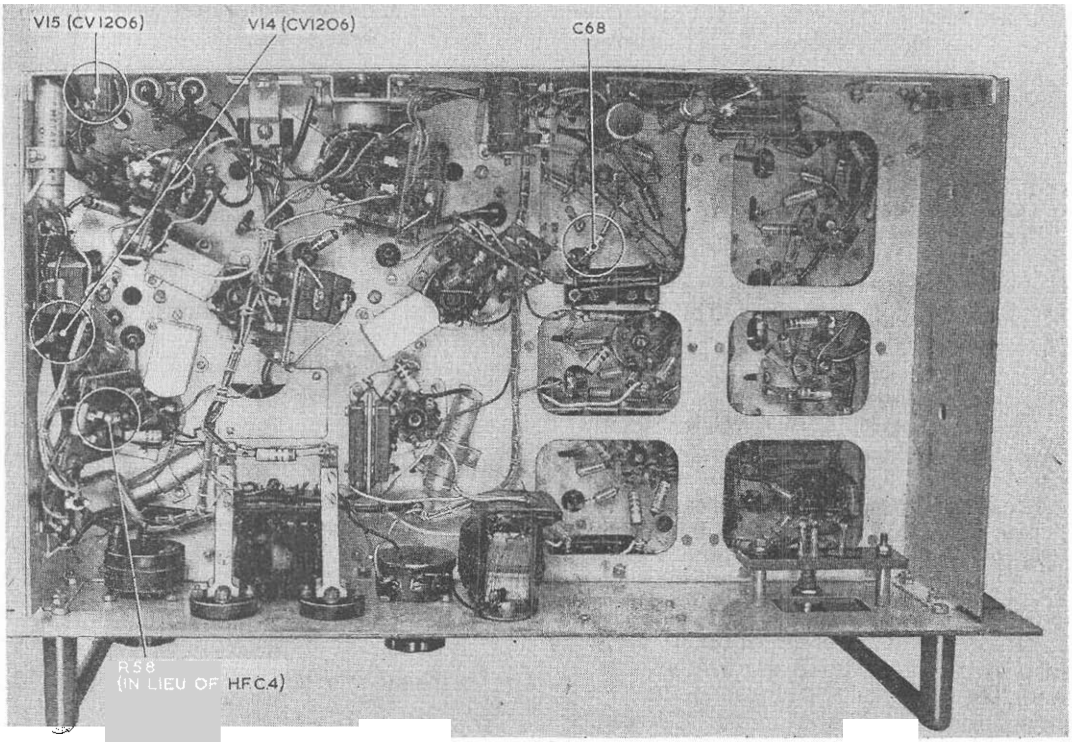


Fig. 3. Underside view of chassis

**Adjustment with common aerial working**

**14.** Throughout the instructions the tuning meter will normally be the meter fitted to the receiver, but in cases where this is not visible when tuning the resonator, an AF wattmeter or a pair of telephones on an extension lead may be used.

The receiver should, whenever possible, be warmed up for at least two hours.

(*a*) *Normal method, using signal generator CT*378

(1) Select the receiver to be used and ensure that the C.A.W. junction box socket to which it is connected is suitable for the required frequency. Switch on the CT378.

(2) Disconnect the input connection from the receiver and connect the CT378 to the input socket using connectors A.P.60861 and 60866.

(3) Insert the correct crystal into the receiver, set the oscillator and signal dials to the approximate frequency and set the gain controls to maximum. Set the gain control switch to TONE MAN. G.C. and the meter switch to OSC.

(4) Adjust the oscillator dial for a dip in the reading in the tuning meter.

(5) Set the meter switch to AUDIO and adjust the signal dial for maximum reading in the tuning meter. The tone frequency control may require adjustment during this operation. Set the gain control switch to MAN. G.C.

(6) Set the CT378 to the approximate frequency, set to INT A.M., adjust carrier to the correct level, set RF attenuator to X1 microvolt on the coarse scale and to 20 on the fine scale.

(7) Adjust the CT378 frequency control for a maximum reading on the tuning meter, reducing the RF gain of the receiver to keep the reading in the centre of the meter scale.

(8) Reduce the CT378 output to 10 on the fine scale and adjust the CT378 frequency control and all the receiver controls for maximum reading on the tuning meter.

(9) Disconnect the CT378 from the receiver and plug the lead from the resonator into the receiver input socket.

(10) (i) When no other receiver is in use:—
Disconnect the aerial connection from the C.A.W. junction box and plug the CT378 into the aerial socket. Ensure that no other resonators are adjusted to the required frequency.

(ii) When other receivers are in use:—
Remove the connector between the C.A.W. junction box and the required resonator *removing the junction box end first*, and plug the CT378 into the free socket of the resonator.

(11) Increase the receiver gain to maximum. Increase the CT378 output to 20 on the fine scale and adjust the resonator for maximum reading on the tuning meter or the loudest signal in the phones. Adjust the receiver gain as necessary.

(12) Reduce the CT378 output to 10 on the fine scale and readjust the resonator and receiver trimmer for maximum output. Lock the resonator and receiver controls.

(13) Disconnect the CT378 and replace the aerial connection or connector; if the latter, the *resonator end must be connected first*.

**Note . . .**

*Should the receiver not have warmed up for at least two hours, a slight readjustment of the oscillator control on a weak incoming signal may be necessary.*

(*b*) *Emergency method, using a transmitter*

Errors may arise by this method due to the excessive strength of the incoming signal and the final adjustment must be done on a received signal. This method must not be used during periods of W/T silence.

(1) Select the receiver to be used and ensure that the C.A.W. junction box socket to which it is connected is suitable for the required frequency.

(2) Insert the correct crystal into the receiver, set the oscillator and signal dials to the approximate frequency and set the gain controls to maximum. Set the gain control switch to TONE MAN G.C. and the meter switch to OSC.

(3) Adjust the oscillator dial for a dip in the reading on the tuning meter. Set the meter switch to AUDIO.

(4) Adjust the signal dial for maximum reading on the tuning meter. Set the meter switch to SIGNAL. Set the gain control to A.G.C.

(5) Set the transmitter on the required frequency and radiate the carrier on the lowest possible power.

(6) Adjust the resonator for maximum dip in the tuning meter. Readjust the receiver dials and the trimmer for maximum dip in the tuning meter.

Lock the resonator and receiver controls.

(7) Switch off the transmitter

**PART 2**

TECHNICAL INFORMATION (MINOR SERVICING AND ALIGNMENT)

# LIST OF CHAPTERS

**Note.**—*A list of contents appears at the beginning of each chapter*

# CHAPTER 1

# MINOR SERVICING, RECEIVERS R.1392A, B, D and E

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### Valves

1. A table of the valves, and their functions, used in the series of receivers R.1392A, B, D and E is given below:

| Valve No. | Function | General Classification | Type |
|---|---|---|---|
| $V_1$ | 1st RF amplifier | Pentode | CV1136 |
| $V_2$ | 2nd RF amplifier | Pentode | CV1136 |
| $V_3$ | Mixer | Pentode | CV1136 |
| $V_4$ | Crystal oscillator and trebler | Pentode | CV1065 |
| $V_5$ | Frequency multiplier (Crystal freq. × 18) | Pentode | CV1136 |
| $V_6$ | Buffer amplifier | Pentode | CV1136 |
| $V_7$ | 1st IF amplifier | Pentode | CV1053 |
| $V_8$ | 2nd IF amplifier | Pentode | CV1053 |
| $V_9$ | 3rd IF amplifier | Pentode | CV1053 |
| $V_{10}$ | Beat frequency oscillator | Pentode | CV1935 |
| $V_{11}$ | Detector and AF amplifier | Double-diode-triode | CV587 |
| $V_{12}$ | AGC rectifier and DC amplifier | Double-diode-triode | CV587 |
| $V_{13}$ | AF output stage | Triode | CV1932 |
| $V_{14}$ | Pulse interference limiter | Diode | CV1092 |
| $V_{15}$ | Muting valve | Diode | CV1092 |

### Valve replacements

2. As all valves in the receiver are not readily accessible, the following procedure should be followed when it is required to replace valves in the following units.

#### *Signal amplifier unit ($V_1$, $V_2$, $V_3$)*

3. The two RF amplifiers $V_1$ and $V_2$, and the mixer valve $V_3$ are all mounted on the signal amplifier unit sub-assembly. These three valves are all easily removable after the

receiver dust-cover has been taken off by using the simple valve removal tool available for this purpose.

*Crystal oscillator and multiplier stages ($V_4$, $V_5$, $V_6$)*

**4.** The crystal oscillator/trebler $V_4$, the frequency multiplier $V_5$, and the buffer amplifier $V_6$ are all mounted on the oscillator unit sub-assembly. The two CV1136 valves, $V_5$ and $V_6$, may be removed with the tool mentioned above, whilst $V_4$, a CV1065, can be pulled from its base in the normal manner.

*IF amplifier section ($V_7$, $V_8$, $V_9$, $V_{10}$)*

**5.** The first, second and third IF amplifiers $V_7$, $V_8$ and $V_9$ can be removed in the normal manner after first removing the cap of the valve screening can and then unscrewing the removable insulated grid connector fitted to each IF can. The valve screening can itself is then removed.

**6.** The beat oscillator $V_{10}$ is removed in a similar manner, the screwed grid connector mounted in the coil chamber being fitted in the same manner as those in the IF transformers. It should be noted that this connector is insulated with plastic sleeving and not Frequentite R ; the two types should not be confused.

*Audio and AGC section ($V_{11}$, $V_{12}$, $V_{13}$)*

**7.** The detector and AGC amplifier valves $V_{11}$ and $V_{12}$ and the output valve $V_{13}$ can be removed in the normal manner.

*Pulse limiter and muting valves ($V_{14}$, $V_{15}$)*

**8.** The pulse limiter diode $V_{14}$ is situated below the chassis near IFT4, whilst the muting diode $V_{15}$ is located near the AGC valve $V_{12}$ at the rear of the chassis. Great care should be taken when removing these valves from their holders since there is a danger of breaking the glass pinch at the anode connection when lifting the valves from the contacts of the holder.

**Unit replacements**

*Introduction*

**9.** It should be noted that the types of oscillator unit and signal amplifier unit for the various models of the R.1392 are slightly different ; they are then given different type numbers, these numbers being as follows :—

| | |
|---|---|
| R.1392A and B | Oscillator unit Type 113 |
| | Amplifier unit Type 180 |
| R.1392D | Oscillator unit Type 326 |
| | Amplifier unit Type 451 |
| R.1392E | Oscillator unit Type 329 |
| | Amplifier unit Type 453 |

The method of mounting these sub-assemblies to the main chassis is identical, and so the following paragraphs on the removal of these units apply to the R.1392A, B, D or E.

**10.** When, for the purpose of servicing, it is necessary to detach the various units and sub-assemblies of the receiver the following method should be adopted after all valves have been removed :—

(1) The oscillator unit should be removed by withdrawing the six screws fixing it to the chassis. The dial must first be removed and the two leads taking supplies from the chassis, the two connections to the crystal socket, and the output lead must be disconnected.

(2) The signal amplifier unit should be removed in a similar way.

*Oscillator unit and amplifier unit*

**11.** (1) Remove valve extractor from rear corner post of the chassis. Remove loose parts of dial clamp and screening cover from tuning unit. (5 screws 6BA).

(2) Slacken 2 grub screws (visible inside tuning unit) securing slow-motion drive to condenser spindle and withdraw complete dial assembly.

(3) Disconnect wire from crystal holder ST1, heater input (green) from C122 (500 pF) and HT input (red) from tag of HFC1.

(4) Identify the polythene insulated wire from tag of variable condenser C14 (to which C67 is connected) in rear of $V_6$ compartment of oscillator unit, to tag-board and C68 in rear of $V_3$ compartment of amplifier unit. Disconnect this wire at tagboard in amplifier unit, draw back carefully through chassis hole, and stow in oscillator unit for protection. Similarly stow the wires mentioned in sub-para. (3).

(5) Remove complete oscillator unit from chassis (8 screws 6BA). The anchor pin for the slow-motion drive will not foul the front panel if the front of the unit is swung upwards from the receiver chassis. The amplifier unit may be removed in a similar manner to the oscillator unit.

**Note . . .**

***Wiring in polythene-braided insulation (usually blue) on these and other units must not be replaced by ordinary sleeving, or the performance of the receiver may be impaired.***

*IF transformer units*

**12.** These should be removed by disconnecting the leads to the terminals projecting through the ½ in. diameter holes in the chassis, then removing the small screens over certain associated leads, and finally withdrawing the four cheese-head screws which hold the transformer to the chassis. The transformers will then come away as units, with the screening covers fixed to the frames. These covers may be removed from the transformer units, either when mounted or unmounted, by undoing the two 6BA cheese-head screws on the top of each can.

**13.** A number of components in the IF transformers are accessible after removing the screening cans, without taking the units from the chassis.

*Beat oscillator Type 165*

**14.** This should be removed complete by disconnecting the three leads under the chassis which are taken into the unit, after first removing the flat screening cover and removing the six bolts which fix the base of the unit to the chassis. Some of the components in the coil chamber of this unit may be replaced, if necessary, by simply removing the screening cover, it being unnecessary to unbolt the whole unit.

*IF amplifier, detector and AGC amplifier valve circuit assemblies*

**15.** These should be removed complete by detaching the few leads which take supplies, etc., to these assemblies, and removing the 6BA half-nuts which fix each assembly, with the associated valve screening can base, to the chassis. It will be found that the 6BA screws which fix the sockets to the brackets of each assembly are tapped into the feet of each bracket and locked. This makes it possible to remove the screening can base, and then the complete assembly, as a unit. It is, of course, necessary to remove the valve concerned before attempting to remove any of the valve circuit assemblies.

*Meter switch and rectifier unit*

**16.** These two components are mounted on a single bracket fixed by 4BA bolts to the chassis. To renew either the switch or the rectifier, it will be necessary to remove the output valve. The RF gain control should be unfastened from the front panel and withdrawn into the chassis, without unsoldering the leads, sufficiently to allow access to the 4BA nuts with a box spanner. The switch and rectifier unit should then be removed complete, after disconnecting the associated leads.

*System switch*

**17.** This is most easily removed by unscrewing with a thin flat spanner the hexagonal nut fixing the switch to its bracket.

**18.** When fitting a new switch it is important not to omit the locking washer behind the nut, otherwise the switch may work loose in operation. This will be evident before the spindle actually becomes loose, since there is appreciable clearance between the locating peg and its corresponding hole. This rule also applies to the fitting of the meter switch on its bracket.

**Voltage measurements**

**19.** The following table shows the approximate voltages using a testmeter Type F (Stores Ref. 10S/1, Avo Model 7), which should exist between the points listed and earth.

| Valve | Cathode | | Screen | Anode |
|---|---|---|---|---|
| $V_1$ | 1·6 | | 195 | 135 |
| $V_2$ | 1·6 | | 195 | 135 |
| $V_3$ | 0 | (no crystal) | 150 | 160 |
| | | (with crystal) | 195 | 185 |
| $V_4$ | 1·8 | (no crystal) | 150 | 200 |
| | 1·6-2·0 | (with crystal) | 140-160 | 190-210 |
| Measured across R4, not from cathode to chassis. | | | | |
| $V_5$ | 1·7 | (no crystal) | — | 130 |
| | 1·3 | (with crystal) | — | 150 |
| $V_6$ | 1·6 | | 200 | 130 |
| $V_7$ | 2·2 | | 74 | 195 |
| $V_8$ | 2·2 | | 74 | 195 |
| $V_9$ | 3·8 | | 115 | 188 |
| $V_{10}$ | — | | 88 | 38 |
| $V_{11}$ | 1·5 | | — | 80 |
| $V_{12}$ | — | | — | 130 |
| $V_{13}$ | 6 | | — | 200 |

**20.** In addition, the following voltages are important. AGC negative supply voltage—50 volts (pin 9 of plug P1 and chassis, or across ends of R67). HT supply voltage—250 volts (pins 10 and 9 of plug P1). HT line voltage—200 volts (pin 10 of plug P1 and chassis).

AIR MINISTRY

RECEIVERS, R.1392A, B, D and E

**This is Amendment List No. 3 to Air Publication 2555F(3), Volume I**

**Part 2.** List of Chapters: *delete* " *(to be issued later)*" after the title of Chapter 2 and *write* "(A.L.3)" in the outer margin against the deletion. *Insert* this Chapter 2 to follow Chapter 1.

*Record* the incorporation of this A.L. in the Amendment Record Sheet.

**SIGNALS**

# Chapter 2

# ALIGNMENT, RECEIVERS R.1392A and B

## LIST OF CONTENTS



### Introduction

**1.** In order to align the receiver R.1392A and B, the following test apparatus is required :—

(1) Signal generator Type 12, Stores Ref. 10SB/17; Connector Type 965, Stores Ref. 10H/13501 } (TF390F/4)

OR

Signal generator Type 31, Stores Ref. 10S/66; Power unit Type 139, Stores Ref. 10K/482; Connector Type 965, Stores Ref. 10H/13501 } (TF390G/4)

(2) Output meter, Type 2, Stores Ref. 10S/11934 (TF340)

(3) To check the AF response, a variable-frequency source is required, a suitable instrument and coupling transformer being :—

Oscillator unit Type 25, Stores Ref. 10V/11940 (TF195L)

Transformer Type 309, Stores Ref. 10K/195 (PO.48A, ratio 1-1)

**2.** Allow the receiver and test apparatus to stabilize over a warming-up period of not less than 10 minutes. Input to the aerial socket of the receiver is from the 14-ohm terminal of signal generator via a resistance of 100 ohms. The RF gain control should be set always at maximum, and the LF gain control set to a suitable level. Adjust output meter to 600 ohms impedance. Test frequencies 999 : 115·02 : 125·1 : 140·13 : 150·12 Mc/s. Crystal frequencies 5280 : 6120 : 6680 : 7515 : 8070 kc/s.

**Note . . .**

*In the following description various references are made to specific valves and components. The location of these valves and components will be made easier by referring to fig. 2 and 5 of Chap. 1, Part 1, and to fig 1, 2, 3 and 4 of Chap. 2, Part 1.*

### IF alignment

**3.** To align the IF circuits proceed as follows :—

(1) Remove the muting valve V15 from its holder. Connect the 14-ohm terminal of the signal generator to the control grid of V9 direct.

(2) Apply a signal of 40 mV at 4·86 Mc/s, referred to crystal standards, with 30 per cent modulation at 1,000 c/s. The frequency difference between transmitter and receiver crystals on any channel may be used to calibrate the signal generator accurately at 4·86 Mc/s. Alternatively, a crystal 4·86 Mc/s, inserted in holder

ST1 will provide adequate output to beat against signal generator.

(3) Adjust the cores of IFT4, for peak output, using the screwdriver end of tuning tool (Stores Ref. 10A/13505) (*para.* 15-18).

(4) Detune the signal generator and observe the frequency deviation required on either side of resonance to cause a reduction in output of 1·5 dB. If the frequency deviation on each side of resonance is not the same, re-adjust L14 and L15 by approximately equal amounts, as observed on the output meter, until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(5) Apply a signal of 4 mV at 4·86 Mc/s to the control grid of V8 and adjust IFT3 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 3 dB. Re-adjust L12 and L13 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be about ±25 kc/s.

(6) Apply a signal of 400 μV at 4·86 Mc/s to the control grid of V7, and adjust IFT2 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 4·5 dB. Re-adjust L10 and L11 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be again about ±25 kc/s.

(7) Identify the wire from tag on variable condenser C14 (to which C67 is also connected in rear of V6 compartment of oscillator unit Type 113) connected to tagboard and C68 in rear of V3 compartment of amplifier unit Type 180. Disconnect this wire at tagboard in amplifier unit and connect the 14-ohm terminal of signal generator to the control grid of V3 via C68.

(8) Apply a signal of 40 μV and adjust IFT1 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 6dB. Re-adjust L8 and L9 for symmetry of resonance and check that the final frequency deviation is not less than ±25 kc/s for an attentuation of 6 dB and not more than ±90 kc/s for an attentuation of 60 dB.

(9) Replace muting valve and connection to C68.

**Beat oscillator alignment**

**4.** The heterodyne oscillator should be aligned as follows :—

(1) Bring the oscillator into operation by switching the system switch to the TONE MAN. GC position.

(2) Set the TONE FREQUENCY CONTROL to the central position, when the condenser C16 should be at half its maximum value.

(3) Apply a signal of 10 μV at 4·8 Mc/s unmodulated from the 14-ohm terminal of the signal generator via C68 as described in para. 3 sub-para. 7. Then adjust the core of L16 to give zero beat, using the tuning tool. (*para.* 15-18.)

(4) Set the TONE FREQUENCY CONTROL to approximately 1,000 c/s and note the output level. This should be at least three times (+10 dB) the output obtained by applying 30 per cent modulation at 1,000 c/s to the injected signal with the switch turned to MAN. GC.

**Crystal oscillator and harmonic amplifier adjustment**

**5.** The sequence is as follows :—

(1) Disconnect chassis end of R7 and insert a milliammeter 0-1 with positive to chassis and remove cover from tuning unit.

(2) During subsequent work, maintain the TUNE SIGNAL dial at the approximate setting of the TUNE OSC. dial.

(3) Insert a crystal 8,070 kc/s in ST1, and set TUNE OSC. and TUNE SIGNAL dials to 150.

(4) Adjust trimmer C4, using hexagon end of tuning tool to give maximum reading on the external milliammeter.

(5) Set meter switch to OSC. and RF GAIN control at maximum.

(6) Identify the tag of variable condenser C11 to which C57 is connected. Connect the 14-ohm terminal of signal generator to this point, via a condenser of 50-100 pF. Apply a signal at 150 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust

the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(7) Adjust trimmers C7, C10, C15 to give maximum audio output, or maximum dip on receiver tuning meter. The signal generator tuning may require slight re-adjustment for maximum output.

(8) Insert a crystal 5,280 kc/s; set both dials at 100 and adjust iron dust core of L4 to give maximum reading on the external milliammeter (*para.* 15-18).

(9) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (5). If necessary adjust inductance of L5, L6, L7 in turn, to give maximum audio output, or maximum dip on receiver tuning meter. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end, or tweezer action, of tuning tool. The signal generator will require adjustment as in (5) and (6).

**Note . . .**

*Once set by the makers, it is unlikely that L5, L6, L7 will need further adjustment when re-aligning the receiver.*

(10) Repeat the above adjustments (2) to (8) until neither set of adjustments affects the other. As the circuits come more closely into line, it is preferable to dispense with the signal generator and to adjust for maximum reading on the external milliammeter and maximum dip on the receiver tuning meter.

(11) Replace cover of tuning unit and secure by centre screw only. Cut sealing film midway between two centre trimmer apertures and turn back the four ends to gain access to trimmers. Repeat (3) and (6) and note final readings on meters. Remove cover and seal trimmers with a small quantity of wax (Philityne, Stores Ref.33C/1084). If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(12) Maximum dip on the tuning meter will now coincide with maximum reading on the external milliammeter at 150 Mc/s and 100 Mc/s. Check that this condition is maintained at 140, 125 and 115 Mc/s (crystal frequencies of 7,515, 6,680 and 6,120 kc/s respectively). A slight error in tracking, shown by a divergence between maximum dip and peak readings on the two meters, may be permitted providing that a dip on the tuning meter of not less than 0·3 mA is obtained at each test frequency. If this is not the case, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15, 16). V4 grid current may be measured, if desired, by disconnecting chassis end of R2 and inserting milliammeter 0-1 or suitable microammeter.

(13) Check the oscillator unit for stability by rotating TUNE OSC. dial slowly, with crystal absent and meter switch at OSC. noting that no dip is shown on the tuning meter at any setting of dial.

(14) Typical readings are shown in the following table. The valve V5 grid current with crystal removed should not exceed 20μA. The tuning meter, with switch at OSC. is in parallel with a shunt in the anode circuit of V3. The standing current indication, with no crystal, should be 0·65 mA approximately (*para.* 13).

| Nominal frequency Mc/s. | Crystal kc/s. | Grid Current, tuned V4 μA | Grid Current, tuned V5 μA | Tuning meter dip with switch at osc. mA |
|---|---|---|---|---|
| 150 | 8,070 | 50–80 | 250–350 | 0·35–0·45 |
| 140 | 7,515 | 60–100 | 250–350 | 0·35–0·45 |
| 125 | 6,680 | 80–120 | 300–400 | 0·37–0·47 |
| 115 | 6,120 | 100–150 | 300–400 | 0·37–0·47 |
| 100 | 5,280 | 100–150 | 300–400 | 0·4 –0·5 |

**Amplifier unit (signal frequency) alignment**

**6.** The sequence is as follows:—

(1) Remove cover from tuning unit, set meter switch to OSC. and system switch at MAN. GC.

(2) Set the tune signal dial at 150. Insert a crystal 8,070 kc/s in ST1, and tune the oscillator to resonance at calibration of 150, by obtaining maximum dip on tuning meter.

(3) Connect the signal generator to the aerial socket as in para. 2 and apply a signal at 150 Mc/s, modulated 30 per cent, at 1,000 c/s. Adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(4) Adjust trimmers C1, C6, C12, using hexagon end of tuning tool, to give maximum audio output. The signal generator tuning may require slight re-adjustment.

(5) Insert a crystal, 5,280 kc/s, set TUNE SIGNAL dial at 100, and tune the oscillator for maximum resonance at calibration of 100 by obtaining maximum dip on tuning meter.

(6) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (3). If necessary, adjust inductance of L1, L2, L3 in turn, to give maximum output. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end of the tuning tool. The signal generator will require re-adjustment as in (4).

**Note . . .**

*Once set by the makers, it is unlikely that L1, L2, L3 will need further adjustment when re-aligning the receiver.*

(7) Repeat the above adjustments (1) to (6) until neither set of adjustments affects the other. A signal of 5 µV at 150 Mc/s and 100 Mc/s, modulated 30 per cent at 1,000 c/s, should give an output of not less than 1 mW + 15 dB into 600 ohms.

(8) Replace cover of tuning unit and secure by one centre screw only. Cut sealing film at rear of centre trimmer aperture and turn back ends to gain access to trimmers. Apply a signal of 5 µV at 150 Mc/s as in (7), adjust C1, C6, C12 to give maximum output and note final reading on output meter. Remove cover and seal trimmers with a small quantity of wax. If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(9) Check that the sensitivity obtained in (7) is maintained at 140, 125 and 115 Mc/s. If not, and the oscillator unit is known to be correctly aligned as in para. 5, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15, 16).

(10) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIG. control (150 Mc/s) with the crystal removed. This is indicated by a fall of the reading of the tuning meter (set to OSC.) when the TUNE OSC. and TUNE SIGNAL controls are rotated. If this is found to be the case, check that the cathode condensers are not defective and that their leads are very short. They should also be placed as near the chassis as practicable.

**AGC characteristics**

**7.** The AGC threshold is defined as the input required to produce a dip in the tuning meter reading of 0·1 mA, with meter switch at SIGNAL and receiver correctly tuned (*para.* 13).

(1) *Threshold*
Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 5µV unmodulated at the five test frequencies in para. 2. The difference in reading of the tuning meter, off-tune, with meter switch at SIGNAL should be not less than 0·1 mA.

(2) *AGC noise*
With the equipment set up as in (1) apply an input of 5µV at 99·9 Mc/s unmodulated. Increase the input level by 40 dB (100 times) and check that the output noise level falls not less than 25 dB (18 times). The noise measurements are made by tuning the unmodulated carrier to peak.

(3) *AGC*
With the equipment set up as in (1) apply a signal of 5µV at 99·9 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust

apply a signal of 5 μV at 99·9 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust the AF gain control to provide an output of 1 mW. Increase the input from the signal generator by amounts up to 80 dB (10,000 times). The AF output should not increase more than 6 dB (2 times).

**Muting adjustment**

**8.** This circuit must be adjusted so that when the noise or signal input to the receiver aerial socket is less than 3 μV the audio output from the receiver is attenuated, whereas noise or signals above 3 μV produce an unattenuated AF output. The " critical voltage," at which the muting diode commences to conduct and produce AF attenuation, is fixed by the setting of the pre-set IF gain control VR3 mounted on the rear of the chassis.

**9.** When VR3 is set for maximum output from the receiver only noise or signals below approximately 1 μV will be attenuated, so that the muting circuit is effectively inoperative and there will be a high level of noise output. When VR3 is adjusted to give a lower receiver output, the " critical voltage " will increase and so a higher level of noise and signals received will produce an attenuated output.

**10.** This test may be performed with the receiver tuned to the normal frequency in use. The procedure for setting-up the muting circuit is as follows :—

(1) Disconnect aerial from the receiver and to the aerial socket connect the signal generator Type 31 using the 14-ohm terminal with a 100-ohm non-inductive resistor in series with it (as in *para.* 2).

(2) Connect output meter Type 2, adjusted to 600-ohm impedance, to the LINE socket of the receiver.

(3) Set the receiver RF and AF gain controls to maximum, system switch to MAN GC. and meter switch to SIGNAL. VR3 should be turned fully counter-clockwise to give maximum output. It will be of assistance to connect a pair of high-resistance telephones to the MONITOR socket of the receiver.

(4) Set the signal generator to the receiver frequency. It should be set to give a 4 μV modulated signal and adjusted so that maximum output is indicated on the output meter.

(5) Using a screwdriver, turn VR3 very slowly in a clockwise direction so that the output is gradually decreased, audibly in the telephones and visually on the output meter. Continue to rotate VR3 until the output of the receiver falls sharply. This will be indicated by the output meter and heard in the decrease of noise in the telephones.

(6) Rotate VR3 very slowly counter-clockwise until the output suddenly rises. The correct setting of VR3 is between these two points and it will be found that the " critical voltage " position of VR3 is easily decided ; the instant when the muting diode V15 has commenced to conduct, producing the rapid attenuation in visual and aural output, is quite obvious.

**11.** It is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements. The muting adjustment should not then be carried out unless the proper equipment is available to check the sensitivity after the muting adjustment has been made.

**AF response checking**

**12.** The method detailed below is arranged to check the overall fidelity of the receiver.

(1) Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 1,000 μV at 99·9 Mc/s unmodulated. Tune for maximum dip on tuning meter, with meter switch at SIGNAL.

(2) Couple the oscillator unit Type 25, by means of transformer Type 309, for external modulation of the signal generator. Set the output switch of the oscillator unit at 600 ohms, and set the frequency at 1,000 c/s. Ascertain, from the A.P. or handbook issued with the signal generator, the voltage required for 30 per cent modulation, and adjust the OUTPUT CONTROL of oscillator to provide this voltage.

(3) Adjust the AF gain control of the receiver to provide an output of 10 mW

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent and find the peak frequency and output, usually between 700 and 1,000 c/s. The attenuation from this peak at frequencies of 300 and 3,000 c/s should be not greater than 6 dB.

(5) The extended frequency response should satisfy the limits given below, relative to the level at 1,000 c/s.

| Modulation frequency c/s | 120 | 5000 | 7000 |
|---|---|---|---|
| Attenuation dB | Not less than 10 | Not less than 20 | Not less than 30 |

(6) If the output control of oscillator does not provide smooth control at low frequencies, connect a loading resistor of 500 to 700 ohms across oscillator output terminals, and repeat whole sequence of test.

**13.** The pre-set control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms to enable meters of different internal resistance to be used with the same shunts (R25, R57). The adjustment should not be disturbed, but if it is suspected, or if it becomes necessary to replace the tuning meter, it may be checked as follows :—

(1) Stand receiver in normal position, with front panel vertical. Set meter switch at OSC., system switch at TONE MAN. GC. and RF GAIN control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65 mA. If a reading is found below 0·6 or above 0·7 mA, adjust VR4 and seal with a small quantity of wax or sealing wax.

#### Typical performance characteristics

**14.** In making the measurements which follow, generator leakage was balanced out at each frequency by placing the signal generator output lead in such a position that no signal was heard in the headphones when the signal generator gave a nominal zero output. The signal generator was made to represent a resistive source of 100 ohms. Tuning meter, with switch at SIGNAL, is in parallel with a shunt in anode circuit of V7. The standing meter current with system switch at AGC and no signal is 0·7 to 0·8 mA.

| System switch at | | Man. GC | AGC | |
|---|---|---|---|---|
| Signal frequency Mc/s | Crystal frequency kc/s | Sensitivity. Input for signal/noise = 20 dB. µV | AGC threshold (para. 6) µV | Tuning meter dip with switch at SIGNAL, for input of 5 µV mA |
| 150 | 8,070 | 3·0 | 2·0 | 0·3 |
| 140 | 7,515 | 3·0 | 2·0 | 0·35 |
| 125 | 6,680 | 3·5 | 2·5 | 0·4 |
| 115 | 6,120 | 4·0 | 2·5 | 0·35 |
| 100 | 5,280 | 4·5 | 3·0 | 0·25 |

**Note . . .**

*Some receivers have sensitivities up to 10µV for signal/noise = 20 dB, and AGC threshold up to 5 µV.*

#### Variable condensers and circuit alignment

**15.** The variable condenser assemblies incorporated in the crystal harmonic amplifier and signal amplifier units consist of individual variable condensers, mechanically ganged by means of self-aligning flexible couplings designed to eliminate angular rotational errors. The condensers are accurately matched to 0·25 pF at six angular positions, after being ganged together mechanically at the maximum capacity position.

**16.** The alignment of the circuits of the receiver can be carried out as previously described. It is recommended, however, that the adjustment of the variable condensers and the alignment of the signal amplifier circuits is only attempted by a competent technician. In most cases it will be far preferable to fit a new unit complete.

**17.** The 1st multiplier, IF transformer and beat oscillator employ iron dust cores controlling inductances L4. These cores will only need re-setting if an associated component is replaced, or during general re-alignment. The cores are unthreaded, and have a single fluting in which is cemented a combined elastic and silk filament. When in use the coil former compresses and forms a thread on the surface of the filament which serves to locate and retain in position the iron dust core. Since the surface area of the thread is small, care must be taken not to exert excessive end pressure when using the screwdriver end of the tuning tool, or the core may be displaced one or more complete threads or forced right through the former. In the case of L4, should this happen and the core is displaced considerably, it is preferable to screw right through and re-insert at the nearer end of the former rather than attempt to unscrew for a long distance against tool pressure. The space available in the other units will not permit this procedure without dismantling, hence the need for care.

**18.** An earlier type of iron dust core may be found in use. This is threaded and may be recognized in position by the presence of a white filler preparation around the core. This preparation fills the clearance between the thread on the core and that in the former. Its stability is such that the settings are maintained under all working conditions, but after some time it sets fairly firmly making adjustment difficult. If it is necessary to re-set any of these cores, it is advisable to warm each core with a narrow soldering-iron bit, so shaped that it will enter the adjusting slot, since the dust cores are rather brittle. If this is made about 4 in. long, and not more than $\frac{3}{16}$ in. diameter, it will not be too hot when fitted to the usual 40 or 80 watt soldering iron heater. The cores should then be adjusted with the appropriate tool. All replacement cores should be of the unthreaded type as in para. 17, irrespective of the type found to be in use.

AL 15

AIR MINISTRY

RECEIVERS, TYPE R.1392A, B, D and E

**This is Amendment List No. 4 to Air Publication 2555F(3), Volume 1, Part 2.** List of Chapters: *delete* "(*to be issued later*)" after the title of Chapter 3 and *write* "(A.L.4)" in the outer margin against the deletion. *Insert* this Chapter 3 to follow Chapter 2. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

SIGNALS

# Chapter 3

# ALIGNMENT, RECEIVERS R.1392D AND E

## LIST OF CONTENTS



### Introduction

**1.** In order to align the receiver R.1392D and E, the following test apparatus is required:—

(1) Signal generator Type 12, Stores Ref. 10SB/17; Connector Type 965, Stores Ref. 10H/13501 } (TF390F/4)

*or*

Signal generator Type 31, Stores Ref. 10S/66; Power unit Type 139, Stores Ref. 10K/482; Connector Type 965, Stores Ref. 10H/13501 } (TF390G/4)

(2) Output meter, Type 2, Stores Ref. 10S/11934 (TF340)

(3) To check the AF response, a variable-frequency source is required, a suitable instrument and coupling transformer being:—
Oscillator unit Type 25, Stores Ref. 10V/11940 (TF195L)
Transformer Type 309, Stores Ref. 10K/195 (PO.48A, ratio 1-1).

**2.** Allow the receiver and test apparatus to stabilize over a warming up period of not less than 10 minutes. Input to the aerial socket of the receiver is from the 14-ohm terminal of the signal generator via a resistance of 100-ohms. The RF gain control should be set always at maximum, and the LF gain control set to a suitable level. Adjust output meter to 600 ohms impedance. Test frequencies 999: 115·02: 125·1: 140·13: 150·12: 156 Mc/s. Crystal frequencies 5280: 6120: 6680: 7515: 8070: 8400 kc/s.

**Note . . .**

*In the following description various references are made to specific valves and components. The location of these valves and components will be made easier by referring to fig. 1 to 7 of Chap. 1, Part 1.*

### IF alignment

**3.** To align the IF circuits proceed as follows:—

(1) Remove the muting valve V15 from its holder. Connect the 14-ohm terminal of the signal generator to the control grid of V9 direct.

(2) Apply a signal of 40 mV at 4·86 Mc/s, referred to crystal standards, with 30 per cent modulation at 1,000 c/s. The frequency difference between transmitter and receiver crystals on any channel may be used to calibrate the signal generator accurately at 4·86 Mc/s. Alternatively, a crystal, 4·86 Mc/s, inserted in holder ST1 will provide adequate output to beat against signal generator.

(3) Adjust the cores of IFT4 for peak output, using the screwdriver end of tuning

tool, Stores Ref. 10A/13505 (*para.* 15-18).

(4) Detune the signal generator and observe the frequency deviation required on either side of resonance to cause a reduction in output of 1·5 dB. If the frequency deviation on each side of resonance is not the same, readjust L14 and L15 by approximately equal amounts, as observed on the output meter, until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(5) Apply a signal of 4 mV at 4·86 Mc/s to the control grid of V8 and adjust IFT3 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 3 dB. Readjust L12 and L13 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(6) Apply a signal of 400 μV at 4·86 Mc/s to the control grid of V7, and adjust IFT2 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 4·5 dB. Re-adjust L10 and L11 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be again about ± 25 kc/s.

(7) Identify the wire from tag on variable condenser C14 (to which C67 is also connected in rear of V6 compartment of oscillator unit Type 326 or 329) connected to tagboard and C68 in rear of V3 compartment of amplifier unit Type 451 or 453. Disconnect this wire at tagboard in amplifier unit and connect the 14-ohm terminal of signal generator to the control grid of V3 via C68.

**Note . . .**

*As stated in Part 2, Chap. 1, para. 9, the oscillator and signal frequency amplifier sub-assemblies for R.1392D and R.1392E, respectively, have different serial numbers. Amplifier unit Type 451 and oscillator unit Type 326 are used in the R.1392D, whilst the R1392E uses amplifier unit Type 453 and oscillator unit Type 329.*

(8) Apply a signal of 40μV and adjust IFT1 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 6 dB. Re-adjust L8 and L9 for symmetry of resonance and check that the final frequency deviation is not less than ± 25 kc/s for an attenuation of 6 dB and not more than ± 90 kc/s for an attenuation of 60 dB.

(9) Replace muting valve and connection to C68.

**Beat oscillator alignment**

**4.** The heterodyne oscillator should be aligned as follows:—

(1) Bring the oscillator into operation by switching the system switch to the TONE MAN. GC position.

(2) Set the TONE FREQUENCY CONTROL to the central position, when the condenser C16 should be at half its maximum value.

(3) Apply a signal of 10μV at 4·8 Mc/s unmodulated from the 14-ohm terminal of the signal generator via C68 as described in para. 3, sub-para. 7. Then adjust the core of L16 to give zero beat, using the tuning tool (*para.* 15-18).

(4) Set the TONE FREQUENCY CONTROL to approximately 1,000 c/s and note the output level. This should be at least three times (+ 10 dB) the output obtained by applying 30 per cent. modulation at 1,000 c/s to the injected signal with the switch turned to MAN. GC.

**Crystal oscillator and harmonic amplifier adjustment**

**5.** The sequence is as follows:—

(1) Disconnect chassis end of R7 and insert a milliammeter 0-1 with positive to chassis and remove cover from tuning unit.

(2) During subsequent work, maintain the TUNE SIGNAL dial at the approximate setting of the TUNE OSC. dial.

(3) Insert a crystal 8·070 kc/s in ST1, and set TUNE OSC. and TUNE SIGNAL dials to 150.

(4) Adjust trimmer C4, using hexagon end of tuning tool to give maximum reading on the external milliammeter.

(5) Set meter switch to OSC. and RF GAIN CONTROL at maximum.

(6) Identify the tag of variable condenser C11 to which C57 is connected. Connect

the 14-ohm terminal of signal generator to this point via a condenser of 50-100 pF. Apply a signal at 150 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(7) Adjust trimmers C7, C10, C15 to give maximum audio output, or maximum dip on receiver tuning meter. The signal generator tuning may require slight re-adjustment for maximum output.

(8) Insert a crystal 5,280 kc/s; set both dials at 100 and adjust iron dust core of L4 to give maximum reading on the external milliammeter (*para.* 15-18).

(9) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (5). If necessary, adjust inductance of L5, L6, L7 in turn to give maximum audio output, or maximum dip on receiver tuning meter. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end, or tweezer action, of tuning tool. The signal generator will require adjustment as in (5) and (6).

**Note . . .**

*Once set by the makers, it is unlikely that L5, L6, L7 will need further adjustment when re-aligning the receiver.*

(10) Repeat the above adjustments (2) to (8) until neither set of adjustments affects the other. As the circuits come more closely into line, it is preferable to dispense with the signal generator and to adjust for maximum reading on the external milliammeter and maximum dip on the receiver tuning meter.

(11) Replace cover of tuning unit and secure by centre screw only. Cut sealing film midway between two centre trimmer apertures, and turn back the four ends to gain access to trimmers. Repeat (3) and (6) and note final readings on meters. Remove cover and seal trimmers with a small quantity of wax (Philityne, Stores Ref. 33C/1084). If not available, sealing wax may be used but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(12) Maximum dip on the tuning meter will now coincide with maximum reading on the external milliammeter at 150 Mc/s and 100 Mc/s. Check that this condition is maintained at 140, 125 and 115 Mc/s (crystal frequencies of 7,515, 6,680 and 6,120 kc/s respectively). A slight error in tracking, shown by a divergence between maximum dip and peak readings on the two meters, may be permitted providing that a dip on the tuning meter of not less than 0·3 mA is obtained at each test frequency. If this is not the case, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15-16). V4 grid current may be measured, if desired, by disconnecting chassis end of R2, and inserting milliammeter O-1 or suitable microammeter.

(13) Check the oscillator unit for stability by rotating TUNE OSC. dial slowly, with crystal absent and meter switch at OSC., noting that no dip is shown on the tuning meter at any setting of dial.

(14) Typical readings are shown in the table below. The valve V5 grid current with crystal removed should not exceed 20 μA. The tuning meter with switch at OSC. is in parallel with a shunt in the anode circuit of V3. The standing current indication with no crystal should be 0·65 mA approximately (*para.* 13).

| Nominal frequency Mc/s. | Crystal kc/s. | Grid current, tuned V4 μA | V5 μA | Tuning meter dip with switch at osc. mA |
|---|---|---|---|---|
| 156 | 8,400 | 50–80 | 250–350 | 0·34–0·44 |
| 150 | 8,070 | 50–80 | 250–350 | 0·35–0·45 |
| 140 | 7,515 | 60–100 | 250–350 | 0·35–0·45 |
| 125 | 6,680 | 80–120 | 300–400 | 0·37–0·47 |
| 115 | 6,120 | 100–150 | 300–400 | 0·37–0·47 |
| 100 | 5,280 | 100–150 | 300–400 | 0·4 –0·5 |

**Amplifier unit (signal frequency) alignment**

**6.** The sequence is as follows :—

(1) Remove cover from tuning unit, set meter switch to OSC. and system switch at MAN. GC.

(2) Set the tune signal dial at 150. Insert a crystal 8,070 kc/s in ST1, and tune the oscillator to resonance at calibration of 150 by obtaining maximum dip on tuning meter.

(3) Connect the signal generator to the aerial socket as in para. 2 and apply a signal at 150 Mc/s modulated 30 per cent at 1,000 c/s. Adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(4) Adjust trimmers C1, C6, C12, using hexagon end of tuning tool, to give maximum audio output. The signal generator tuning may require slight re-adjustment.

(5) Insert a crystal, 5,280 kc/s, set TUNE SIGNAL dial at 100, and tune the oscillator for maximum resonance at calibration of 100 by obtaining maximum dip on tuning meter.

(6) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (3). If necessary, adjust inductance of L1, L2, L3 in turn, to give maximum output. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end of the tuning tool. The signal generator will require re-adjustment as in (4).

**Note . . .**

*Once set by the makers, it is unlikely that L1, L2, L3 will need further adjustment when re-aligning the receiver.*

(7) Repeat the above adjustments (1) to (6) until neither set of adjustments affects the other. A signal of 5µV at 150 Mc/s and 100 Mc/s, modulated 30 per cent at 1,000 c/s, should give an output of not less than 1 mW + 15 dB into 600 ohms.

(8) Replace cover of tuning unit and secure by one centre screw only. Cut sealing film at rear of centre trimmer aperture and turn back ends to gain access to trimmers. Apply a signal of 5µV at 150 Mc/s as in (7), adjust C1, C6, C12 to give maximum output and note final reading on output meter. Remove cover and seal trimmers with a small quantity of wax. If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(9) Check that the sensitivity obtained in (7) is maintained at 140, 125 and 115 Mc/s. If not, and the oscillator unit is known to be correctly aligned as in para. 5, the condenser alignment will have to be corrected by split end vane adjustment (*para* 15, 16).

(10) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIG. control (150 Mc/s) with the crystal removed. This is indicated by a fall of the reading of the tuning meter (set to OSC.) when TUNE OSC. and TUNE SIGNAL controls are rotated. If this is found to be the case, check that the cathode condensers are not defective and that their leads are very short. They should also be placed as near the chassis as practicable.

**AGC characteristics**

**7.** The AGC threshold is defined as the input required to produce a dip in the tuning meter reading of 0·1 mA with meter switch at SIGNAL and receiver correctly tuned (*para.* 13).

(1) *Threshold*

Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 5µV unmodulated at the five test frequencies in para. 2. The difference in reading of the tuning meter, off-tune, with meter switch at SIGNAL should be not less than 0·1 mA.

(2) *AGC noise*

With the equipment set up as in (1) apply an input of 5µV at 99·9 Mc/s unmodulated. Increase the input level by 40 dB (100 times) and check that the output noise level falls not less than 25 dB (18 times). The noise measurements are made by tuning the unmodulated carrier to peak.

(3) *AGC*

With the equipment set up as in (1)

the AF gain control to provide an output of 1 mW. Increase the input from the signal generator by amounts up to 80 dB (10,000 times). The AF output should not increase more than 6 dB (2 times).

**Muting adjustment**

**8.** This circuit must be adjusted so that when the noise or signal input to the receiver aerial socket is less than 3μV the audio output from the receiver is attenuated, whereas noise or signals above 3μV produce an unattenuated AF output. The "critical voltage," at which the muting diode commences to conduct and produce AF attenuation, is fixed by the setting of the pre-set IF gain control VR3 mounted on the rear of the chassis.

**9.** When VR3 is set for maximum output from the receiver only, noise or signals below approximately 1μV will be attenuated, so that the muting circuit is effectively inoperative and there will be a high level of noise output. When VR3 is adjusted to give a lower receiver output, the "critical voltage" will increase and so a higher level of noise and signals received will produce an attenuated output.

**10.** This test may be performed with the receiver tuned to the normal frequency in use. The procedure for setting up the muting circuit is as follows :—

(1) Disconnect aerial from the receiver and to the aerial socket connect the signal generator Type 31 using the 14-ohm terminal with a 100-ohm non-inductive resistor in series with it (*as in para.* 2).

(2) Connect output meter Type 2, adjusted to 600 ohms impedance, to the LINE socket of the receiver.

(3) Set the receiver RF and AF gain controls to maximum, system switch to MAN. GC. and meter switch to SIGNAL. VR3 should be tuned fully counter-clockwise to give maximum output. It will be of assistance to connect a pair of high-resistance telephones to the MONITOR socket of the receiver.

(4) Set the signal generator to the receiver frequency. It should be set to give a 4μV modulated signal and adjusted so that maximum output is indicated on the output meter.

(5) Using a screwdriver, turn VR3 very slowly in a clockwise direction so that the output is gradually decreased, audibly in the telephones and visually on the output meter. Continue to rotate VR3 until the output of the receiver falls sharply. This will be indicated by the output meter and heard in the decrease of noise in the telephones.

(6) Rotate VR3 very slowly counter-clockwise until the output suddenly rises. The correct setting of VR3 is between these two points and it will be found that the "critical voltage" position of VR3 is easily decided; the instant when the muting diode V15 has commenced to conduct, producing the rapid attenuation in visual and aural output, is quite obvious.

**11.** It is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements. The muting adjustment should not, then, be carried out unless the proper equipment is available to check the sensitivity after the muting adjustment has been made.

**AF response checking**

**12.** The method detailed below is arranged to check the overall fidelity of the receiver.

(1) Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 1,000 μV at 99·9 Mc/s unmodulated. Tune for maximum dip on tuning meter with meter switch at SIGNAL.

(2) Couple the oscillator unit Type 25, by means of transformer Type 309, for external modulation of the signal generator. Set the output switch of the oscillator unit at 600 ohms, and set the frequency at 1,000 c/s. Ascertain, from the A.P. or handbook issued with the signal generator the voltage required for 30 per cent modulation, and adjust the OUTPUT CONTROL of oscillator to provide this voltage.

(3) Adjust the AF gain control of the receiver to provide an output of 10 mW.

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent, and find the peak frequency and output, usually between 700 and 1,000 c/s. The attenuation from this peak at

frequencies of 300 and 3,000 c/s should not be greater than 6 dB.

(5) The extended frequency response should satisfy the limits given below, relative to the level at 1,000 c/s.

(6) If the output control of oscillator does not provide smooth control at low frequencies, connect a loading resistor of 500 to 700 ohms across oscillator output terminals and repeat whole sequence of test.

| Modulation frequency c/s | 120 | 5000 | 7000 |
|---|---|---|---|
| Attenuation dB | Not less than 10 | Not less than 20 | Not less than 30 |

**13.** The pre-set control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms to enable meters of different internal resistance to be used with the same shunts (R25, R57). The adjustment should not be disturbed, but if it is suspected, or if it becomes necessary to replace the tuning meter, it may be checked as follows:—

(1) Stand receiver in normal position, with front panel vertical. Set meter switch at OSC., system switch at TONE MAN. GC. and RF gain control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65 mA. If a reading is found below 0·6 or above 0·7 mA, adjust VR4 and seal with a small quantity of wax or sealing wax.

**Typical performance characteristics**

**14.** In making the measurements below, generator leakage was balanced out at each frequency by placing the signal generator output lead in such a position that no signal was heard in the headphones when the signal generator gave a nominal zero output. The signal generator was made to represent a resistive source of 100 ohms. Tuning meter, with switch at SIGNAL, is in parallel with a shunt in anode circuit of V7. The standing meter current with system switch at AGC and no signal is 0·7 to 0·8 mA.

**Note . . .**

*Some receivers have sensitivities up to 10 µV for signal noise = 20 dB, and AGC threshold up to 5 µV.*

**Variable condensers and circuit alignment**

**15.** The variable condenser assemblies incorporated in the crystal harmonic amplifier and signal amplifier units consist of individual variable condensers, mechanically ganged by means of self-aligning flexible couplings, designed to eliminate angular rotational errors. The condensers are accurately matched to 0·25 pF at six angular positions, after being ganged together mechanically at the maximum capacity position.

**16.** The alignment of the circuits of the receiver can be carried out as previously described. It is recommended, however, that the adjustment of the variable condensers and the alignment of the signal amplifier circuits is only attempted by a competent technician. In most cases it will be far preferable to fit a new unit complete.

**17.** The 1st multiplier, IF transformer and beat oscillator employ iron dust cores controlling inductances L4. These cores will only need resetting if an associated component is replaced, or during general realignment. ~~The cores are unthreaded and have~~ a single fluting in which is cemented a combined elastic and silk filament. When in use the coil former compresses and forms a thread on the surface of the filament which serves to locate and retain in position the iron dust core. Since the surface area of the thread is small, care must be taken not to exert excessive end pressure when using the screwdriver end of the tuning tool or the core may be displaced one or more complete

| System switch at Signal frequency Mc/s | Crystal frequency kc/s | MAN. GC Sensitivity. Input for Signal/Noise = 20 dB. µV | AGC AGC threshold (refer para. 6) µV | Tuning meter dip with switch at SIGNAL, for input of 5 µV mA. |
|---|---|---|---|---|
| 156 | 8,400 | 3·0 | 2·0 | 0·3 |
| 150 | 8,070 | 3·0 | 2·0 | 0·3 |
| 140 | 7,515 | 3·0 | 2·0 | 0·35 |
| 125 | 6,680 | 3·5 | 2·5 | 0·4 |
| 115 | 6,120 | 4·0 | 2·5 | 0·35 |
| 100 | 5,280 | 4·5 | 3·0 | 0·25 |

threads or forced right through the former. In the case of L4, should this happen and the core is displaced considerably, it is preferable to screw right through and re-insert at the nearer end of the former rather than attempt to unscrew for a long distance against tool pressure. The space available in the other units will not permit this procedure without dismantling, hence the need for care.

**18.** An earlier type of iron dust core may be found in use. This is threaded and may be recognized in position by the presence of a white filler preparation around the core. This preparation fills the clearance between the thread on the core and that in the former. Its stability is such that the settings are maintained under all working conditions, but after some time it sets fairly firmly making adjustment difficult. If it is necessary to re-set any of these cores, it is advisable to warm each core with a narrow soldering-iron bit, so shaped that it will enter the adjusting slot, since the dust cores are rather brittle. If this is made about 4-in. long, and not more than $\frac{3}{16}$-in. diameter, it will not be too hot when fitted to the usual 40 or 80 watt soldering-iron heater. The cores should then be adjusted with the appropriate tool. All replacement cores should be of the unthreaded type as in para. 17, irrespective of the type found to be in use.

# Chapter 4

# ALIGNMENT OF RECEIVER 62 H

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## ILLUSTRATION



**Introduction**

**1.** In order to align the receiver 62H the following test apparatus is required:—

(1) Signal generator CT218, 10S/86780 *or* Test oscillator CT212, ZD.00784 *or* Signal generator A.P.54704.

(2) Output meter A.P.54708 *or* Wattmeter, absorption A.F. CT.44, ZD.02417 *or* Decibel meter No. 3, ZD.02970.

(3) Noise generator CT207, A.P.63451 (see remarks at end of para. 5) *or* Signal generator A.P.54705 and 56 ohms resistor *or* Test oscillator CT378.

(4) Crystal, 9·72 Mc/s or 4·86 Mc/s.

(5) Meter, about 1mA F.S.D.

**Note . . .**

*Before carrying out any alignment the receiver must be switched on for four hours.*

**IF alignment**

**2.** (1) Remove the muting valve V15.

(2) Apply a signal of 20mV at 9·72 Mc/s with 30 per cent modulation at 1,000 c/s to the control grid of V9. (A 9·72 Mc/s crystal inserted in the holder ST1 on the receiver will provide adequate output to beat against the signal generator, zero beat providing a crystal check point at 9·72 Mc/s. "Resonance" in subsequent steps of the paragraph refers to this crystal check-point.)

**Note . . .**

*The setting of the centre frequency* (9·72 *Mc/s*) *of the I.F. is of extreme importance in the alignment of this receiver.*

(3) Adjust the cores of IFT4 (L14 and L15) for peak output.

(4) Detune the signal generator, observing the frequency deviation required either side of resonance for a fall in output of 1·5dB. If the deviation either side of resonance is not the same, readjust the cores by equal amounts (as observed on the output meter), until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be approximately ±45 kc/s.

(5) Apply a signal of 4mV at 9·72 Mc/s to the control grid of the V8 and adjust the cores of IFT3 (L12 and L13) for maximum output. Observe the frequency deviation either side of resonance to cause a 3dB reduction in output. Readjust the cores until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be approximately ±45 kc/s.

(6) Apply a signal of 400μV at 9·72 Mc/s to the control grid of V7 and adjust the cores of IFT2 (L10 and L11) for maximum output. Observe the frequency deviation required for either side of resonance to cause a 4·5dB reduction in output. Readjust the cores of the transformer until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be about ±45 kc/s.

(7) Disconnect the condenser C68 from the anode of V6 and apply a 40μV signal at 9·72 Mc/s via this condenser to the control grid of V3, and adjust the cores of IFT1 (L8 and L9) for maximum output. Observe the frequency deviation on either side of resonance to cause a reduction in output of 6dB. Readjust if necessary the transformer cores to obtain symmetrical curves about the resonant frequency, and check that the final frequency deviation is not less than ±41 kc/s at 6dB down and not more than ±160 kc/s at 60dB down. See also Chap. 6 for measurement of bandwidth and centre frequency.

**Note . . .**

*On no account should the alignment of the I.F. transformers be continued by "peaking" the circuits.*

(8) Replace the muting valve V15 and reconnect condenser C68 to the anode of V6.

**Heterodyne oscillator alignment**

**3.** (1) Set the system switch of the receiver to the TONE MAN GC position. Remove V15 and disconnect condenser **C68** from V6 anode. Apply an **unmodulated input** of 100μV at exactly 9·72 Mc/s via C68 to the grid circuit of V3 (use the 9·72 Mc/s crystal provided, inserted in holder ST1, which will provide an adequate output to beat against the signal generator).

(2) Set the TONE FREQUENCY CONTROL to the central position. Check that the zero beat of the signal generator coincides with the mid-point setting of the TONE FREQUENCY CONTROL. If this is not the case, slightly adjust the core of **L16**.

(3) Set the TONE FREQUENCY CONTROL to approximately 1,000 cycles and adjust the LF GAIN control of the receiver to provide an output of 1mW + 10dB (10mW) in 600 ohms.

(4) Switch the system switch of the receiver to the MAN GC position and modulate the signal at 30 per cent modulation at 1,000 cycles. Check that the output level falls by approximately 8dB.

(5) Switch the receiver METER SWITCH to AUDIO, check that the reading of the tuning meter is between 0·45 and 0·60mA when an output level of 1mW + 20dB into 600 ohms is obtained in the external output meter. Replace V15 and reconnect condenser C68 to the anode of **V6.**

**Crystal oscillator and harmonic amplifier adjustment**

**4.** (1) Disconnect the chassis end of R7 and insert a 0—1 milliammeter with positive terminal to chassis and negative to resistor, and remove the cover from the tuning unit.

(2) Insert a 7810 kc/s crystal into the holder ST1 and set TUNE SIGNAL and TUNE OSC. dials to 150·3 Mc/s. Tune receiver to resonance.

(3) Adjust trimmer C4 for maximum reading on milliammeter.

(4) Set METER SWITCH to OSC. and turn R.F. GAIN control fully clockwise.

(5) Apply a signal of 150·3 Mc/s modulated at 30 per cent at 1,000 cycles and adjust the output level of the signal generator so

that the signal is just audible. As the alignment is improved the output of the signal generator must be reduced.

(6) Adjust the trimmers C7, C10 and C15 to give maximum audio output or for maximum dip in the receiver tuning meter.

(7) Insert a 5070 kc/s crystal into the holder ST1 and set the TUNE SIGNAL and TUNE OSC. dials to 100·98 Mc/s. Adjust L4 to give maximum reading on the milliammeter.

(8) Apply a signal of 100·98 Mc/s and increase the output level of the signal generator until the signal is just audible. Readjust L5, L6 and L7 to give maximum dip on the receiver tuning meter.

(9) Repeat the above adjustments (3) to (8) until neither set of adjustments affects the other.

(10) Maximum dip on the tuning meter should now coincide with the maximum reading on the milliammeter on 150·3 and 100·98 Mc/s. Check that this condition is maintained at 139·5, 122·22 and 116·28 Mc/s (crystal frequencies of 7210, 6250 and 5920 kc/s respectively) and that a dip of at least 0·2mA is obtained.

(11) Check the receiver oscillator units for stability, by removing the crystal from the holder ST1, switching the METER SWITCH to OSC., and rotating the TUNE OSC. dial slowly. Note that no dip is shown on the tuning meter on any setting of the dial.

**Note . . .**
*If, when carrying out step (3) of this paragraph, any dip at all is detectable on the tuning meter as C4 is adjusted, the crystal oscillator and harmonic amplifiers are only slightly misaligned and the tuning meter may be used for realignment throughout, i.e. a signal generator is not required.*

**Amplifier unit alignment**

**5.** (1) Remove the cover from the tuning unit, set the receiver METER SWITCH to OSC., the system switch to MAN G.C., and R.F. GAIN control to maximum.

(2) Set the TUNE SIGNAL dial to approximately 150·3 Mc/s, insert the 7810 kc/s crystal into the holder ST1 and tune the oscillator to resonance at 150·3 Mc/s by obtaining maximum dip on the tuning meter. Connect the signal generator to the aerial socket and apply a signal of 150·3 Mc/s modulated 30 per cent at 1,000 cycles.

(3) Adjust the output level of the signal generator so that the signal is just audible. Adjust trimmers C1, C6, C12 to give a maximum audio output.

(4) Insert a 5070 kc/s crystal in the holder ST1, set the TUNE SIGNAL dial to 100·98 Mc/s and tune the oscillator for maximum dip on the tuning meter.

(5) Set the signal generator to 100·98 Mc/s and increase the output level until the signal is just audible. Adjust L1, L2 and L3 to give maximum output.

(6) Repeat the above adjustments (1) to (5) until neither set of adjustments affects the other. A signal of 5$\mu$V at 150·3 Mc/s and 100·98 Mc/s modulated 30 per cent at 1,000 cycles should give an output of not less than 1mW +15dB in 600 ohms. The signal generator must be 75 ohms impedance or be made up to this value (e.g. by using the 56 ohms series resistor with A.P.54705).

(7) Check that the sensitivity in (6) is maintained at 139·5, and 122·22 and 116·28 Mc/s (crystal frequencies 7210, 6250 and 5920 kc/s respectively). See chap. 6 for R.F. sensitivity measurements.

(8) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIGNAL control, with no crystal in the holder ST1. Instability is indicated by a fall of the reading of the tuning meter (switched to OSC.) when the TUNE OSC. and TUNE SIGNAL controls are rotated. Noise Generator CT207 may be used instead of a signal generator for the amplifier unit alignment provided that, with the noise generator connected to the aerial socket and the diode current set to about 100 mA, some deflection due to noise can be obtained on the output meter when the receiver is switched to TONE MAN. GC. The capacitors and inductors can then

be adjusted for maximum noise output. Adjustment must always be made with some noise from the noise generator, particularly when adjusting the first circuit. After alignment the specification figures quoted in Chap. 5 may be used (instead of the figure given in step (6) of this para.) though a good receiver will normally give better figures after realignment, e.g. the typical figures also quoted in Chap. 5.

#### AGC characteristics

*Threshold*

**6.** The AGC threshold level is defined as the unmodulated input required to produce a dip of 0·2mA in the tuning meter, when the METER SWITCH is switched to SIGNAL. Set the system switch to MAN G.C., the R.F. GAIN and L.F. GAIN controls to maximum and apply a signal of 10μV modulated 30 per cent **at a 1,000** cycles at the following frequencies:-

| *Mc/s* | | | | |
|---|---|---|---|---|
| 100·98 | 116·28 | 122·22 | 139·5 | 153·72 |

| *Crystal kc/s* | | | | |
|---|---|---|---|---|
| 5070 | 5920 | 6250 | 7210 | 8000 |

and ensure that the threshold occurs below 10μV.

*AGC noise*

**7.** AGC noise is defined as the variation of the output noise power caused by an increase of RF input level. With the equipment set up as described in para. 6, apply an unmodulated input of 5μV at 100·98 Mc/s. Increase input level by 40dB and check that the output noise level falls by not less than 25dB.

*AGC*

**8.** With the equipment set up as described in para. 6, with an input level of 10μV modulated 30 per cent at 1,000 cycles at 100·98 Mc/s, adjust the A.F. GAIN control to produce an output of 1mW. With an increase in the input level of 80dB the AF output should not increase more than 5dB.

#### Muting adjustment

**9.** The smallest signal which is useful for communications is one which, when modulated 30%, produces a signal to noise ratio of 6dB at the output of the receiver. The muting circuit must be adjusted so that when the signal input into the aerial socket is less than this value the audio output from the receiver is attenuated, whereas noise from signals above this value produce an unattenuated AF output. The critical voltage at which the muting diode conducts and produces AF attenuation is fixed by the setting of the preset IF gain control VR3 mounted at the rear of a chassis.

**10.** (1) Disconnect the aerial from the receiver, and with the system switch set to MAN GC and R.F. GAIN control at maximum, apply an input at 100·98 Mc/s modulated 30 per cent at 1,000 cycles. VR3 should be turned fully counter-clockwise to give a maximum output. Adjust the signal input until a signal to noise ratio of 6dB is obtained (i.e. vary the signal input until the audio output is 6dB greater when the carrier is modulated than when it is unmodulated). Set the signal input to this value and switch ON the modulation.

(2) Turn VR3 slowly in a clockwise direction to reduce output, (audibly on the headset and visually on the output meter), continue to rotate VR3 until the output of the receiver falls sharply.

(3) Rotate VR3 counter-clockwise until the output suddenly rises. The correct setting of VR3 is found between these two points and it will be found that the critical voltage position of VR3 is easily decided; the instant when the muting diode V15 commences to conduct and produces rapid attenuation is quite obvious.

(4) With the input as in (1) above and the anode to V15 disconnected, the output noise level should remain unchanged. If the anode of V15 is reconnected and an unmodulated input at 100·98 Mc/s of 1½ times the value set in step (1) is switched off, the output noise level should fall by approximately 20dB.

**Note . . .**
*As it is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements, the muting adjustments should be carefully carried out and the receiver sensitivity checked after this adjustment has been made.*

#### AF response check

**11.** The AF response is defined as the variation of the receiver AF output level when the modulation frequency of the RF input signal is varied, the depth of modulation remaining constant. See Chap. 6 for AF sensitivity.

**12.** (1) Set the system switch to A.G.C. Remove V15 and disconnect C68 from the crystal harmonic amplifier (V6), so that an external signal may be applied via this condenser to the mixer valve grid.

(2) Apply an unmodulated input of 2μV at 9·72 Mc/s.

(3) Modulate the signal externally to a depth of 30 per cent at 1,000 cycles and adjust the A.F. GAIN control to provide an output of 10mW.

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent, and determine the peak frequency and output. Check that the attenuation from this peak at modulation frequencies of 300 and 3,000 cycles is not greater than 6dB.

(5) The extended frequency response, relative to the level at 1,000 cycles should satisfy the limits given below.

| | | | |
|---|---|---|---|
| Modulation frequency c/s | 120 | 5,000 | 7,000 |
| Attenuation dB not less than | 10 | 20 | 30 |

#### Tuning meter

**13.** Preset control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms, to enable meters of different internal resistance to be used with the same shunts (R25, R57). If it becomes necessary to replace tuning meters, check as follows:—

(1) Stand receiver in normal position with front panel vertical. Set the meter switch to OSC., system switch to TONE MAN GC and R.F. GAIN control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65mA. If the reading is below 0·6 or above 0·7mA readjust VR4 and reseal.

#### Overall sensitivity

**14.** (1) With system switch set to MAN GC, R.F. GAIN and L.F. GAIN controls set to maximum, apply a signal of 10μV modulated 30 per cent at 1,000 cycles at the following frequencies:—

| | | | | |
|---|---|---|---|---|
| *RF Mc/s* | | | | |
| 100·98 | 116·28 | 122·22 | 139·5 | 153·72 |
| *Crystal kc/s* | | | | |
| 5070 | 5920 | 6250 | 7210 | 8000 |

(2) Check that at each of the above frequencies an output is obtained of not less than 1mW +15dB in 600 ohms.

(3) Increase the input to 15μV at each of the above frequencies and ensure that the signal to noise ratio is not less than 20dB. (The noise measurement is made by tuning the unmodulated carrier peak, and the input signal is that produced by a modulation depth of 30 per cent at 1,000 cycles. The L.F. GAIN control should be adjusted to ensure that the signal output during the tests is not greater than 1mW +15dB in 600 ohms). A check of noise factor and gain using noise generator CT207 is described in Chap. 5. This check should be used for all routine measurements.

**TABLE 1**
**List of capacitors**

| Circuit Ref. | Description | Value pF | Stores No. | Tolerance ± | Tolerance Max. | Tolerance Min. |
|---|---|---|---|---|---|---|
| C1 | Var | 2—16 | Z.160009 | | | |
| 2 | Var LH | 6—48 | A.P.61798 | | | |
| 3 | Var RH | 7—61 | A.P.61796 | | | |
| 4 | A.M. Type 962 | 2—8 | 10C/2072 | | | |

**Table I**—*cont.*

| Circuit Ref. | Description | Value pF | Stores No. | Tolerance ± | Max. | Min. |
|---|---|---|---|---|---|---|
| 5 | Var RH | 6—48 | A.P.61797 | | | |
| 6, 7 | A.M. Type 962 | 2—8 | 10C/2072 | | | |
| 8, 9 | Twin Var. | 7—61 | A.P.71695 | | | |
| 10 | A.M. Type 962 | 2—8 | 10C/2072 | | | |
| 11 | Var RH | 6—48 | A.P.61797 | | | |
| 12 | A.M. Type 962 | 2—8 | 10C/2072 | | | |
| 14 | Var | 7—61 | A.P.61796 | | | |
| 15 | A.M. Type 962 | 2—8 | 10C/2072 | | | |
| 16 | Type 3111 | 4·5—20 | 10C/5686 | | | |
| 17, 18 | | 10,000 | 10C/12407 | | 100% | 0 |
| 19 | Fixed ceramic | 3·3 | Z.132419 | 5pF | | |
| 20 | ,, ,, | 100 | Z.132300 | 10% | | |
| 21 | | 10,000 | 10C/12407 | | 100% | 0 |
| 22 | Fixed ceramic | 100 | Z.132300 | 10% | | |
| 23 | ,, ,, | 33 | Z.132283 | 10% | | |
| 24 | ,, ,, | 100 | Z.132300 | 10% | | |
| 25 | ,, ,, | 1,000 | Z.132630 | 20% | | |
| 26 | ,, ,, | 100 | Z.132300 | 10% | | |
| 27 | ,, ,, | 22 | Z.132275 | 10% | | |
| 28—32 | ,, ,, | 100 | Z.132300 | 10% | | |
| 33 | Fixed mica | 10,000 | Z.124412 | 10% | | |
| 34, 35 | Fixed ceramic | 100 | Z.132300 | 10% | | |
| 36 | ,, ,, | 47 | Z.132289 | 10% | | |
| 37 | ,, ,, | 3·3 | Z.132419 | 0·5pF | | |
| 40 | ,, ,, | 1,000 | Z.132630 | 20% | | |
| 41, 42 | Fixed ceramic | 100 | Z.132300 | 20% | | |
| 43 | ,, ,, | 8·2 | Z.132269 | 5% | | |
| 44 | ,, ,, | 47 | Z.132289 | 10% | | |
| 45 | ,, ,, | 12 | Z.132244 | 0·5pF | | |
| 46—48 | ,, ,, | 100 | Z.132300 | 10% | | |
| 51, 52 | ,, ,, | 100 | Z.132300 | 10% | | |
| 53 | Fixed mica | 1,000 | Z.124074 | | 100% | 0 |
| 55 | Fixed ceramic | 100 | Z.132300 | 10% | | |
| 56 | ,, ,, | 47 | Z.132289 | 10% | | |
| 57 | ,, ,, | 3·3 | Z.132419 | 0·5pF | | |
| 59 | ,, ,, | 3·3 | Z.132419 | 0·5pF | | |
| 60, 61 | ,, ,, | 100 | Z.132300 | 10% | | |
| 64 | ,, ,, | 100 | Z.132300 | 10% | | |
| 65 | ,, ,, | 1,000 | Z.132630 | 20% | | |
| 66 | ,, ,, | 1·5 | Z.132264 | 0·5pF | | |
| 67 | ,, ,, | 33 | Z.132283 | 10% | | |
| 68 | ,, ,, | 3·3 | Z.132419 | 0·5pF | | |
| 69, 71 | ,, ,, | 100 | Z.132300 | 10% | | |
| 72 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 73 | ,, ,, | 8,200 | Z.124368 | 10% | | |
| 74, 75 | Fixed ceramic | 70 | Z.132[illegible]8 | 2% | | |
| 76 | Fixed mica | 8,200 | Z.124368 | 10% | | |
| 78, 79 | ,, ,, | 10,000 | Z.124412 | | 100% | 0 |
| 80 | Fixed ceramic | 70 | Z.132258 | 2% | | |
| 81, 82 | Fixed mica | 8,200 | Z.124368 | 10% | | |
| 83 | Fixed ceramic | 70 | Z.132258 | 2% | | |
| 84 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 85 | Fixed paper | 100,000 | Z.115286 | 20% | | |

**Table 1**—*cont.*

| Circuit Ref. | Description | Value pF | Stores No. | Tolerance ± | Tolerance Max. | Min. |
|---|---|---|---|---|---|---|
| 86 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 87 | „ „ | 8,200 | Z.124368 | 10% | | |
| 88 | Fixed ceramic | 65 | Z.132525 | 2% | | |
| 89 | „ „ | 70 | Z.132258 | 2% | | |
| 90 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 91, 92 | „ „ | 10,000 | Z.124407 | 20% | | |
| 93, 94 | „ „ | 10,000 | Z.124412 | | 100% | |
| 95 | „ „ | 68 | Z.125190 | 2% | | |
| 96 | „ „ | 22 | Z.132277 | 10% | | |
| 97 | „ „ | 10,000 | Z.124412 | | 100% | 0 |
| 98 | Fixed ceramic | 3·3 | Z.132419 | 0·5pF | | |
| 99, 100 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 101 | „ „ | 68 | Z.123582 | 10% | | |
| 102 | „ „ | 8,200 | Z.124368 | 10% | | |
| 103 | Fixed ceramic | 60 | Z.132247 | 2% | | |
| 104 | „ „ | 70 | Z.132258 | 2% | | |
| 105 | Fixed mica | 68 | Z.123582 | 10% | | |
| 107 | „ „ | 1,000 | Z.124074 | | 100% | 0 |
| 108 | Fixed paper | 500,000 | Z.115285 | 20% | | |
| 109 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 110 | Fixed paper | 100,000 | Z.115286 | 20% | | |
| 111 | Fixed mica | 470 | Z.123410 | 5% | | |
| 112 | „ „ | 10,000 | Z.124412 | | 100% | 0 |
| 113 | „ „ | 1,000 | Z.124074 | | 100% | 0 |
| 114 | „ „ | 10,000 | Z.124407 | 20% | | |
| 115 | Fixed paper | 100,000 | Z.115286 | 20% | | |
| 116 | Fixed mica | 10,000 | Z.124412 | | 100% | 0 |
| 117, 118 | Fixed paper | 10,000 | Z.115027 | 20% | | |
| 119, — 121 | „ „ | 100,000 | Z.115286 | 20% | | |
| 122 | Fixed mica | 500 | Z.123466 | | 100% | 0 |
| 123 | „ „ | 10,000 | Z.124412 | | 100% | 0 |
| 125 | Fixed ceramic | 100 | Z.131206 | 10% | | |
| 126 | Fixed mica | 500 | Z.123457 | 20% | | |

**TABLE 2**

**List of resistors**

| Circuit Ref. | Type | Stores | Value Kilohms | Rating Watts | Tolerance per cent |
|---|---|---|---|---|---|
| R1 | | Z.222195 | 33 | ¾ | 10 |
| 2 | | Z.222216 | 47 | ¾ | 10 |
| 3 | | Z.222006 | 1 | ¾ | 10 |
| 4 | | Z.221186 | 0·39 | ¾ | 10 |
| 5 | | Z.222216 | 47 | ¾ | 10 |
| 6 | | Z.222132 | 10 | ¾ | 10 |
| 7 | | Z.223039 | 100 | ¾ | 10 |
| 8 | | Z.222069 | 3·3 | ¾ | 10 |
| 9 | | Z.221153 | 0·22 | ¾ | 10 |
| 10, 11 | | Z.222048 | 2·2 | ¾ | 10 |
| 12 | | Z.221174 | 0·33 | ¾ | 10 |
| 13 | | Z.223081 | 220 | ¾ | 10 |
| 14 | | Z.222132 | 10 | ¾ | 10 |
| 15 | | Z.221216 | 0·68 | ¾ | 10 |
| 16 | | Z.221153 | 0·22 | ¾ | 10 |
| 17 | | Z.222048 | 2·2 | ¾ | 10 |
| 18 | | Z.223101 | 330 | ½ | 10 |
| 19 | | Z.222048 | 2·2 | ¾ | 10 |
| 20 | A.M.5858 | 10W/17402 | 0·2 | 2 | 2 |
| 21 | | Z.223123 | 470 | ¾ | 10 |
| 22 | | Z.222132 | 10 | ¾ | 10 |
| 23 | | Z.221153 | 0·22 | ¾ | 10 |
| 24 | | Z.223132 | 10 | ¾ | 10 |
| 25 | A.M.5853 | 10W/17397 | 0·01 | 0·05 | 2 |
| 26 | | Z.222048 | 2·2 | ¾ | 10 |
| 27 | | Z.222047 | 2·2 | ½ | 10 |
| 28 | | Z.223038 | 100 | ½ | 10 |
| 29 | | Z.222132 | 10 | ¾ | 10 |
| 30 | | Z.221216 | 0·68 | ¾ | 10 |
| 32 | | Z.222006 | 1 | ¾ | 10 |
| 33 | | Z.222047 | 2·2 | ½ | 10 |
| 34 | | Z.212143 | 12 | 1 | 10 |
| 35 | | Z.212153 | 15 | 2½ | 10 |
| 36 | | Z.222006 | 1 | ¾ | 10 |
| 37 | | Z.223038 | 100 | ½ | 10 |
| 38 | | Z.222132 | 10 | ¾ | 10 |
| 39 | | Z.222047 | 2·2 | ½ | 10 |
| 41 | | Z.221216 | 0·68 | ¾ | 10 |
| 42 | | Z.222131 | 10 | ½ | 10 |
| 43 | | Z.223039 | 100 | ¾ | 10 |
| 44 | | Z.223080 | 220 | ½ | 10 |
| 45 | | Z.223123 | 470 | ¾ | 10 |
| 46 | | Z.223039 | 100 | ¾ | 10 |
| 47 | | Z.223081 | 220 | ¾ | 10 |
| 48 | | Z.223165 | 1000 | ¾ | 10 |
| 49 | | Z.223079 | 220 | ¼ | 10 |
| 50 | | Z.223100 | 330 | ¾ | 10 |
| 51 | | Z.221186 | 0·39 | ¾ | 10 |
| 52 | | Z.222216 | 47 | ¾ | 10 |
| 53 | | Z.222047 | 2·2 | ½ | 10 |

(A.L.11, Sept. 54)

**Table 2**—*cont.*

| Circuit Ref. Type | Stores | Value Kilohms | Rating Watts | Tolerance per cent |
|---|---|---|---|---|
| 54 | Z.223018 | 68 | $\frac{3}{4}$ | 10 |
| 55 | Z.222214 | 47 | $\frac{1}{4}$ | 10 |
| 56 | Z.222132 | 10 | $\frac{3}{4}$ | 10 |
| 57 A.M. 5854 | 10W/17398 | | | |
| 58 | Z.223072 | 180 | $\frac{3}{4}$ | 10 |
| 59 | Z.222069 | 3·3 | $\frac{3}{4}$ | 10 |
| 60 | Z.222048 | 2·2 | $\frac{3}{4}$ | 10 |
| 61 | Z.223165 | 1000 | $\frac{3}{4}$ | 10 |
| 62 | Z.223101 | 330 | $\frac{1}{2}$ | 10 |
| 63 | Z.222006 | 1 | $\frac{3}{4}$ | 10 |
| 64 | Z.223080 | 220 | $\frac{1}{2}$ | 10 |
| 65 | Z.222216 | 47 | $\frac{3}{4}$ | 10 |
| 66 | Z.222144 | 12 | $\frac{3}{4}$ | 10 |
| 67 A.M. Type | 10W/15173 | 0·68 | 7·5 | 5 |
| 68 | Z.222048 | 2·2 | $\frac{3}{4}$ | 10 |
| 69 | Z.222132 | 10 | $\frac{3}{4}$ | 10 |
| 70 | Z.223123 | 470 | $\frac{3}{4}$ | 10 |
| 71 | Z.223249 | 4700 | $\frac{3}{4}$ | 10 |
| 100 | Z.223037 | 100 | $\frac{1}{4}$ | 10 |
| 101 | Z.223058 | 150 | $\frac{3}{4}$ | 10 |
| 102 | Z.223037 | 100 | $\frac{1}{4}$ | 10 |
| 103 | Z.223058 | 150 | $\frac{3}{4}$ | 10 |
| 104 | Z.223037 | 100 | $\frac{1}{4}$ | 10 |
| 105 | Z.223058 | 150 | $\frac{1}{4}$ | 10 |

**TABLE 3**

**List of valves**

| Circuit Ref. | Type |
|---|---|
| V1—3 | CV. 1136 |
| 4 | CV. 1065 |
| 5, 6 | CV. 1136 |
| 7—9 | CV. 1053 |
| 10 | CV. 1935 |
| 11, 12 | CV. 587 |
| 13 | CV. 1067 |
| 14, 15 | CV. 1092 |

## TABLE 4

### List of miscellaneous components

| Circuit Ref. | Name | Stores | Remarks |
|---|---|---|---|
| VR1 | Resistor, style R.A.D. | Z.271756 | 2·5 megohms |
| VR2 | Resistor, Morgan type H.N.A.R. | 10W/15861 | 2 megohms |
| VR3 | Resistor, Morgan type L.H.N.A.R. | 10W/15096 | 10000 ohms |
| VR4 | Resistor, A.M. Type 4231 | 10W/15222 | 200 ohms Painton type CV2 |
| P1 | Plug, A.M. Type 206 | 10H/426 | |
| J1, J2 | Jack. A.M. Type 1 | 10H/1739 | |
| M/A | Milliammeter | 5Q/87 | 0—1 mA |
| ST1 | Socket, A.M. Type 665 | 10H/19246 | |
| ST2 | Socket | 10H/185 | |
| IFT 1 | Transformer unit | A.P.61439 | |
| 2 | ,, ,, | A.P.61440 | |
| 3 | ,, ,, | A.P.61441 | |
| 4 | ,, ,, | A.P.61442 | |
| IF des 2a | ,, ,, | A.P.61438 | |
| HFC 1 | ChokeHF | 10C/16885 | |
| 2 | ,, ,, | 10C/79 | |
| 3 | ,, ,, | 10C/16885 | |
| 5 | ,, ,, | 10C/13422 | |
| 6, 7 | ,, ,, | 10C/2185 | |
| Amplifier unit | R/F43D | A.P.61436 | |
| LFC1 | Choke, LF | 10C/16887 | |
| Oscillator unit | Des. 7 | A.P.61437 | |
| T1 | Transformer | 10K/16292 | |
| S1 | Switch | 10F/1247 | |
| 2, 3 | ,, | 10F/1248 | |
| HBS1 | Rectifier, metal | 10D/10972 | |



Dmd 6605 456622 2875 12/54 AB539/3 8976

# Chapter 5

# ROUTINE PERFORMANCE CHECKS ON RECEIVER 62H

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS

**Introduction**

**1.** This chapter contains information on the use of the noise generator CT207 for routine performance checks on the receiver 62H. In all the checks given in this chapter access to the internal circuits of the receiver *is not* required. The use of C.N.R.T.E. (Common Naval Radio Test Equipment) for detailed fault finding, in which access to the internal circuits of the receiver *is* usually required, is described in Chap. 6.

**Use of noise generator**

*General*

**2.** The noise generator CT207 offers a simple and reliable method of checking whether or not the performance of both the VHF receiver and its associated resonators, when fitted, has changed. If it was known that the receiving system was in good operational order when the initial results were taken, subsequent noise generator tests can be performed as a quick routine and results compared to check performance.

**3.** Although noise generators cannot measure bandwidth or centre frequency of the IF, the trend of the results obtained over a period of time can be used as a reliable indication of performance and to detect deterioration in the vast majority of cases. Full testing details together with a fault diagnosis table are given in this chapter.

*Performance checks required*

**4.** There are two distinct sets of results to be obtained, namely:—

(1) The noise factor and noise output of the receiver are measured as in para. 16 to 19. These tests should be carried out monthly on all receivers and the results tabulated and processed as detailed later.

(2) The attenuation (i.e. loss) of the resonators associated with each receiver in C.A.W. (Common Aerial Working) is measured as in para. 30 to 32. It is not, however, necessary for these measurements to be made as frequently as the receiver performance checks. Resonator loss is most conveniently obtained by measuring the receiver factor and noise output at a given frequency and then measuring the overall noise factor with the resonator inserted between the noise generator and the receiver.

**5.** The recommended routines are as follows:—

(1) Measure the receiver noise factor and noise output as detailed in para. 16 to 19, record the results and determine the noise gain (see step (12) of para. 19 and specimen tables 6A and 6B at the end of the chapter).

(2) Where C.A.W. is employed, measure the overall system noise factor, i.e. with resonator inserted between the CT207 and the receiver (see para. 30 to 32). Complete tables results (see specimen Tables 6A and 6B).

(3) Repeat step (1) at monthly intervals and at each third month include also step (2), i.e. the receiver measurements are to be made monthly and the resonator measurements quarterly.

*Purpose of checks*

**6.** The object of the tests given in para. 16 to 19 is to check the noisiness of the receiver and its overall gain by measurement and its bandwidth by implication. By carefully recording the test figures obtained, the trend of the receiver performance can be watched and the receiver taken out of service when it has deteriorated beyond the permissible limit or a marked discontinuity in the trend is observed. This will enable *planned maintenance* to become the established routine. Wrong diagnosis is much less likely to occur if the trend of the results is watched (see para. 28 and 29).

**Brief theory of noise factor as applied to a communications receiver**

**7.** A full explanation of the use of noise generators for receiver testing will not be included here. For further information on the noise generator CT207, see B.R.1771(15). Notes on the use of noise generator measurements are given below.

**8.** The measurement of noise factor will indicate whether or not the receiver is generating more internal noise than is normal. If the noise factor is bad (i.e. high) then the receiver is generating excessive internal noise, and very weak signals which would normally be received are lost below the noise level. The reasons for an increased noise factor are discussed in para. 28 and 29.

**9.** The measurement of noise output power on the audio output meter of the CT207 will indicate any change of noise gain. This assumes that the noise factor has remained constant.

**10.** Noise factor can best be understood by considering a practical receiver (and therefore one whose circuits generate some noise themselves) and its effect on signal to noise ratio. To state that such a receiver has a noise factor N means that, owing to the extra noise produced by the receiver, the noise output is increased as if the aerial noise had been multiplied N times (N being a ratio) although the signal is not correspondingly increased. Thus a practical receiver causes a deterioration of signal to noise ratio measured at the output as compared with the signal to noise ratio at the aerial. This deterioration in signal to noise ratio is caused by noise generated throughout the receiver though in practice only the first few stages contribute an important amount. For convenience, this noise, although generated throughout the receiver, is expressed as an *equivalent source* of noise at the input of the receiver and it is this equivalent source which causes the apparent increase of N times the aerial noise. (N, as stated earlier, is the noise factor of the receiver).

**11.** It is convenient to regard the aerial noise as being ordinary thermal noise (see B.R.1771(12) or (15)) and for this purpose the aerial is assumed to be a resistor at room temperature. This thermal noise is known exactly and it provides a fixed standard of reference which is obviously essential as a basis for measurement. It should nevertheless be appreciated that in practice aerials are not simply resistors at room temperature and thus the significance of an increase in noise factor will depend on the actual noise level in the aerial.

**12.** The *equivalent source* of noise mentioned in para. 10 can be considered as separate from the receiver—in other words, the "noisy" receiver can be divided into a noise generator developing N times thermal noise feeding into a receiver which generates no noise itself. Thus by measuring the noise factor of a receiver the power generated by the equivalent noise source feeding the receiver is also measured—it is N times the thermal noise. This is the power input to the receiver. The noise power output of the receiver can be measured by an audio power meter and since the ratio of these two powers —the output power divided by the input power—gives the gain of the receiver:—

$$\text{Gain} = \frac{\textit{Noise output power as measured}}{\text{N times thermal noise}}$$

**13.** Now thermal noise is a constant for any given type of receiver (provided the bandwidth is approximately correct). Hence for any given type of receiver the ratio $\frac{\textit{Noise output power}}{\text{N}}$ is a measure of the gain and changes in the value of this ratio can be used to detect changes in gain. The ratio is called the noise gain and if both the noise output power and the noise factor N are expressed in decibels:—

Noise gain (dB) = Noise output (dB)—Noise factor (dB)

Thus a record of noise factor and noise gain will enable any changes in the receiver performance to be checked. It will be seen for example that if the noise factor is bad and the noise output normal the gain of the receiver must be low.

**14.** In general noise factor can be read to an accuracy of about $\pm\frac{1}{2}$ dB and noise output to about $\pm\frac{1}{4}$ dB. Variations in conditions under which the measurements are made can cause further experimental errors so that variations in noise factor of less than $\pm 1$ dB and in noise gain of less than $\pm 2$ dB are more probably experimental errors than receiver variations. Variations of this order will probably "smooth out" over several readings. Inspection of readings over a period of time will show any obvious downward trend of results. This idea of watching the trend in readings over a period—so common in other branches of engineering—demonstrates the importance of recording the actual readings obtained rather than just marking the test as satisfactory on test sheets.

**15.** In para. 13 it was shown that to obtain the noise gain of a receiver the noise factor (dB) was subtracted from the noise output power (dB). To make this clear two examples are given below.

*Example A*
Noise factor 15 dB

*Example A (contd.)*
Noise output 1 dB
Noise gain = Noise output (dB) — Noise factor (dB)
= 1 dB—15 dB = —14 dB

The negative sign need not cause any confusion since the noise gain is only a relative figure and applies only to the particular type of receiver, i.e. in this case 62H.

*Example B*
Noise factor 20 dB
Noise output 1 dB
Noise gain = 1dB—20dB = —19dB

The gain of this receiver therefore is 5dB (i.e. the difference between —14dB and —19dB) worse than the receiver quoted in Example A.

**Measurement of noise factor, noise output, and noise gain**

*Apparatus required*

**16.** The test rig for the measurements is shown in fig. 1, the following test apparatus being required:—

(1) Noise generator CT207, Admiralty Pattern 63451.

(2) Audio lead, Admiralty Pattern W1034, 5438 or 7149.

(3) R.F. lead, Admiralty Pattern 63909.

(4) R.F. adaptor lead, Admiralty Pattern 63908 or a longer version of this lead which will be supplied later.

(5) Selected test crystals, three in number. (These should be carefully kept for all test purposes).

One in frequency range
7500 to 7800 (7520) kc/s.
6250 to 6750 (6500) kc/s.
5100 to 5800 (5720) kc/s.

The frequency in the bracket is, in each case, the best crystal frequency to use if available.

(6) Avometer (to measure mains voltage).

(7) Receiver to be tested. This must be switched on and set to an operational condition for at least 4 hours before making the test.

**Note . . .**
*Leads Admiralty Pattern* 7149 *and the R.F. lead in* (4) *above are for use if the alternative leads specified are too short.*

*Preliminary settings of controls*

**17.** The settings of the noise generator controls and the connections to be made to the instrument are as follows:—

(1) Set the VOLTAGE SELECTOR to suit the mains voltage.

(2) Set the AUDIO POWER switch to 5mW.

(3) Turn the SET DIODE CURRENT control fully counterclockwise, i.e. to minimum.

(4) Set the DIODE CURRENT selector switch initially to +4dB. (This will measure noise factors in the range up to 15dB and normally the 62H will lie in this band). If the noise factor lies in the range 15 to 20dB it will be necessary to set the DIODE CURRENT selector switch to the +10dB position.

(5) Connect lead Admiralty Pattern 63909 to the noise generator.

(6) Connect the adaptor lead Admiralty Pattern 63908 (see Note at end of para. 16) to lead Admiralty Pattern 63909.

(7) Connect the other end of the adaptor lead Admiralty Pattern 63908 to the aerial socket of the receiver.

(8) Connect the audio lead Admiralty Pattern W1034 or 5438 (see Note at end of para. 16) to the AUDIO POWER INPUT 600Ω socket of the noise generator and the other end to the LINE (*not* MONITOR) socket of the 62H receiver.

(9) Switch on the noise generator 5 minutes before taking readings.

**18.** The following settings should be made to the receiver 62H controls:—

(1) Insert the appropriate crystal in the receiver.

(2) Set the R.F. GAIN control to maximum (fully clockwise).

(3) Set the L.F. GAIN control to maximum (fully clockwise).

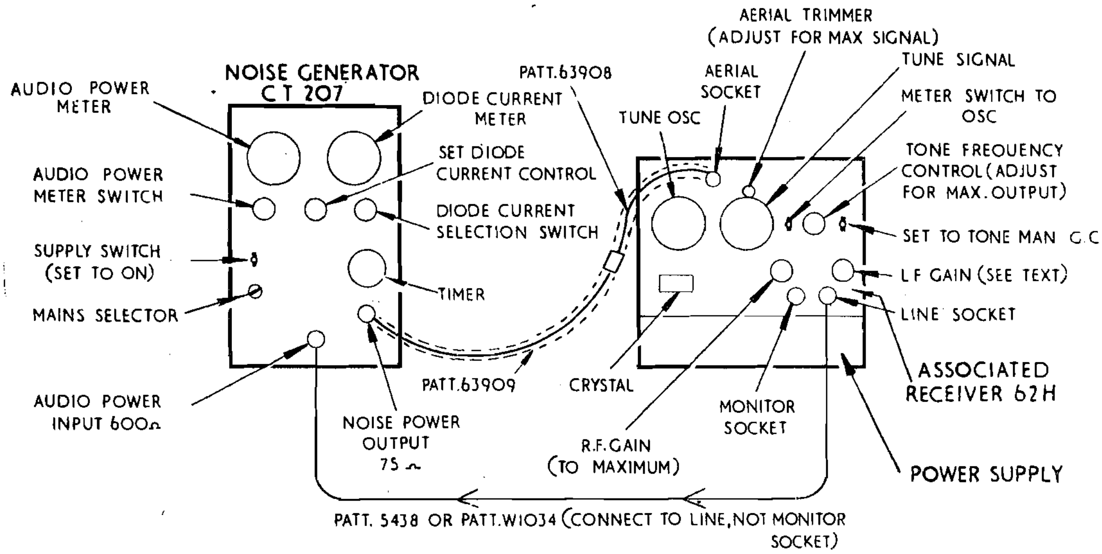



**Fig. 1. Test rig for noise factor and noise output**

(4) Set the A.G.C. switch to TONE MAN. G.C. (i.e. B.F.O. operating).

(5) Set the TONE FREQUENCY CONTROL so that its pointer is vertical. (This control will be adjusted for maximum noise output later).

(6) Set the METER SWITCH to OSC.

**Note . . .**
*Remember that the receiver must be switched on and set to an operational condition for* at least 4 hours *before any measurements are taken. (The reason for this is to enable the receiver to attain a stable temperature).*

*Measurement procedure*

**19.** (1) Insert the selected crystal at the low frequency end (e.g. 5720 kc/s) and adjust the TUNE OSC. control for maximum dip on the receiver meter. Record the oscillator dip, i.e. crystal current dip as in the specimen Table 6. Check that the frequency shown on the TUNE OSC. dial is approximately correct (in the example shown 112 Mc/s) to ensure that the oscillator and its multipliers are set to the correct frequencies.

**Note . . .**
*It is important that any considerable difference between the expected* TUNE OSC. *frequency and that actually shown on the dial should be investigated since in this particular type of receiver it is possible, by tuning the* TUNE OSC. *control to a very wrong frequency, to select the wrong multiplication ratio. However, provided the frequency shown on the dial and that to be expected with the particular crystal in use agree to within a few Mc/s, incorrect harmonics cannot be obtained.*

(2) Set the noise generator TIMER to 8 minutes and inject noise from the noise generator into the receiver. As a guide, the SET DIODE CURRENT control should be advanced in a clockwise direction until the diode is passing a current of between 10 and 15mA. It will be found that the injection of noise greatly facilitates tuning the receiver.

(3) Adjust the TUNE SIGNAL control to the same frequency as the TUNE OSC. control and then tune it slowly either side for maximum noise output (it may be necessary to reduce temporarily the audio, i.e. L.F. GAIN, control of the receiver). *Very careful* adjustment of the TUNE SIGNAL control is necessary.

(4) Very carefully adjust the aerial trimmer control—this is marked ADJUST FOR MAX. SIGNAL—for maximum noise output power. This adjustment is critical and even a slight misadjustment can cause an apparently serious deterioration in noise factor.

(5) Check that the TUNE OSC. and TUNE SIGNAL controls are at their best adjustment for maximum noise output and re-check the adjustment of the aerial trimmer.

(6) Switch the DIODE CURRENT selector switch on the noise generator to OFF, turn the SET DIODE CURRENT control fully counterclockwise, turn the receiver L.F. GAIN control to maximum, and check that, with the exception of the DIODE CURRENT selector switch, all controls on the receiver and noise generator are set as given in Fig. 1 and para. 17 and 18.

(7) On the receiver adjust the TONE FREQUENCY CONTROL for maximum noise output. If the AUDIO POWER METER on the noise generator reads full scale it may be necessary to advance the AUDIO POWER switch on the noise generator to 50mW (i.e. +10dB); in this instance 10dB must be added to all readings on the dB scale.

(8) Record the reading of the noise generator AUDIO POWER METER in decibels in the column marked Noise Output dB (see specimen Table 6). It is better to use the decibel scale rather than the milliwatt scale since the use of decibels simplifies calculation.

(9) Adjust the receiver L.F. GAIN control to bring the noise generator AUDIO POWER METER reading to a convenient level (say a whole number at about half full scale). The AUDIO POWER switch should, if possible, be set to the 5mW (i.e. +0dB) position.

(10) Switch the DIODE CURRENT selector switch to the +4dB position (see step (4) of paragraph 17) and advance the SET DIODE CURRENT control clockwise until the noise output (i.e. the reading on the AUDIO POWER METER) has increased by 3dB (the original power in mW has been doubled).

(11) On the DIODE CURRENT METER note the reading for noise factor in dB by reading the noise factor scale and adding the appropriate number of dB shown on the DIODE CURRENT selector switch.

(12) Subtract the noise factor in dB (i.e. the reading obtained in the previous step) from the noise output in dB (i.e. the reading obtained in step (8)) to obtain the noise gain of the receiver. This figure should be inserted in the appropriate position in the table provided (see examples in Tables 6A and 6B).

**Note . . .**
*The above completes the noise generator measurements on the receiver at the chosen frequency. If the resonator loss* is not *being checked change the crystal in the receiver and repeat the whole of the paragraph for the other frequencies. The check should be carried out at the bottom, middle and top of the frequency range and the table of noise generator readings completed. If the resonator loss* is *being measured it will be found more convenient to make this measurement (see para.* 30 *to* 32) *before changing the crystal. Then change the crystal and repeat the whole procedure for the other frequencies. The time taken for a complete noise generator test of a 62H receiver and resonator at one frequency is from* 5 *to* 15 *minutes.*

*Example on the measurement procedure*

**20.** Assume that in step (7) of the previous paragraph a reading of —2dB is obtained on the AUDIO POWER METER with the AUDIO POWER switch set to the 50mW (i.e. +10dB) range. Then (since the +10dB range on the noise generator is being used) the noise output of the receiver is given by 10dB+(—2dB) i.e. 8dB and this figure is recorded in the appropriate column (see specimen Table 6). The L.F. GAIN control on the receiver is now reduced (see step (9) of paragraph 19) to bring the AUDIO POWER METER reading to a suitable level. Since it is preferable, if possible, to use the 5mW (i.e. +0dB) position of the AUDIO POWER switch for the subsequent measurements, adjust the L.G. GAIN control on the receiver so that, in this position of the switch, the AUDIO POWER METER reads, say, 0dB (1mW on the upper scale). Switch the DIODE CURRENT selector switch to the +4dB position and advance the SET DIODE CURRENT control clockwise until the reading on the AUDIO POWER METER has increased by 3dB, i.e. in this example until the reading is +3dB (2mW on the upper scale). Observe the reading in dB on the DIODE CURRENT METER. Assume in this example that this is 10dB. Then, since the DIODE CURRENT selector switch is on the +4dB range, the noise factor of the receiver is given by 4dB +10dB, i.e. 14dB. Record this figure in the appropriate column.

Finally, since the noise output is 8dB and the noise factor is 14dB, the noise gain is —6dB (i.e. 8dB —14dB) and this figure should also be recorded in the appropriate column.

**Readings obtained from noise generator measurements**

*Variation of readings*

**21.** Variations of mains supply voltage will not cause any errors in the readings of the CT207 noise generator. However, variations in the supply voltage will affect the receiver noise factor slightly and the noise output (and hence noise gain) appreciably as indicated in the following table:—

| Mains voltage variation | Noise factor change | Noise gain change |
|---|---|---|
| —10% | +1 dB (i.e. 1 dB worse) | —2.5 dB |
| +10% | —1 dB (i.e. 1 dB better) | +2·5 dB |

It is therefore advisable to note the mains voltage throughout the test and to avoid doing tests when large mains voltage variations exist. (For variations of readings due to faults see para. 28 and 29).

**22.** In the absence of a fault the noise gain of any given 62H receiver should remain constant or show a slow steady deterioration during the life of the receiver. In paragraphs 25 and 26 some typical and specification figures are given, but it must be remembered that the possible variation between receivers is often greater than the variation in a receiver's performance due to the development of a fault. For this reason it is essential to record all test figures and watch the trend of the results. Any sudden deterioration or discontinuity in the trend of results merits investigation, even though the latest results recorded remain above the reject levels. A significant change, having regard to the possibility of experimental error, is one of more than 2dB.

**23.** Noise gain figures quoted in this chapter apply only to receivers 62H measured with the noise generator CT207. Comparisons between different types of receivers on the basis of their respective noise gain figures are invalid. Note that the noise gain figure obtained for a receiver 62H is usually of negative sign. This should not lead to confusion; a receiver with, say, a noise gain of —8dB is 2dB down in gain on a similar type of receiver with a noise gain of —6dB. Any change in noise factor is allowed for in noise gain. If for example a receiver normally had a noise factor of 14dB and a noise output of +8·0dB, then the noise gain would be —6·0dB (i.e. +8dB —14dB). Suppose the gain of the first RF valve were to suddenly fall the result would be an increase in noise factor with possibly a slight drop in noise output; the noise factor might become 17dB and the noise output drop by 1dB to +7·0dB. The noise gain would then be +7·0dB —17dB, i.e. —10·0dB. This would indicate that the gain of the receiver had in fact fallen more than was indicated by the change in noise output.

**24.** Following on from the example at the end of the previous paragraph it is also important to realise that even if two receivers have identical noise output they do not necessarily have the same gain. The two examples below make this clear.

*Receiver No.* 1
Noise factor 18·5dB    Noise output +0·5dB
Noise gain=(+0·5—18·5) dB= —18dB

*Receiver No.* 2
Noise factor 13·0dB    Noise output +0·5dB
Noise gain=(+0·5 —13·0) dB= —12.5dB

If two receivers have normal gain but one has a good noise factor and the other a bad noise factor the latter receiver will give greater noise output; hence noise output alone cannot be used as a measure of receiver gain.

*Typical readings*

**25.** Typical readings taken on a new 62H Receiver are given in Table 1. It will be noted that a correctly aligned receiver with a good OSC. (i.e. crystal) current dip gives consistent results over the whole band. (See para. 28 and 29 for wide variations).

**TABLE 1**

| Col. 1 | Col. 2 | | Col. 3 | Col. 4 | Col. 5 |
|---|---|---|---|---|---|
| Crystal frequency kc/s | Osc. Current dip mA From | To | Noise output dB | Noise factor dB | Noise gain (Col. 3—Col. 4) dB |
| 5450 | 0·65 | 0·35 | +8·0 | 14·0 | —6·0 |
| 6300 | 0·65 | 0·35 | +8·0 | 14·0 | —6·0 |
| 7490 | 0·65 | 0·35 | +8·0 | 14·0 | —6·0 |

**Note . . .**
*Noise output on new receivers may lie between 0dB and +10dB. Noise factor on new receivers may lie between 12dB and 15dB.*

*Specification figures*

**26.** Table 2 gives the equivalent noise generator results for a receiver just up to its specification for signal to noise ratio and gain. The noise factor corresponding to the specification signal to noise ratio of 20dB for an input signal of 20μV modulated at 1,000c/s 30% can be given, but since the gain of the receiver is the other specified quantity it will be noticed that the noise output column has been left blank. It should be realised that if the receiver has a gain just equal to its specification, the actual noise output will depend upon the noise factor.

**TABLE 2**

| Col. 1 | Col. 2 | Col. 3 | Col. 4 | Col. 5 |
|---|---|---|---|---|
| Crystal frequency | Osc. current dip mA | Noise output dB | Noise factor dB | Noise gain dB |
| Any crystal to give signal frequency 100 to 150 Mc/s | Not less than 0·2mA change | See note below | 17·5 | —17·5 |

**Note . . .**
*This means that if a receiver had a noise factor of 17·5dB the noise output for specification conditions would be 0·0dB (i.e. 1mW).*

*Reject figures*

**27.** Table 3 gives the figures for noise factor and noise gain below which a receiver should not be allowed to fall. In general when a receiver has deteriorated to its specification condition in Table 2 more detailed tests should be employed to restore the lost performance. If time is not available, however it is permissible to allow the receiver performance to deteriorate to the figures given in Table 3. It must be emphasised, however, that if a more detailed test shows a serious off-setting of the centre frequency of the IF from 9·72 Mc/s further measurements should be made (see Chap. 4). If it is *proved* that realignment is necessary, the instructions in Chap. 4 may be carried out as an emergency measure only, the set being made a Dockyard Defect item as soon as convenient. Provided the CT218 (the recommended instrument) is used, no trouble should be experienced due to leakage from the signal generator.

**TABLE 3**

| Col. 1 | Col. 2 | Col. 3 | Col. 4 | Col. 5 |
|---|---|---|---|---|
| Crystal frequency | Osc. current dip mA | Noise output dB | Noise factor dB | Noise gain dB |
| As in Table 2 | Minimum dip 0·2 | When less than —5 reject for low gain | 19·0 | —24·0 |

**Note . . .** *Receivers should not normally be allowed to fall to the low level indicated in the above table.*

**Fault diagnosis**

*General indications*

**28.** When a fault occurs its location may often be traced by noise generator tests. Whilst it is not possible to include here every type of fault, an effort has been made to tabulate those which are most likely to occur. The following important points should be noted:—

(1) A worsening, i.e. increase, in noise factor is due to a fault in either of the first two RF valves or their associated circuits. A big increase usually indicates that the first RF valve or its circuit is faulty. Changes in audio and IF gain do not affect the noise factor. Noise factor can be affected by the BFO circuit being off frequency or a failure of the BFO valve since this will alter the point on the second detector curve at which the noise factor is normally measured.

(2) A change in noise gain without a change of noise factor almost certainly indicates an IF or AF loss of gain.

(3) A poor crystal or oscillator, giving a small dip in oscillator current, will normally decrease the noise gain but not affect the noise factor. It is for this reason that the OSC. current dip is recorded (see specimen Tables 6A and 6B).

(4) In most receivers the exact centre of the intermediate frequency is not of vital importance; in the 62H type of receiver, however, the correctness of the centre of the intermediate frequency *is* important since both the receiver local oscillator and the transmitter associated with the receiver are crystal controlled. The noise generator test cannot measure either the IF bandwidth or its centre frequency but practical work has shown that, provided these were correct on installation, any change will be apparent by a change of noise gain. Nevertheless an occasional check of the centre frequency and the bandwidth should be made (see Chap. 6).

(5) Variations in mains voltage will affect both noise factor and noise gain (see para. 21).

*Fault diagnosis table*

**29.** The possible faults which may be responsible for variations in noise factor are given in the first part of Table 4 below. The second part of the table lists faults which may be responsible for variations in noise gain.

**TABLE 4**
**Noise factor faults**

| Symptom | | Fault | Remedy or check |
|---|---|---|---|
| Poor noise factor over whole band | A. | Bad contact in RF valves | Check overall gain. Clean valve pins. Check valve holder contacts. |
| | B. | RF valves failing | Check valves for emission on CT160. |
| | C. | Low RF gain | Check components in RF circuit. |
| | D. | Poor crystals used, i.e. low activity | Check that a dip in the current meter when set to OSC. is not less than 0·2mA as the TUNE OSC. dial is rotated through the tuned position. |
| Poor noise factor over part of band usually at one end. | E. | Poor activity crystal. See D above | |
| | F. | Misalignment of RF stages | Refer to chapter 4 and check overall sensitivity at each end of band. |

TABLE 4—*continued*

| Symptom | | Fault | Remedy or check |
|---|---|---|---|
| | G. | Aerial trimmer maladjusted | Repeat measurement adjusting the trimmer carefully for maximum noise output with the noise generator on. |
| Excessively low noise factor is obtained, e.g. 1 to 8 dB | H. | Open circuited 75 ohm terminating resistor in CT207. (Refer to Instrument Handbook B.R.1771(15)) | Repair CT207 (As a check on this fault an RF lead of different length may be used to connect the CT207 to the receiver. If this fault is present a different noise factor will be obtained). |
| Noise factor not obtainable owing to no increase in receiver output noise when noise input is increased | J. | Incorrect tuning | Repeat steps (3), (4) and (5) of para. 19. |
| | K. | Open circuited RF lead from CT207 to receiver | Check lead for continuity. |
| | L. | Aerial input lead of receiver disconnected | Visual inspection. |
| | M. | Very poor noise factor, i.e. greater than 22 dB | See checks under poor noise factor. |
| | | **Noise gain faults** | |
| Noise gain low over whole band | A. | Mains voltage or HT supply voltage low | Measure with avometer. |
| | B. | Loss of gain in receiver | Check AF, IF, and overall sensitivity as described in Chap. 6. |
| | C. | Change of bandwidth | Dockyard defect. |
| | D. | BFO not operating properly | Refer to Chap. 4. |
| | E. | Low oscillator drive | If dip in tuning meter is less than 0·2mA change oscillator valve or crystal. |
| Noise gain low at one frequency or over part of tuning range. Noise factor normal. | F. | Bad oscillator multiplier tracking | Check osc. current dip. Apply more detailed tests as in Chap. 4. |
| | G. | Bad crystal giving poor dip in current | Replace crystal. |
| Noise gain low over whole band. Noise factor bad | H. | First or second RF stage gain low | Check valve pins, components, and valves of 1st and 2nd RF stages. |
| | J. | Aerial trimmer not peaking properly | Check visually for correct working of trimmer. |
| Noise gain higher than usual | K. | Mains voltage and HT supply high | Measure voltage using avometer. |
| Noise gain higher than usual. Noise factor excessively low | L. | Open circuited 75 ohm terminating resistor in in CT207. (Refer to Instrument Handbook B.R.1771(15)) | Repair CT207. (As a check on this fault an RF lead of different length may be used to connect the CT207 to the receiver. If this fault is present a different noise factor will be obtained). |

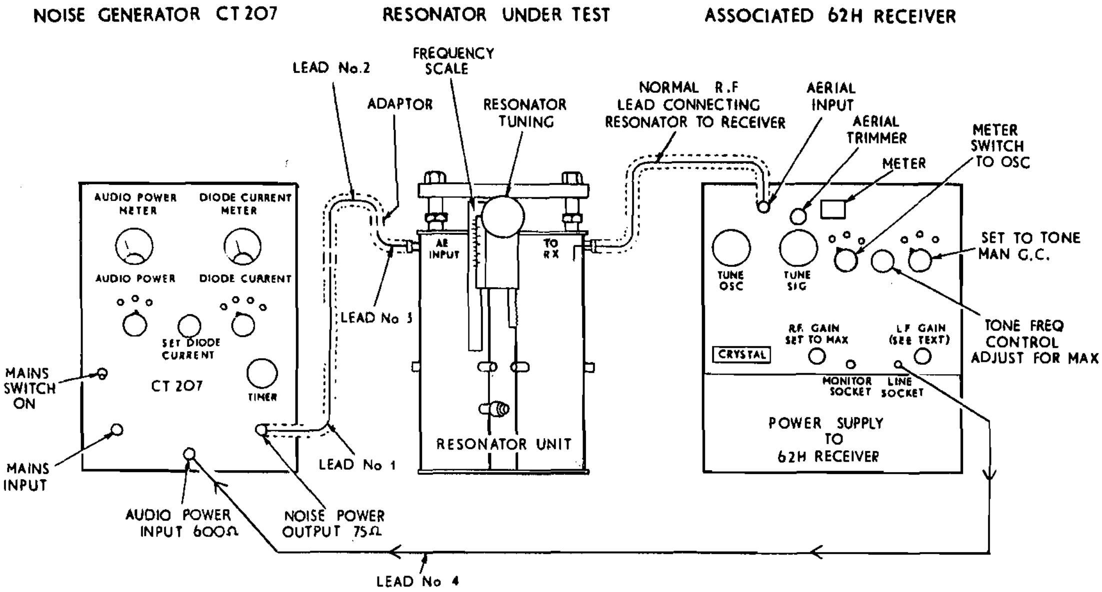
**Measurement of resonator attenuation**

*Preliminary setting-up*

**30.** As recommended in para. 5, the resonator loss should be checked every three months. This is best done at the same time as the measurement of receiver noise factor and noise output. Assuming then that the noise factor and noise output have been measured at a given frequency, the receiver controls and settings should be left as at the end of step (12) of para. 19. The following connections should be made (see fig. 2):—

(1) Disconnect the noise generator RF output lead from the aerial input socket of the receiver and reconnect the RF lead from the resonator to this aerial socket, i.e. as in normal operation.

(2) Disconnect, at the junction box end, the RF lead from the junction box to the resonator input. Connect the now free end of the lead via connector 10H/276 (which will later be supplied with the CT207) to the free end of the noise generator RF lead (A.P.63908 or the longer lead if required).




LEAD No 1 RF LEAD A.P.63909 SUPPLIED WITH CT207
LEAD No 2 RF LEAD A.P.63908 " " CT207 (IN SOME CLASSES OF SHIP THIS LEAD IS OF INSUFFICIENT LENGTH AND A LONGER LEAD IS BEING SUPPLIED)
LEAD No 3 RF LEAD FITTED BETWEEN RESONATOR AND JUNCTION BOX IN CAW SYSTEMS
LEAD No 4 AUDIO LEAD A.P W1034 OR A P 5438 (IT IS PERMISSIBLE TO LENGTHEN THIS LEAD IF NECESSARY OWING TO OFFICE LAYOUT i.e USE LEAD A.P 7149)
ADAPTOR 10H/276 THIS WILL BE PROVISIONED FOR USE WITH THE CT207

**Fig. 2. Test rig for measurement of resonator attenuation**

*Measurement procedure*

**31.** (1) Set the DIODE CURRENT switch on the CT207 to the +10dB (i.e. 100mA) position and adjust the SET DIODE CURRENT control to give a reading of approximately 50mA (18·5dB).

(2) Set the noise generator TIMER to 8 minutes. Turn the L.F. GAIN control on the 62H receiver to maximum (fully clockwise) and set the AUDIO POWER switch on the CT207 to give a convenient deflection on the AUDIO POWER METER.

(3) Adjust the resonator tuning control so that the frequency shown on the

frequency scale corresponds approximately to the TUNE SIGNAL and TUNE OSC. dials on the 62H receiver.

(4) *Carefully* tune the resonator to obtain a noise power maximum as shown on the AUDIO POWER METER of the CT207. Tune the resonator through the peak in both directions. Owing to possible backlash in the resonator tuning mechanism the value of the peak may differ in the two cases. The final setting should be made in the direction which gives the maximum rise. **Great care is needed in tuning as the whole accuracy of the measurement depends on the exact setting of this maximum.**

**Note . . .**
*If no rise can be obtained the* SET DIODE CURRENT *control may be adjusted to give a reading of* 100*mA and step* (4) *repeated.* (*The diode current must not be left at* 100*mA for any period of time as overheating will result*). *If it is still not possible to obtain a rise in noise power either the resonator attenuation is excessive or there is an open circuit in the lead between the connector* 10*H*/276 *and the resonator* (*i.e. the lead which normally connects junction box and resonator*). *To check whether this lead is faulty disconnect it at both ends and connect the lead from the noise generator directly to the resonator. Repeat step* (4). *If a peak can be obtained the fault lies in the lead previously referred to whereas if a peak is still not obtainable the resonator is faulty and should be taken out of service.*

(5) *Very carefully* readjust the TUNE SIGNAL, TUNE OSC., aerial trimmer (marked ADJUST FOR MAX. SIGNAL), and TONE FREQUENCY CONTROL on the 62H receiver to give maximum noise output on the AUDIO POWER METER of the CT207. Turn the DIODE CURRENT switch on the CT207 to the OFF position.

(6) Adjust the L.F. GAIN control on the 62H receiver to bring the reading on the AUDIO POWER METER of the CT207 to 0dB. It may be necessary to set the AUDIO POWER switch to a lower range to do this.

(7) Turn the SET DIODE CURRENT control fully counterclockwise. Set the DIODE CURRENT switch to the +10dB (i.e. 100mA) position and advance the SET DIODE CURRENT control until the noise output has increased by 3dB (i.e. the AUDIO POWER METER reads 3dB).

**Note . . .**
*If it is not possible to obtain a 3dB rise in noise output the alternative measurement procedure described in para.* 32 *must be employed.*

(8) On the DIODE CURRENT METER note the reading for noise factor in dB by reading the noise factor scale and adding 10. The result is the overall noise factor of the 62H receiver combined with the resonator. (In other words, the measurement given in this para. 31 is a measurement of the receiver noise factor via the resonator).

(9) Subtract the noise factor of the 62H receiver alone from the overall noise factor obtained in step (8) above in order to obtain the resonator attenuation. For example if the overall noise factor were 20·5dB and the noise factor of the 62H receiver alone (i.e. the figure obtained in step (11) of para. 19) were 14dB then the resonator attenuation would be (20·5—14) dB, that is 6·5dB.

(10) Disconnect the resonator, re-connect the noise generator as in fig. 1, and, at the next frequency required, carry through first the procedure given in para. 19 for the measurement of noise factor and noise gain and then the procedure given above for the measurement of resonator attenuation. Enter the figures obtained in the table (see specimen Table 6A).

*Alternative procedure using Abac*

**32.** As mentioned in the note after step (7) of the previous paragraph it may not always be possible to obtain the required 3dB increase in noise output. This breakdown of the method is likely to occur when the receiver noise factor is bad and/or the resonator attenuation high. The following alternative procedure, which involves the use of an abac (fig. 3), must then be used.

(1) If in step (7) of the procedure given in the previous paragraph the 3dB rise cannot be obtained (it is assumed that the procedure has been carried through to this stage) advance, instead, the SET DIODE CURRENT control until the DIODE CURRENT METER reads exactly 100mA.

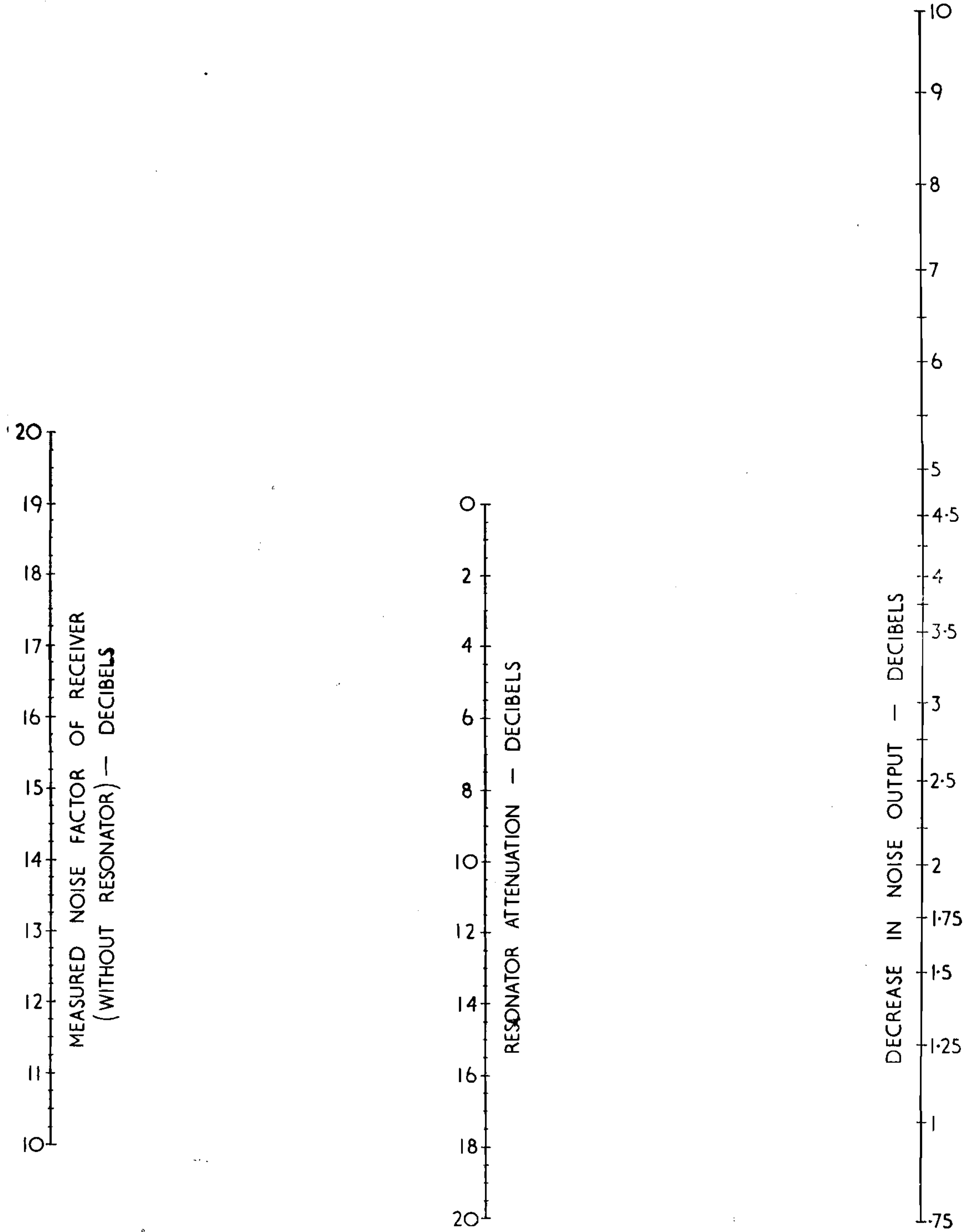



Fig. 3. Abac for estimation of resonator loss

(2) Readjust the L.F. GAIN control on the 62H receiver so that the largest whole figure—if possible the 6dB mark—is indicated on the dB scale of the CT207 AUDIO POWER METER. It may be necessary to set the AUDIO POWER switch to a lower range to achieve this.

(3) Turn the DIODE CURRENT switch on the CT207 to the OFF position and note the decrease in the dB reading on the AUDIO POWER METER dial. Enter this figure (i.e. the difference between the two AUDIO POWER METER readings) in the table (see specimen Table 6B).

(4) Let N be the noise factor of the 62H receiver (that is, the figure obtained in step (11) of paragraph 19) and D the decrease in noise output noted in step (3) above, both quantities being expressed in dB. On the abac (fig. 3) set a ruler or straight edge to pass through a point corresponding to figure N in the first column and a point corresponding to figure D in the third column. The straight edge will then pass through a point in column 2 which gives the insertion loss of the resonator in dB; that is, the resonator attenuation.

*Example*

Noise factor of 62H receiver=14dB.
Decrease in noise output=2dB.
Hence, by using abac, attenuation of resonator=10dB.

**Resonator attenuation readings**

**33.** Table 5 gives the typical figure to be expected from a double resonator and also the specification and rejection figures. Since however the resonators are used in conjunction with a particular 62H receiver, reference should be made to paragraph **34** for the overall rejection figure. This is necessary since a receiver with a good (low) noise factor of say 12 or 14dB can work with a poor resonator having the rejection figure of 8dB as its loss. If, however, the receiver is at its rejection figure of 19·0dB for noise factor the resonator loss should not be allowed to fall to the rejection figure of 8dB.

**TABLE 5**

| Double resonator A.P.65767A or A.P.53293 | Attenuation | | |
|---|---|---|---|
| | Typical | Specification | Rejection |
| The junction box of the common aerial working unit should not be included in circuit for these tests. | 3 to 5 dB | 7 dB | 8 dB |

**Overall performance figure**

*Rejection figure for receiver and resonator*

**34.** Though the rejection figure for the noise factor of a receiver is 19·0dB and the rejection figure for the resonator attenuation is 8dB, both items being considered separately, it is *not* permissible to operate the combination with both items at their rejection figures. The overall condition beyond which a resonator and receiver combination should not be allowed to fall is as follows:—

Receiver noise factor (in dB)+Resonator attenuation (in dB) must never be more than 24dB.

*Results for a typical receiver and resonator combination*

**35.** Table 6A gives a set of results for a typical receiver, resonator combination and would be considered to be satisfactory. The following notes are important in the interpretation of results.

(1) In this receiver and resonator unit it will be seen that when measuring resonator attenuation the method given in para. 31, i.e. the measurement of the noise factor via the resonator, has been used. Column 8 is therefore not used.

(2) The figures in columns 4 and 5 are measured on the receiver as described in para. 19. The figure in column 6 is obtained by subtracting the figure in column 5 from that in column 4. For 62H receivers the result will nearly always be a negative quantity.

(3) The significant figures for the receiver performance are those entered in columns 5 and 6.

(4) The figure for resonator attenuation in column 9 is obtained by subtracting the figure in column 5 from that in column 7.

(5) The overall performance figure in column 10 is obtained by adding the figure in column 5 to that in column 9.

*Results for a receiver and resonator combination of just acceptable performance*

**36.** Table 6B gives a set of results for a receiver and resonator unit which, though somewhat worse than normal, is of just acceptable performance. In this case it will be noted that it is column 7 which is left blank because, with these lower values of performance, the alternative method of measuring resonator attenuation given in para. 32 must be used. The remarks in (2) and (3) of the previous paragraph also apply to Table 6B. The figure for column 9 is obtained by using the abac (fig. 3) as detailed in para. 32. As before the overall performance figure in column 10 is obtained by adding the figure in column 5 to that in column 9.

*General information*

**37.** The noise generator tests on the receiver only, i.e. columns 1, 2, 3, 4, 5 and 6 in Table 6, will normally be performed more frequently than the whole operation involving the resonator attenuation. For this reason columns 7, 8, 9 and 10 will often be left blank. As stated at the beginning of the chapter it is recommended that the receiver tests be performed monthly and the combined receiver and resonator test be performed quarterly. These noise generator tests will indicate any deterioration in overall performance.

**38.** If it is found that the noise generator results are satisfactory but that the receiver and resonator do not appear to be operationally up to standard it is recommended that, if possible, the exact centre frequency and bandwidth of the IF amplifier be established as described in the next chapter. This check will only be possible on certain classes of ship which hold the necessary test equipment. Realignment of the receiver should only be undertaken as an emergency measure, the receiver being returned for Dockyard repair at the earliest opportunity.

## TABLE 6A

| Receiver 62H | | | | | | Resonator A.P.65767A or 53293 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Col. 1 | Col. 2 | Col. 3 | Col. 4 | Col. 5 | Col. 6 | Col. 7 | Col. 8 | Col. 9 | Col. 10 |
| | | | Receiver tests Paragraph 16, 17, 18 and 19 | | | Resonator tests Paragraphs 30, 31 and 32 | | | |
| Date | Crystal Frequency kc/s | Osc. current dip mA | Noise output dB | Noise factor dB | Noise gain dB | Noise factor via resonator dB | Noise output drop dB | Resonator attenuation dB | Overall performance test receiver noise factor + Resonator attenuation dB |
| 8/2/57 | 5450 | 0·6 to 0·3 | +6·5 | 13·0 | —6·5 | 18·0 | — | 5·0 | 18·0 |
| 8/2/57 | 6300 | 0·6 to 0·3 | +7·5 | 12·7 | —5·2 | 17·8 | — | 5·1 | 17·8 |
| 8/2/57 | 7490 | 0·6 to 0·3 | +5·2 | 12·8 | —7·6 | 18·0 | — | 5·2 | 18·0 |

## TABLE 6B

| Receiver 62H | | | | | | Resonator A.P.65767A or 53293 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Col. 1 | Col. 2 | Col. 3 | Col. 4 | Col. 5 | Col. 6 | Col. 7 | Col. 8 | Col. 9 | Col. 10 |
| | | | Receiver tests Paragraph 16, 17, 18 and 19 | | | Resonator tests Paragraphs 30, 31 and 32 | | | |
| Date | Crystal Frequency kc/s | Osc. current dip mA | Noise output dB | Noise factor dB | Noise gain dB | Noise factor via resonator dB | Noise output drop dB | Resonator attenuation dB | Overall performance test receiver noise factor + Resonator attenuation dB |
| 8/2/57 | 5450 | 0·7 to 0·5 | +2·0 | 16·0 | —14·0 | — | 2·4 | 7·0 | 23·0 |
| 8/2/57 | 6300 | 0·7 to 0·5 | +2·5 | 17·0 | —14·5 | — | 2·0 | 7·0 | 24·0 |
| 8/2/57 | 7490 | 0·6 to 0·4 | +1·5 | 15·5 | —14·0 | — | 2·8 | 6·6 | 22·1 |



Dmd 7596 245334 3250 3/58 AB539/3 1689

# Chapter 6

# DETAILED FAULT FINDING ON RECEIVER 62H USING C.N.R.T.E.

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS

### General

**1.** Detailed tests will normally be required when the noise generator tests described in Chapter 5 indicate either that a fault has developed or that the receiver has deteriorated beyond its "reject level" of performance. In either case access to the receiver circuits will be required, and the following paragraphs detail the procedure for using C.N.R.T.E. and the test figures to be expected.

**2.** It is recommended that detailed fault tracing should be accomplished in the following order:—

(1) Test of overall IF sensitivity and measurement of IF bandwidth and centre frequency. This will determine whether the fault lies in a pre-IF stage or in the IF and AF stages. If the fault lies in the IF or AF stages proceed to (2), but if the fault lies in a pre-IF stage proceed to (4).

(2) Test of overall AF sensitivity. If this is satisfactory proceed to (3).

(3) Test of individual IF stages by measurement of IF sensitivity and individual IF stage gains.

(4) Test of overall RF gain.

### Trend of results

**3.** Generally, the trend of the results of previous routine noise generator tests will give a clue to the location of the fault, e.g. see fault diagnosis table, Chapter 5, para. 29.

### Test rigs and instruments

**4.** In the following paragraphs, detailed test rigs are included for IF bandwidth and centre frequency, AF sensitivity, IF sensitivity, RF sensitivity, and Tables giving typical input and output voltages or powers are included. Individual receivers vary widely, however, and the figures given are an average set of figures for a normal receiver. The type of test instrument used will depend upon the part of the circuit under test and also on the class of ship. Sufficient information is included for all relevant C.N.R.T.E. instruments but the actual instrument used will depend upon the test outfit allowed to the particular ship.

**5.** The test rigs given should be closely followed, particularly when RF and IF measurements are being made. Variation of layout can alter the results obtained. During all sensitivity tests other than AF the muting valve V15 should be removed.

## OVERALL IF SENSITIVITY—BANDWIDTH—AND CENTRE FREQUENCY

### Choice of signal generator

**6.** The receiver 62H should be switched on for at least four hours before attempting this test. When performing a check of the centre frequency and bandwidth of the receiver IF unit, three signal sources are possible.

(a) Signal generator CT218.

(b) Test oscillator CT212.

(c) Signal generator A.P.54704A.

The order given is that of preference, i.e. if a CT218 is available it should always be used. The other signal sources cannot give such an accurate measurement of either bandwidth or centre frequency.

**7.** It is important to realise that in this type of receiver, where the transmitter frequency is crystal controlled and the local oscillator of the receiver is crystal controlled, the exact value of the centre frequency of the IF is of vital importance. For this reason it is essential that whichever of the three signal sources quoted above, is used, the position of 9·72 Mc/s must be accurately known. The method of setting the signal source to this frequency is described in Chapter 4, para. 2(2), but for convenience the method is repeated more fully below.

### Calibration of signal source

**8.** Proceed as follows:—

(1) Connect up as for overall IF sensitivity, as detailed in para. 22 and fig. 2 with the signal generator connected to the grid of V3 (pin 6).

(2) Set the receiver 62H controls as follows:—

(i) R.F. GAIN to maximum (fully clockwise).

(ii) No crystal inserted.

(iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.

(iv) Meter switch to SIGNAL.

(v) Selector switch to MAN G.C.

(vi) I.F. GAIN control to maximum (i.e. fully clockwise).

(vii) Audio output connected from LINE socket.

(viii) Switch on receiver and check that mains voltage and receiver voltages are normal.

(3) Disconnect AF wattmeter and replace it by a pair of headphones, plugged into the LINE socket.

(4) Set signal generator or test oscillator to give a CW output signal at 9·72 Mc/s, and 40 dB (100 $\mu$V) level.

(5) Insert a 9·72 (or 4·86) Mc/s crystal into the crystal socket of the receiver.

(6) Tune the signal generator or test oscillator slowly about 9·72 Mc/s, for a zero beat. The dial reading of the signal generator or test oscillator at which this zero beat occurs represents 9·72 Mc/s output.

(7) *In the case of CT*218, the "pointer" on the frequency dial should be adjusted so that the frequency scale reads correctly at 9·72 Mc/s. The scale accuracy of the CT218 is then sufficient to use direct reading from the scale when performing a bandwidth measurement.

*In the case of CT*212 *an A.P.*54704*A*. it is necessary to note both the main frequency scale and the logging scale. Measurement of bandwidth necessitates interpolation using the logging scale. This is detailed more fully for the CT212 below (para. 12).

**Measurement of IF bandwidth and centre frequency, using CT218**

**9.** Having established the position for a 9·72 Mc/s signal, the bandwidth and centre frequency are measured as below. It is essential when measuring centre frequency that the receiver should have had a warming up period of 4 hours.

(1) Disconnect headphones and reconnect audio output meter, setting it to 600 ohm impedance and on such a range as to measure +15 dB (32 mW).

(2) Set signal generator to give a 9·72 Mc/s signal modulated 30% at 1,000 c/s and of such an amplitude as to give +15 dB (32 mW) audio output into the audio output meter

(3) Increase the signal generator output by 6 dB using the attenuators, and detune the signal source to a lower frequency until the audio output meter again reads +15 dB (32 mW). Note the signal source frequency $f1$ in Mc/s.

(4) Now tune signal source to the frequency above 9·72 Mc/s at which the audio output meter again reads +15 dB (32 mW) and note this frequency $f2$ in Mc/s.

(5) The bandwidth is then obtained by subtracting $f1$ from $f2$ and the centre frequency by taking the mean of $f1$ and $f2$, i.e.,

$$\frac{f1+f2}{2} \text{ Mc/s}$$

For example, let $f1$ be 9·68 Mc/s and $f2$ be 9·77 Mc/s.

The bandwidth at 6 dB $= f2 - f1 = 9{\cdot}77$ Mc/s $- 9{\cdot}68$ Mc/s.

$$= 0{\cdot}09 \text{ Mc/s}$$
$$= 90 \text{ kc/s}$$

Centre frequency of IF $= \dfrac{f1+f2}{2}$

$$= \frac{19{\cdot}45 \text{ Mc/s}}{2} = 9{\cdot}725 \text{ Mc/s} = F.$$

Thus centre frequency $F = 9{\cdot}725$ Mc/s.

From this it will be seen that though the bandwidth is approximately correct at ±45 kc/s (90 kc/s), the centre frequency is, however, 5 kc/s high.

(6) The bandwidth at 60 dB down is measured in a similar manner to that at 6 dB, except that the signal source output is increased 60 dB instead of 6 dB. It is advisable to detune the signal source by 200 kc/s, before increasing the output by 60 dB, or damage to the audio output meter may result.

**Results to be expected (specification)**

**10.** The Specification provides as follows:—

(a) Bandwidth at 6 dB level must be not less than ± 40 kc/s (80 kc/s).

(b) Bandwidth at 60 dB level must not be more than ± 160 kc/s (320 kc/s).

(c) Centre frequency must be within ±6 kc/s of 9·72 Mc/s.

**Results when using CT212**

**11.** When using the CT212 for measuring bandwidth, the same procedure is adopted as given above except that it is not possible to read the frequencies directly from the dial. It is necessary to note the dial reading and the logging scale reading, and to estimate the bandwidth by interpolation. Since there is some backlash in the drive and the scale is non-linear in this region, the results obtained will be of a lower order of accuracy than those obtained with the CT218. This fact should be allowed for when assessing whether or not realignment is necessary.

**12.** As an example on the measurement of bandwidth and centre frequency the following results were obtained. It also demonstrates the method of using the logging scale.

Reading of CT212 logging scale when the test oscillator is set by the crystal to 9·72 Mc/s was +10 division.

Reading of CT212 logging scale for 6 dB in high frequency end=45.

Reading of CT212 logging scale for 6 dB in low frequency end=64.

Number of divisions on logging scale to tune main dial from 9·5 to 10·0 Mc/s=380 divisions.

Thus, each division represents approximately

$\frac{500}{380}$ kc/s=1·315 kc/s.

Now the lower frequency 6 dB position ($f1$) occurred at a logging scale reading of 64, and turning the tuning control in a counter-clockwise direction (through 46 divisions) the logging scale completes one revolution (add 100) and moves on to the graduation on the logging scale marked 10 to give the 9·72 Mc/s position, at a scale reading of 110 (100+10). This means that the 6 dB point was 46 divisions (110—64) from the 9·72 Mc/s point. When tuning is continued in a counter-clockwise direction to obtain the higher frequency 6 dB point, it occurs at a scale reading of 145 (100+45 divisions). Thus the logging scale has been turned through 35 (145—110) divisions above the 9·72 Mc/s point to reach the higher frequency 6 dB point.

Thus:—

$f1$ is 46 divisions below 9·72 Mc/s, i.e. 60·6 kc/s,

and

$f2$ is 35 divisions above 9·72 Mc/s, i.e. 46·2 kc/s

Hence:—$f1$=9·6594 Mc/s

$f2$=9·7662 Mc/s

Hence bandwidth at 6 dB

$=f2-f1$

=106·8 kc/s

and centre frequency $=\frac{f1+f2}{2}$

=9·7128 Mc/s.

=9·71 Mc/s approximately.

From this it will be seen that the centre frequency is nearly 10 kc/s low and the bandwidth is 106·8 kc/s wide. The bandwidth at 60 dB can be found in a similar manner.

**13.** If two crystals, spaced about 50 kc/s to 100 kc/s either side of 9·72 Mc/s are also available, it is possible to calibrate the logging scale of the CT212 more accurately by using the zero beat principle used to set the signal generator to 9·72 Mc/s. In this case the test oscillator is tuned for zero beat for each crystal, and the logging scale then calibrated. Thus, by using three crystals of, for example, 9·77 Mc/s, 9·72 Mc/s and 9·67 Mc/s, the logging scale can be calibrated in kc/s per division.

**RF alignment**

**14.** Details of this test are given in Part 2, Chapter 4, para. 5, steps (2) to (8). However, the noise generator CT207 may be used instead of a signal generator for this alignment, as detailed at the end of para. 5(8) in Chap. 4.

**15.** When IF realignment is performed as an emergency operation, the receiver should be made a Dockyard Defect item as soon as practicable.

**AUDIO FREQUENCY—SENSITIVITY MEASUREMENT**

**Instruments required**

**16.** Test rigs are shown in fig. 1(a) and 1(b.) Where several suitable types of instruments are available the following is the order of preference:—

(1) Audio oscillator G205, A.P.W7252 *or* Audio frequency oscillator A.P.104290 (Advance J1).

(2) Audio attenuator A.P.100321.

(3) Valve voltmeter CT54 A.P.67921
Avometer model 7X A.P.32144 *or*
Avometer model A.P.48A

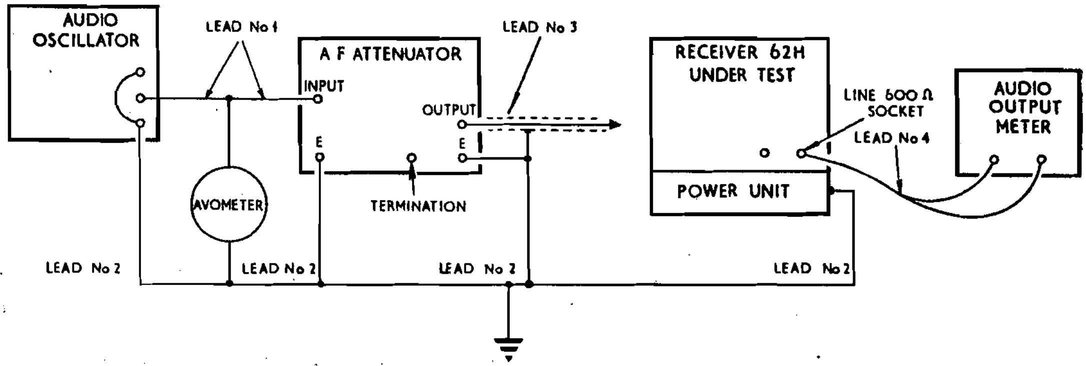
(4) Audio output meter (wattmeter AF) CT44, ZD00661 *or*

Wattmeter AF A.P.54708 *or*
Decibel meter No. 3 ZD02970

Connecting leads are as shown in the test rig and as detailed later (para. 28).

**Preliminary settings**

**17.** Connect test apparatus and receiver as shown in fig. 1(a) and 1(b). As indicated, the connecting leads used will depend upon the apparatus available. The results to be expected are, however, the same.



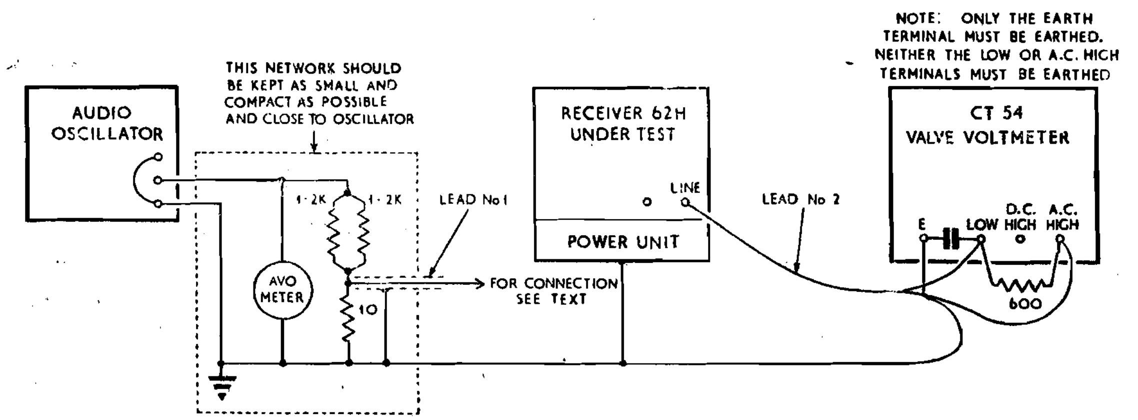

| AUDIO OSCILLATOR G 205 | AUDIO OSCILLATOR ADVANCE J1 |
|---|---|
| 1 SET METER SWITCH TO A.C. VOLTS<br>2 CONNECT ONE OUTPUT TERMINAL TO EARTH & E TERMINAL & OTHER TERMINAL AS SHOWN | 1 TAKE OUTPUT FROM 600Ω TERMINALS<br>2 SET 600Ω ATTENUATOR TO 0 dB |
| 3 SET DIALS FOR AN OUTPUT SIGNAL OF 1000 c/s & 10 VOLT READING AVOMETER<br>4 ENSURE THAT THIS VOLTAGE IS MAINTAINED THROUGHOUT THE TEST | |

| A F ATTENUATOR |
|---|
| 1 SET "TERMINATION" TO "INT"<br>2 SET STEP ATTENUATOR TO 20dB<br>3 ADJUST FINE ATTENUATOR AS DETAILED IN TEXT |

| RECEIVER 62H |
|---|
| 1 SET ALL CONTROLS AS IN TEXT WITH A F GAIN TO MAXIMUM<br>2 CONNECT LEAD No 3 AS IN TEXT<br>3 AUDIO OUTPUT TO BE TAKEN FROM 600Ω LINE JACK & NOT THE MONITOR JACK<br>4 THE TYPES OF LEAD USED FOR LEAD No 4 WILL DEPEND ON TYPE OF WATTMETER AVAILABLE |

| AUDIO OUTPUT METER |
|---|
| 1 SET IMPEDANCE TO 600Ω<br>2 SET RANGE AS DETAILED IN TEXT<br>3 NEITHER OUTPUT TERMINAL MUST BE EARTHED |

**Fig. 1(a). Test rig for AF sensitivity (big ships)**




| AUDIO OSCILLATOR |
|---|
| 1 SET CONTROLS AS DETAILED IN 2(a) THEN ADJUST OUTPUT AS DETAILED IN TEXT |

| RECEIVER 62H |
|---|
| 1 SET CONTROLS AS DETAILED IN 2(a) & TEXT |

| CT54 VOLTMETER |
|---|
| 1 CONNECT UP AS SHOWN<br>2 SET METER TO READ 4·4V. A.C. AS DETAILED IN TEXT |

**Fig. 1(b). Test rig for audio frequency sensitivity (small ship rig)**

(1) *Receiver settings*

(i) RF GAIN to minimum.

(ii) No crystal inserted.

(iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.

(iv) Meter switch to AUDIO.

(v) Selector switch to MAN GC.

(vi) LF GAIN to maximum i.e. fully clockwise.

(vii) Output from LINE socket.

(2) *Audio oscillator settings using G205*

(i) Meter switch to A.C. VOLTS and mains switch to ON.

(ii) Connect one output terminal to the E terminal and to earth and the other terminal to the AF attenuator input terminal.

(iii) Set frequency for 1000 c/s output.

(iv) Adjust output control knob, until avometer reads 10 volts AC.

**(3)** *Audio oscillator settings using Advanc J.1 (A.P.104290)* (alternative instrument to G205).

(i) Take output from 600 ohms terminals, and earth left-hand terminal of the 600 ohms pair; the right-hand terminal should be connected to the input terminal of the AF attenuator.

(ii) Connect the E terminal to earth.

(iii) Set 600 ohms attenuator (on right hand edge of panel) to 0 dB.

(iv) Adjust output frequency to 1000 c/s.

(v) Adjust output voltage control for 10 volts A.C. on Avometer.

(4) *AF attenuator settings (A.P.100321)*

(i) Set termination to INT.

(ii) Set coarse attenuator to 20 dB.

(iii) Set fine attenuator to 25 dB.

(iv) Connect output terminal of attenuator via a short screened lead to the live (top) contact of the LF volume control VR2 of the 62H Receiver (junction of C107 and VR2) (see circuit fig. 1, B.R.1511 A.P.2555F, Vol. 1, Part 2, Chapter 4, A.L.11).

(v) Earth the screening of this cable and also connect it to the E terminals of the AF attenuator.

(5) *Wattmeter absorption settings; A.F. No. 1 ZD00661, CT44*

(i) Set impedance to 600 ohms (right hand control).

(ii) Set power range to +15 dB (60 mV) (read red calibration for dB).

(6) *Settings using A.P.54708 wattmeter AF*

(i) Set OHMS to 60.

(ii) Set IMPEDANCE MULTIPLIER to 10.

(iii) Set METER MULTIPLIER to 0 dB (×1·0).

(iv) Connect lower terminal to earth conductor of lead No. 4.

(v) Connect upper terminal to the "live" conductor of lead No. 4.

(7) *Settings using decibel meter portable No. 3, ZD02970*

(i) Set left hand control to TRANSM, 600 (red scale).

(ii) Set right hand control to DECIBELS +20.

**Procedure for AF sensitivity measurement**

**18.** Proceed as follows:—

(1) Switch on receiver and check that mains voltage and HT are correct.

(2) Check that Avometer across audio oscillator is reading 10 volts AC.

(3) Adjust fine attenuator of the AF attenuator A.P.100321 until the output meter reads +15 dBm (above 1 mV, i.e. 32 mW).

(4) Note the reading of the fine attenuator in dB.

(5) In a typical receiver, this fine attenuator should read between 13 dB and 19 dB (i.e. total attenuation should lie between 33 and 39 dB). (This means, in effect, that 0·15 volts r.m.s. at 1000 c/s is required at the input to give +15 dBm output.)

#### Testing in small ships

**19.** In small ships where test equipment is limited, the test rig given in fig. 1(b) may be used. The value of resistors should be checked and those closest to the value indicated chosen. The valve voltmeter CT54 can be used as an output meter. The voltage indicated by the valve voltmeter CT54 can be converted to the equivalent power by reference to fig. 3.

#### Small ship test rig

**20.** Proceed as follows:—

(1) Connect the apparatus as shown in fig. 1(b). The output of the resistor network should be connected via a short screened lead to the live (centre) contact of LF volume control, VR2 (Junction of C107 and VR2); see fig. 1 B.R.1511, A.P.2555F Vol. 1, Part 2, Chapter 4, A.L.11.

(2) Set 62H Receiver controls as in para. 17, (1), and the audio oscillator as in para. 17(2), or 17(3) depending upon the oscillator used.

(3) The OUTPUT LEVEL control of the audio oscillator should be adjusted until the valve voltmeter reads 4·4 volts, corresponding to 15 dBm audio output power (fig. 3). With this output, the Avometer reading will normally lie between 7 volts and 14 volts for a typical receiver.

### MEASUREMENT OF IF SENSITIVITY AND INDIVIDUAL IF STAGE GAINS

#### General conditions for test

**21.** It is important that attention be directed to the following points:—

(1) Before measuring the IF sensitivity and stage gain it must be known that the centre frequency of the IF amplifier is correct. A test to establish this centre frequency has already been given (para. 9).

(2) If available, a screened room should be used for all IF and RF measurements and the special leads or adaptors used when called for in the text.

(3) When measuring the individual stage gains, the signal source frequency must be adjusted each time for peak audio output.

(4) The signal generator (or test oscillator) is always used in its terminated condition, and modulated to a depth of 30% at 1000 c/s.

(5) The receiver muting valve V15 should be removed during the tests.

#### Measurement of IF sensitivity and individual IF stage gains—preliminary settings

**22.** The warming up period must not be less than 15 mins. (for a quick test), and should preferably be longer (4 hours for consistent results). Connect the test instruments as shown in fig. 2. Where several instruments are suitable, they are detailed in order of preference.

(1) *Receiver 62H settings*

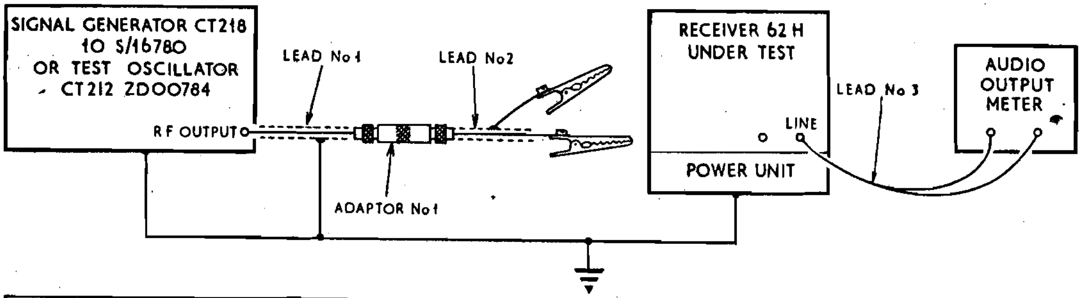
- (i) RF gain to maximum (fully clockwise).
- (ii) No crystal inserted.
- (iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.
- (iv) Meter switch to SIGNAL.
- (v) Selector switch to MAN G.C.
- (vi) L.F. gain control to maximum (i.e. fully clockwise).
- (vii) Audio output connected from LINE socket.
- (viii) Switch on receiver and check that mains voltage and receiver voltages are normal.

(2) *AF wattmeter settings*

The audio output meters and methods of connection already detailed should be used (para. 17(5), (6) and (7)).

(3) *Settings with signal generator CT218*

- (i) Set crystal check to OFF.




| SIGNAL GENERATOR CT218 | TEST OSCILLATOR CT212 |
|---|---|
| 1 CRYSTAL, CHECK "OFF" | 1 FREQUENCY RANGE – 6 |
| 2 FREQUENCY RANGE "G" | 2 MODULATION TO – A.M. |
| 3 MODULATION TO A.M. | 3 DEVIATION TO 30 |
| 4 MAINS "ON" | 4 SET TUNING AS DETAILED IN TEXT |
| 5 MODULATION FREQUENCY 1000 c/s | 5 SET CARRIER LEVEL TO "CAL" |
| 6 OUTPUT VOLTAGE & MULTIPLIER, SEE TEXT | 6 SET MODULATION TO "CAL" |
| 7 SET CARRIER LEVEL TO x1 | 7 SET FINE & COARSE ATTENUATORS AS DETAILED IN TEXT |
| 8 SET MODULATION TO 30% | |
| 9 SET TO FREQUENCY AS DETAILED IN TEXT | |

| AUDIO OUTPUT METER |
|---|
| 1 SET IMPEDANCE TO 600 Ω |
| 2 SET RANGE TO READ +15 dBm (32 mW) |
| 3 NEITHER OUTPUT TERMINAL MUST BE EARTHED |

LEADS & ADAPTORS

| LEAD No | DESCRIPTION | PATT No |
|---|---|---|
| 1 | 3FT 75Ω UNIRADIO 32 OR 70 | ZD00378 |
| 2 | SHORT ADAPTOR LEAD WITH CROCODILE CLIPS | A.P. 60865 |
| 3 | DEPENDS ON WATTMETER USED | |
| ADAPTOR No 1 | TERMINATING L-PAD 75 OHMS | A.P. 71232 |

**Fig. 2. Test rig for IF sensitivity of 62H type receiver**

(ii) Set frequency range to G.

(iii) Set modulation selector to A.M.

(iv) Set mains to ON and carrier to ON.

(v) *Set modulation frequency to 1000 c/s.

(vi) Set output voltage multiplier as detailed in text (see Table below).

(vii) Set carrier level to 'X1'.

(viii) Set modulation depth to 30%.

(ix) Set frequency to 9·72 Mc/s and then adjust it for peak audio output as described in text.

(x) Connect output from RF output plug by leads detailed later (para. 28) and to test points in the receiver as shown below in Table (para. 23).

(4) *Settings with test oscillator CT212, ZD00784*

(i) Set frequency range to 6.

(ii) Set modulation to A.M.

(iii) Deviation control setting immaterial.

(iv) Set tuning to 9·72 Mc/s and adjust for peak audio output as in text.

(v) *Set carrier level to CAL.

(vi) Set modulation level to CAL.

*With selector switch set to appropriate position.

(vii) Set fine and coarse attenuators as detailed in Table (see below).

(viii) Connect RF output from RF plug by leads as detailed later (para. 28(3)).

**Signal injection points typical results**

**23.** Stage gains and overall gains are given in terms of decibels, since the signal generator readings are more easily interpreted using decibels. The corresponding input voltages are given in brackets, e.g. Input 20 Bd (10$\mu$V) means that the input is 20 dB above 1$\mu$V (i.e. 10$\mu$V).

The figures quoted in the Table that follows are those for a typical receiver. Variations of up to $\pm$6dB may be expected in the stage gain (third column) figures obtained from good receivers. It will be observed that, since the stage gain may differ by $\pm$6 dB from the figures quoted, there may be quite wide variations from the figures quoted in the second column (for signal generator input level), particularly at the early IF stages.

| VOLTS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mW | 1·67 | 6·67 | 15·0 | 26·7 | 41·7 | 60·0 | 81·7 | 107 | 135 | 167 | 201 | 240 | 282 | 327 | 375 | 427 | 481 | 540 | 602 | 667 |
| dBm | 2·22 | 8·24 | 11·8 | 14·3 | 16·2 | 17·8 | 19·1 | 20·3 | 21·3 | 22·2 | 23·0 | 23·8 | 24·5 | 25·1 | 25·7 | 26·3 | 26·8 | 27·3 | 27·8 | 28·2 |

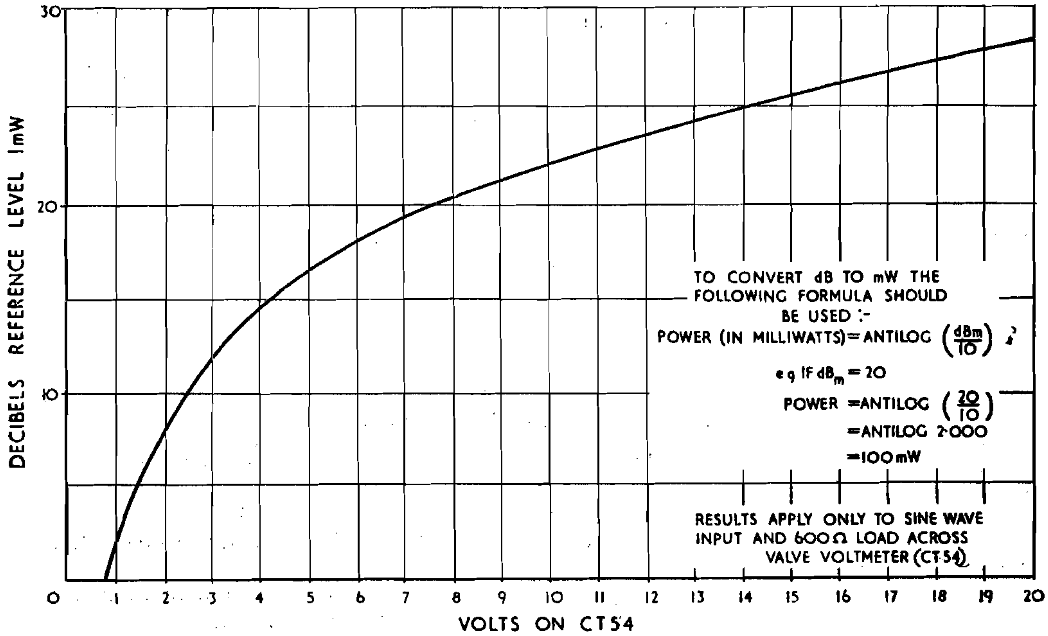


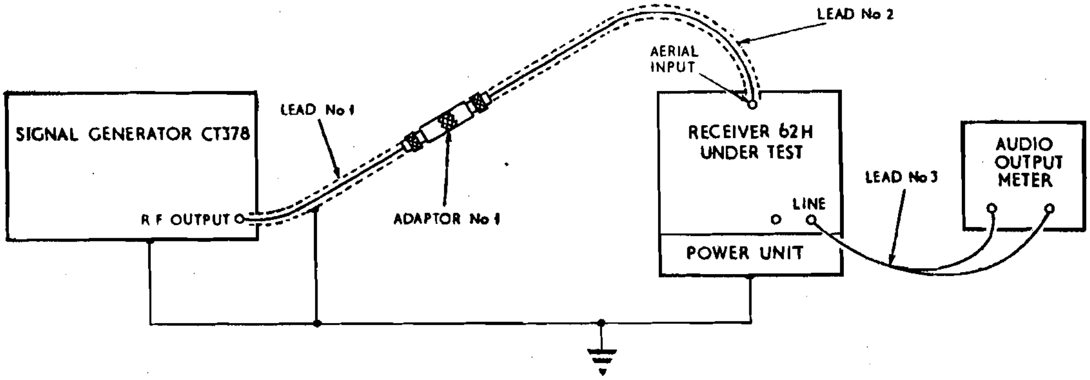

**Fig. 3. Conversion graph for using CT54 as a wattmeter**

**TABLE 1**

**Results from a typical receiver**

| *Test point in circuit* | *Approx. signal generator input in dB above 1μV* | *Typical stage gain in dB* | *Audio output in dB above 1 mW* |
|---|---|---|---|
| V3 grid via C68* | 48 dB (250μV) | Via C68=18 dB | + 15 dB (32 mW) |
| V3 grid direct (pin 6) | 30 dB (32μV) | Of $V_3$=35 dB | +15 dB (32 mW) |
| V7 grid (top cap) | 65 dB (1·8 mV) | Of $V_7$=21 dB | +15 dB (32 mW) |
| V8 grid (top cap) | 86 dB (20 mV) | Of $V_8$=23 dB | +15 dB (32 mW) |
| V9 grid (top cap) | 97 dB (70·8 mV) | — | +3 dB (2 mW) |

*During this measurement C68 should be disconnected from the junction of C67 and L7, the signal generator being fed to the free end of C68.




| SIGNAL GENERATOR CT378 |
|---|
| 1 FREQUENCY RANGE —G |
| 2 MODULATION TO "INT. A.M." |
| 3 MAINS "ON" |
| 4 ADJUST COARSE & FINE ATTENUATORS AS DETAILED IN TEXT |
| 5 SET CARRIER LEVEL TO x 1 |

| RECEIVER 62H |
|---|
| 1 SWITCH ON |
| 2 SET R F GAIN TO MAXIMUM (CLOCKWISE) |
| 3 INSERT APPROPRIATE CRYSTAL |
| 4 SET METER SWITCH TO "OSC" |
| 5 SET SELECTOR SWITCH TO "MAN. G. C" |
| 6 SET L F GAIN TO MAXIMUM (CLOCKWISE) |
| 7 CONNECT AUDIO OUTPUT LEAD TO LINE SOCKET |
| 8 ADJUST "TUNE OSC", "TUNE SIG" & AERIAL TRIMMER FOR MAXIMUM AS TUNING PROCEDURE |

| AUDIO OUTPUT METER |
|---|
| 1 SET IMPEDANCE TO 600Ω |
| 2 SET RANGE TO READ + 15 dBm (32 mW) |
| 3 NEITHER OUTPUT TERMINAL MUST BE EARTHED |

**Fig. 4. Test rig for overall RF sensitivity**

### OVERALL RF GAIN MEASUREMENTS

**General conditions for test**

**24.** It is recommended that only an overall gain from aerial socket to AF output be performed, since noise generator test figure will usually indicate any loss of RF gain (see fault diagnosis table, Chapter 5). The test rig is shown in fig. 4. Attention is drawn to the following points:—

(1) When performing an overall RF measurement, it is very important to use the correct leads and adaptors to prevent stray radiation and instability.

(2) The recommended signal source is Marconi signal generator, type TF801B/3 J.S. Catalogue No. 6625–99–943–1911, in Dockyards; and the signal generator CT378 (A.P. 71115) on board ship.

(3) The noise generator CT207 may also be used as detailed in Chapter 5.

**Overall RF gain measurement—preliminary settings**

**25.** The warming up period must not be less than 15 minutes and should preferably be longer (4 hours).

(1) *Receiver 62H settings*

(i) Set R.F. GAIN to maximum (fully clockwise) and switch on receiver.

(ii) Insert crystal at appropriate frequency.

(iii) Set meter switch to TUNE OSCILLATOR.

(iv) Set selector switch to MAN G.C.

(v) Set L.F. gain control to maximum (fully clockwise).

(vi) Connect audio output to meter from the LINE socket, *not* the MONITOR socket.

(vii) Adjust TUNE OSC., TUNE SIG., and AERIAL TRIMMER controls as in normal operation (see Chapter 4). Note also that the crystal current dip on the tuning meter is not less than 0·2 mA.

(2) *AF wattmeter setting*

The setting of the instrument is the same as that already detailed (para. 17(5), (6) or (7)).

(3) *Signal generator CT378* (*A.P.*71115)

(i) Set mains to ON.

(ii) Set frequency range to frequency in use (Range G).

(iii) Set modulator selector to INT. A.M.

(iv) Adjust coarse and fine attenuators to give 1μV initially, and then adjust as in text.

(v) Set carrier level to X1.

**Procedure for overall RF gain measurement**

**26.** Proceed as follows:—

(1) If available a screened room should be used.

(2) Note that the centre frequency of the IF amplifier must be known to be correct.

(3) The muting valve V15 should still be removed.

(4) The connections are as shown in fig. 4, and it is important to use the coaxial terminating unit shown. This prevents standing waves being set up in the coaxial lead No. 1. The use of clip terminations or similar temporary connections is not acceptable as it gives rise to wide variations in results.

(5) Ensure that all connections are correct and all instruments and the receiver are switched on and thoroughly warmed up. Increase the input from the signal source until an audio output power of 15 dB above 1 mW (i.e. 32 mW) is obtained.

A typical receiver will require 14 to 20 dB (5 to 10$\mu$V) input to obtain this audio output.

**General rules and conclusions**

**27.** The information given in this Chapter is sufficient to enable all normal servicing using C.N.R.T.E. test instruments to be performed. The actual test rig used will depend upon the allocation of instruments and class of ship. The following general rules should be observed:—

(1) IF realignment should never be attempted unless it has definitely been proved beyond all doubt that the IF centre frequency and bandwidth are at fault, and in the case of 62H, the exact frequency of the centre of the IF is important and the signal generator must be calibrated by a 9·72 Mc/s crystal in the oscillator circuit (see para. 8). The receiver and signal source used must have at least 4 hours running to stabilise.

(2) The most suitable signal generator to use is the CT218, which should be used as detailed in its handbook, and the exact frequency of the IF 9·72 Mc/s set against a crystal (see para. 8).

(3) If the CT218 is not available, a less accurate result can be obtained using the CT212 test oscillator. It is necessary in this case to use the logging scale and interpolate the results. Due to the possibility of backlash in the drive mechanism, all bandwidth measurements should be made by tuning the signal generator in to the desired frequency in one direction only (i.e. either always clockwise or always counter-clockwise).

(4) After an emergency realignment, the receiver should be entered as soon as possible as a Dockyard Defect item, giving full details of the fault which necessitated the realignment.

**Details of connecting cables for the different test rigs**

**28.** (1) *Test rig fig.* 1(*a*)

| *Lead No.* | *Details* | *Pattern No.* |
|---|---|---|
| 1 | Short piece of insulated p.v.c. covered wire, as short as possible. | — |
| | (**Note:** *All leads between oscillator and attenuator should be short.*) | |
| 2 | Earth lead of similar type to No. 1. | — |
| 3 | Should be as short as possible and screened. Connect screening to earth. | — |
| 4 | Depends upon wattmeter used. A 'phone jack connected to a short length of twin cable is satisfactory. | — |

(2) *Test rig fig.* 1(*b*)

| *Lead No.* | *Detail* | *Pattern No.* |
|---|---|---|
| Note | Circuit in dotted lines should be kept as small and compact as possible and all leads as short as possible. | — |
| 1 | Should be a screened audio cable as lead 3 above. | — |
| 2 | A 'phone jack connected to a short length of twin cable is satisfactory. | — |

(3) *Test rig fig.* 2

| *Lead No.* | *Detail* | *Pattern No.* |
|---|---|---|
| 1 | 75 ohm 5 ft. long (supplied with CT202) | A.P.61670 5 ft. long |
| | *or* | |
| | 75 ohm 3 ft. long (supplied with CT218) | ZD00378 3 ft. long |
| 2 | Supplied with CT82 box of connectors | A.P.60865 |
| 3 | As leads para. (b) 2 and para. (a) 4 above | — |
| Adaptor No. 1 | Terminating "L" pad 75 ohms. | A.P.71232 |

(4) *Test rig, fig.* 4

| *Lead No.* | *Detail* | *Pattern No.* |
|---|---|---|
| 1 | 75 ohm 5 ft. long supplied with CT202<br>75 ohm 3 ft long supplied with CT218 | A.P.61670<br>ZD00378 |
| 2 | 75 ohm lead supplied with CT82 | A.P.60866 |
| 3 | Depends upon wattmeter used, see para. (b) 2 and para. (a) 4 above. | — |
| Adaptor No. 1 | Terminating "L" pad 75 ohm | A.P.71232 |



Dmd 6270 267152 3250 8/58 AB539/3 1770

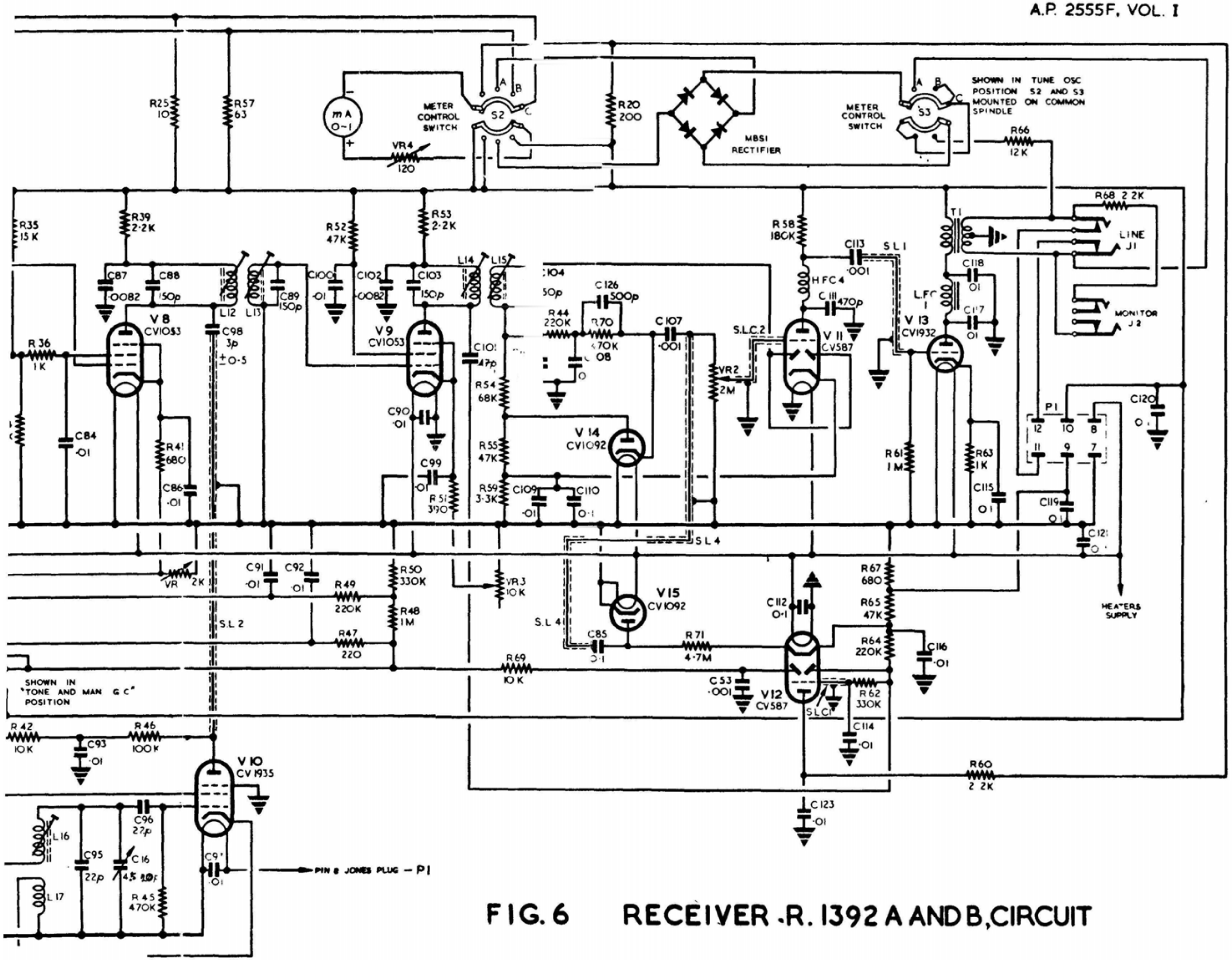



FIG. 6 RECEIVER -R. 1392 A AND B, CIRCUIT

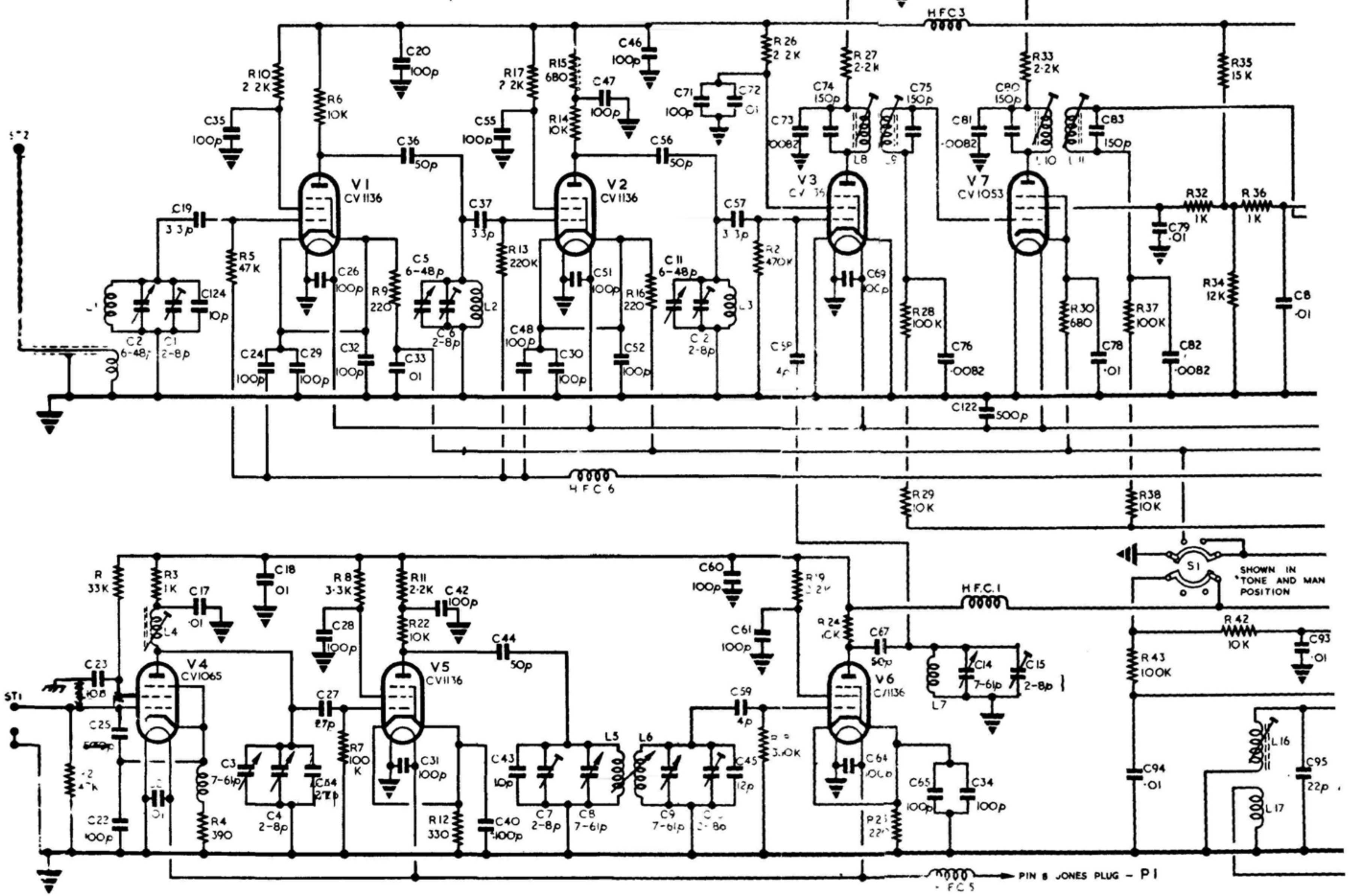
**NOTES.—**

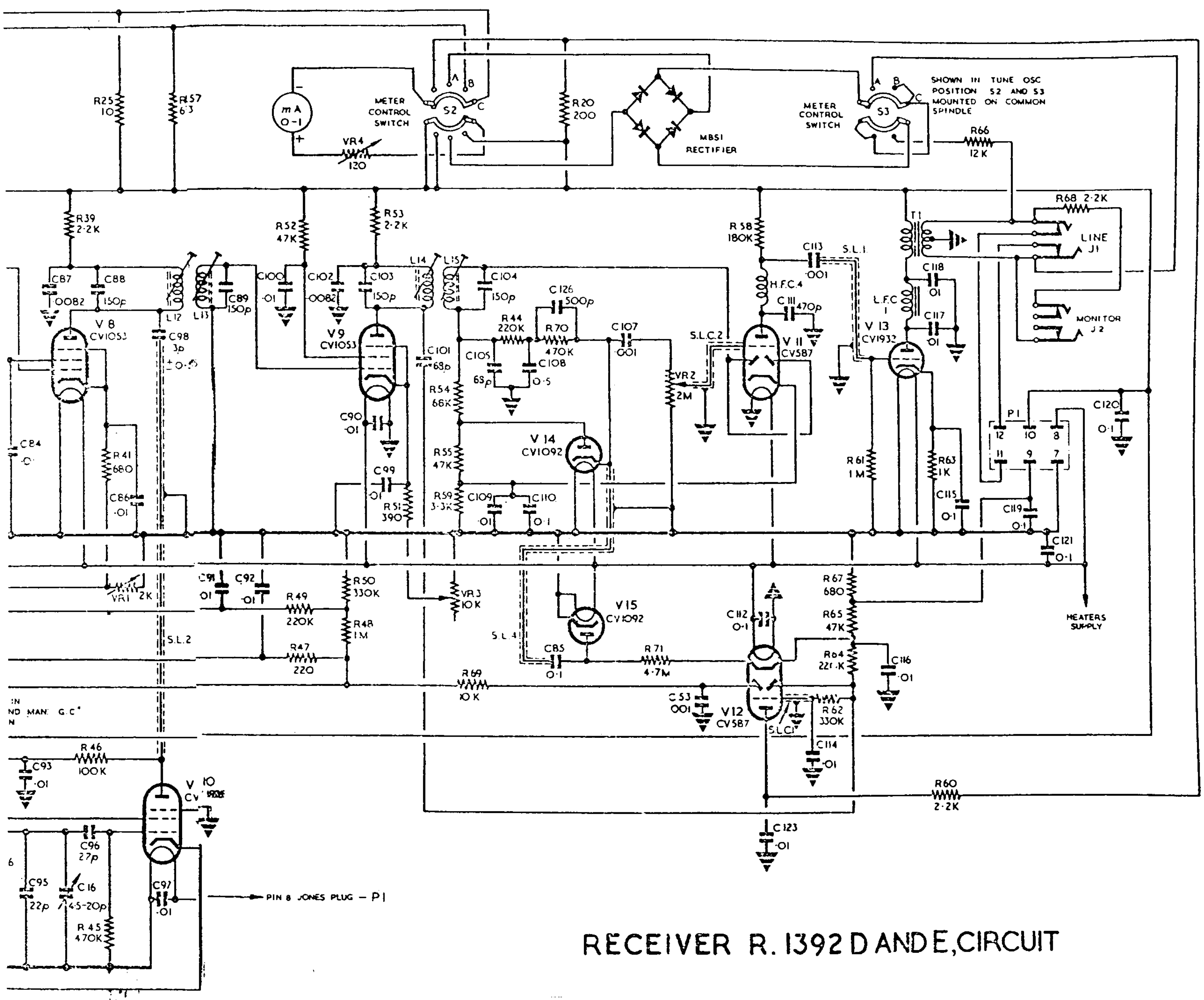
SL 1 = SCREENED LEAD ASSEMBLY No 1
SL 2 = " " " No 2

SL 4 = " " " No 4
SL 5 = " " " No 5
SLC1 = " " AND CLIP ASSEMBLY No 1
SLC2 = " " " " " No 2

**S2 AND S3 SWITCHING REFERENCE**

POSITION A ADJUST AUDIO LEVEL
" B TUNE SIGNAL
" C TUNE OSC



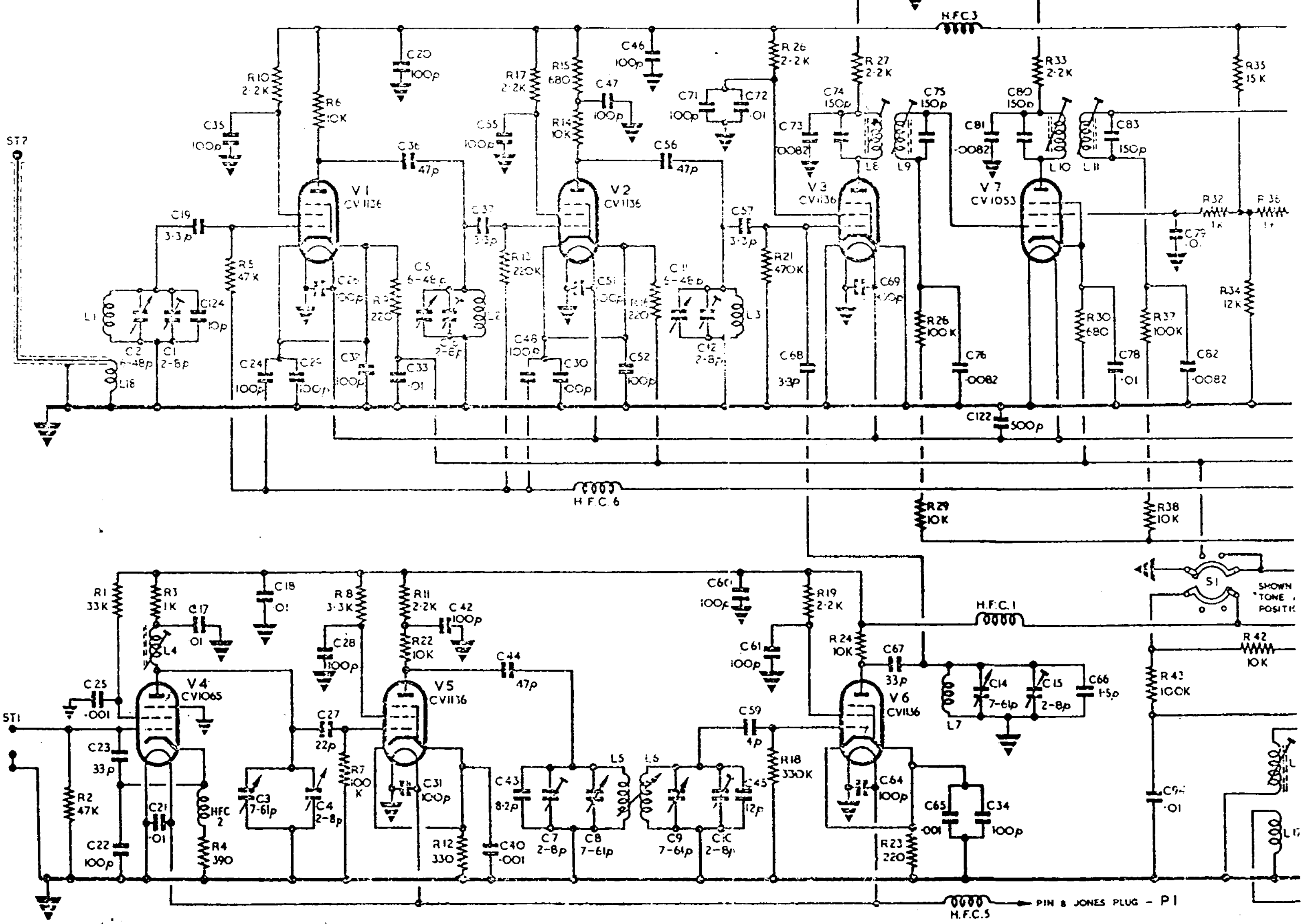



RECEIVER R. 1392 D AND E, CIRCUIT

NOTES:—

S.L.1 = SCREENED LEAD ASSEMBLY No. 1
S.L.2 = " " " No. 2
S.L.4 = " " " No. 4
S.L.5 = " " " No. 5
S.L.C.1 = " " AND CLIP ASSEMBLY No. 1
S.L.C.2 = " " " " " No. 2

S2 AND S3 SWITCHING REFERENCE
POSITION A ADJUST AUDIO LEVEL
" B TUNE SIGNAL
" C TUNE OSC.



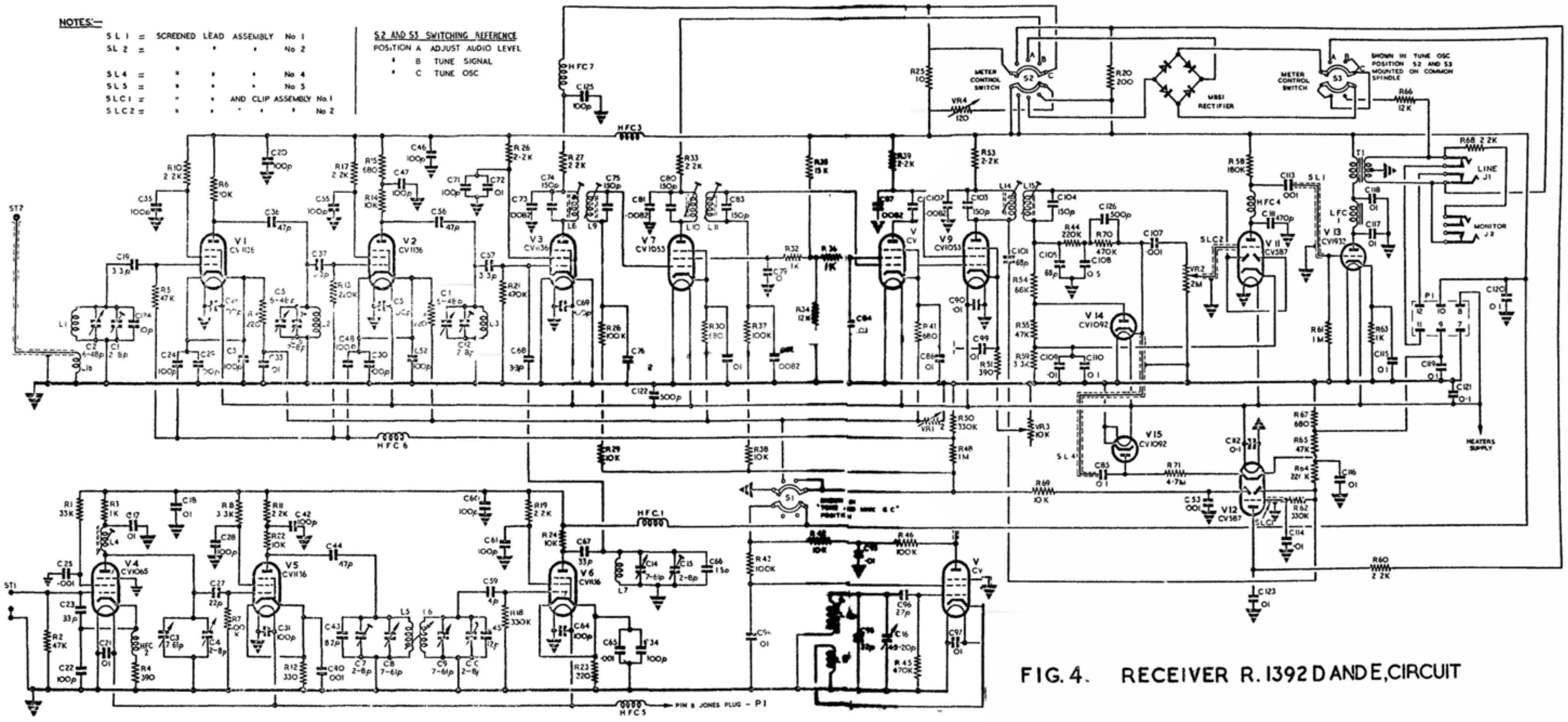



FIG. 4. RECEIVER R. 1392 D AND E, CIRCUIT