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2. Select the correct printer if necessary.
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Please get in touch with me at archivist@vmarsmanuals.co.uk.

Richard Hankins, VMARS Archivist, Summer 2004

ELECTRICAL AND MECHANICAL
ENGINEERING REGULATIONS
(By Command of the Army Council)

TELECOMMUNICATIONS
E 744

RECEPTION SET, EDDYSTONE, 730/4 (Z4/ZA 51262)

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

This EMER must be read in conjunction with Tels E 742 Part 2 which contains figures and tables to which reference is made.

SUBJECT INDEX

Distribution - Class 1190. Code No 4

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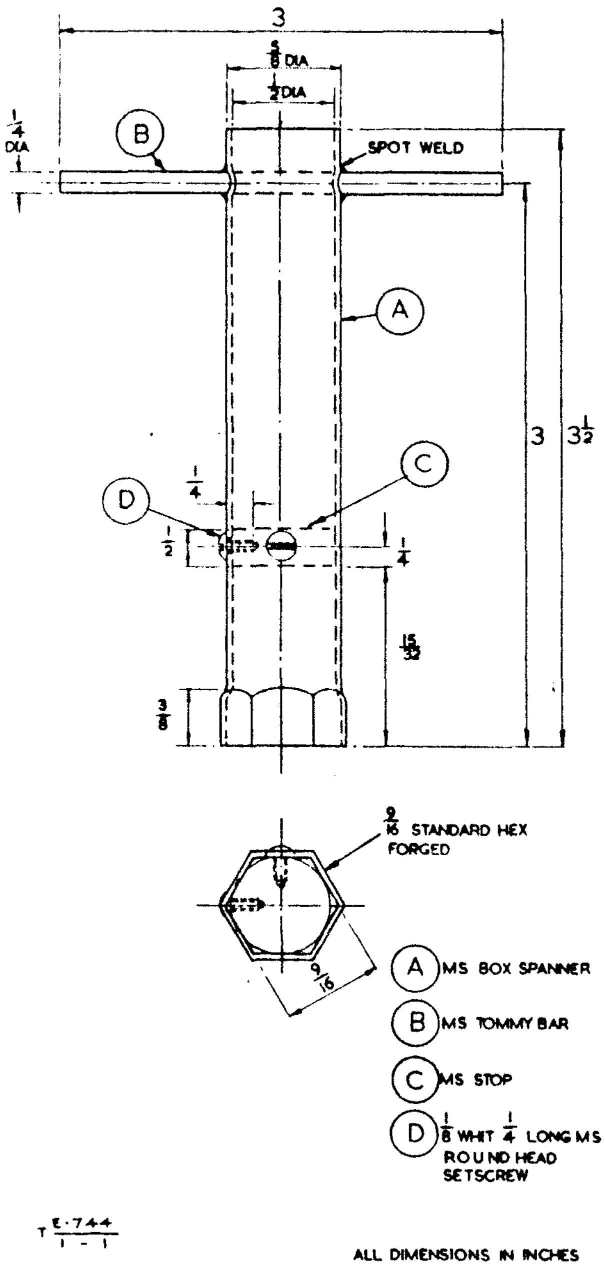
INTRODUCTION

1. This regulation details the procedure to be adopted when repairing Reception Set, Eddystone, 730/4, in field or base workshops. Circuit diagrams and layout drawings of the equipment are to be found in Tels E 742 Part 2: a technical description of the receiver appears in Tels E 742 Part 1.

MECHANICAL

Removal of panel

2. The operations listed in the following paragraphs must be carried out in the order given if damage to the drive assembly is to be avoided. When removing components secured to the black finger plate, use every effort to avoid marking the surface. The box-spanner used to remove large hexagonal nuts should be fitted with a 'bottoming' device to prevent contact between the spanner and the finger-plate. A suggested method is shown in Fig 1. Ring type retaining nuts, used on the MAINS switch etc should be removed by the use of a tool such as that shown in Fig 2.



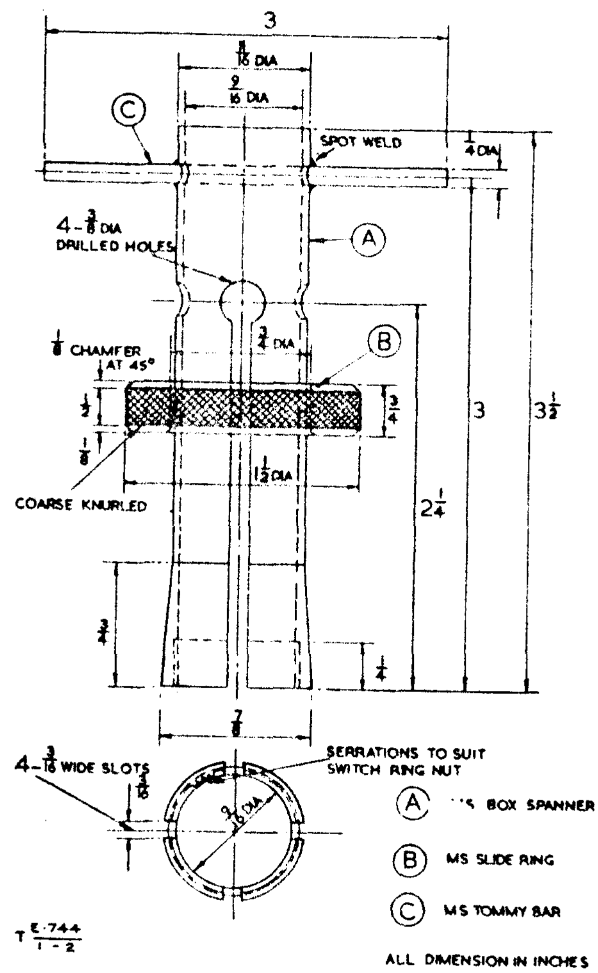


Fig 1 - 'Bottomed' box-spanner

Fig 2 - Ring-nut spanner

Removing the set from its case

3. Proceed as follows:-

(a) Remove the mains and shorting plugs if fitted.

(b) Turn the TUNING control knob and the set pointer to the centre of its travel. (If the drive wire is broken the pointer can be moved by hand).

(c) Place the receiver face downwards on its chromed protecting handles.

(d) Remove four large plated screws at the rear of the cabinet.

(e) Insert a suitably ended screwdriver into the small cut-outs provided on the underside of the cabinet, and gently ease the cabinet from the panel. The whole case can now be lifted clear.

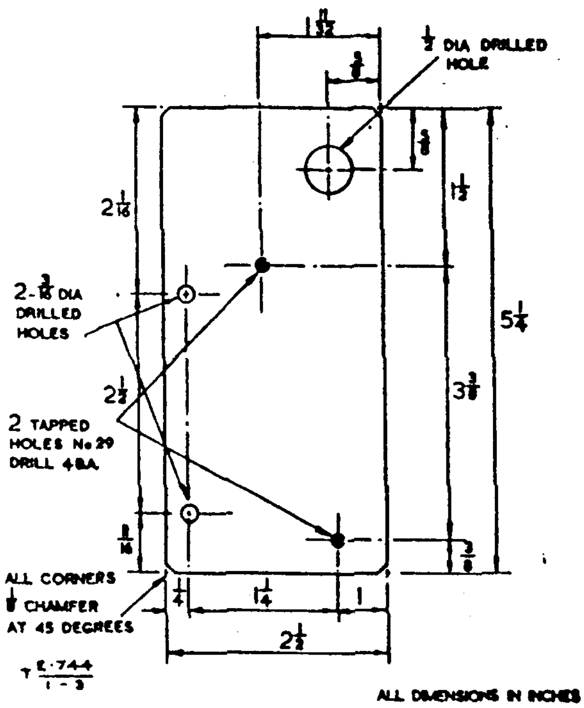


Fig 3 - Mounting plate for crystal calibrator

Removing the ganged capacitor cover

4. (a) Remove the four screws at the corners of the crystal calibrator sub-chassis.

(b) Lift off the calibrator and lay it, temporarily, on top of the i.f. transformers.

(c) Take out V5 to gain access to the screw in the side of the ganged capacitor cover. Remove this screw and the four screws on top of the cover. Replace V5.

(d) Undo the ring-nut on the h.t. switch. Lift the cover away from the ganged capacitor. Lay the h.t. switch on one side of the capacitor assembly.

(e) Fit the plate shown in Fig 3 to the holes in the rear cover bracket. Mount the crystal calibrator and h.t. switch on the plate.

Freeing the meter and lamps

5. (a) Release the coupler between the ganged capacitor shaft and the dial shaft (four grubscrews).

(b) Take the leads off the 'S' meter terminals. Replace the washers and nuts.

(c) Stand the set on its back, taking care not to damage the Pye plug and take out the screws from the cable loom clips nearest the front panel.

(d) Remove the screw from the cleat of the indicator lamp cable loom.

(e) Release the captive screw on the indicator lamp bracket and withdraw the bracket, complete with lamps.

(f) Turn the set right way up. Remove the three dial lamps by pressing the spring-clip on either side of the lamp and withdrawing the holder.

Freeing the controls

6. (a) Remove the name-plate from the finger-plate: do not replace the screws.

(b) Remove all knobs. Fibre washers are fitted behind the TUNING knob. The number may vary from one to three. They are fitted to provide a silent drive and must not be lost. It is advisable to replace the TUNING knob after removing the finger-plate.

(c) Using the 'bottomed' box-spanner, remove the nuts from both gain control shafts.

(d) Using the ring-nut tool, remove the locking rings from the tumbler switches.

(e) Remove the finger-plate.

(f) Remove the two countersunk screws retaining each of the following items: SELECTIVITY switch, PHONES jack, CRYSTAL PHASING capacitor and B.F.O. capacitor.

(g) Check that all components are free.

Freeing the panel

7. (a) At each corner of the panel, a 1/4 in. BSF bolt passes through the panel into the carrying handles. Loosen each bolt about three turns.

(b) Place the receiver right way up with the panel over-hanging the front of the bench.

(c) Remove completely the bolts at the upper corners of the panel (loosened in operation 7(a)). Catch the washers as they fall.

(d) Release the handles by unscrewing the bolts at the lower corners of the panel. Leave the bolts and washers in place.

(e) The die-cast coil box is held to the panel by four tapered brass screws. It is most important that these screws should not be damaged. Choose a screwdriver which is an exact fit and remove all four screws.

(f) Remove the front panel.

Panel replacement

8. The panel is replaced by repeating the operations in the reverse order to that given above. When first offering the panel to the chassis be careful to avoid damage to the vernier scale from the wavechange switch shaft. The clearance is very small. At the same time, ensure that the dial drive shaft engages the coupler on the shaft of the variable capacitor.

9. Panels are not directly interchangeable with chassis. This is because the height of the ganged capacitor is adjusted to take up manufacturing tolerances in the dial drive assembly. Readjustment of the capacitor to accommodate a different panel entails the removal of all soldered connections. As far as possible, therefore, the panel should be identified with the chassis from which it was taken.

Replacing the dial drive cord

10. Under certain conditions of backlash, the drive cord may jump the pulley gear. It may also break, particularly at the points where it is secured to the pulley gears. The repair procedure in each case is the same, except of course that no replacement cord is needed in the case of a jumped drive.

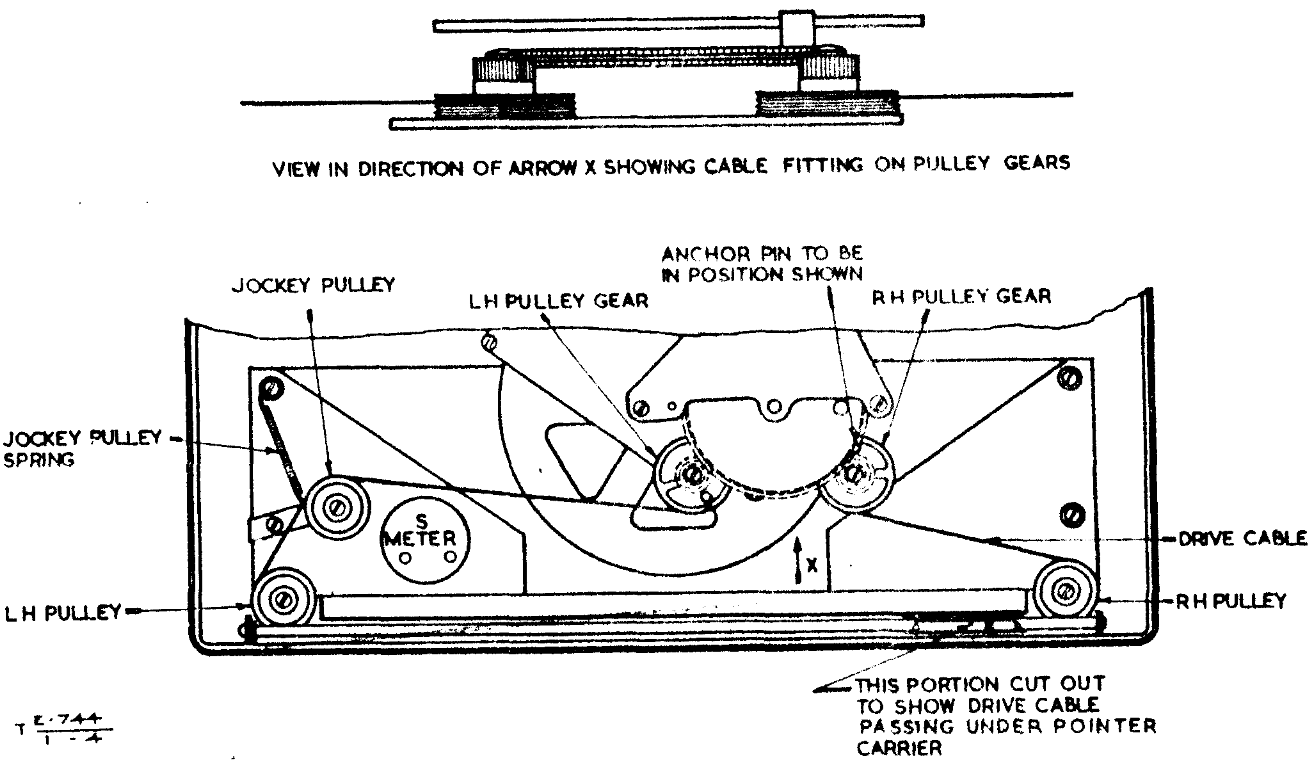


Fig 4 - Dial drive mechanism

11. The procedure is as follows:-

(a) Remove the set from its case as detailed in paragraph 3.

(b) Remove the gang cover as detailed in paragraph 4.

(c) Remove the dial lamps.

(d) Remove the drive wire guard.

(e) Place the receiver face downwards, the top facing the operator.

(f) Unsolder the drive cord from the pegs on the pulley gears and from the pointer (see Fig 4)* See Note below*

*Note: **Where the pulleys are made of nylon,** as distinct from bakelite, a soldering tag secured by a screw is used instead of a peg. As nylon softens with heat it is advisable first to estimate where the cord should be soldered to the tag, to remove the tag, make the soldered joint and afterwards to resecure the tag by its screw.*

(g) Rotate the TUNING control fully clockwise to the stop.

(h) Slide the pointer to the high frequency end of the scale, ie to the right.

(j) Remove the right-hand pulley gear from its shaft.

(k) Solder one end of the replacement cord to the peg.

(l) Wind 3.1/4 turns of cord on to the pulley gear and use a piece of adhesive tape to hold them in place.

(m) Replace the pulley gear with the peg in the 9 o'clock position, ie to the left.

(n) Thread the cord over the right-hand pulley, under the pointer carrier, over the left-hand pulley and around the jockey pulley.

(o) Take up nearly all the tension on the jockey pulley spring by pushing the jockey arm towards the top of the panel.

(p) Thread the cord through the top groove of the left-hand pulley gear, take up the slack and solder the cord to the peg.

(q) Remove the adhesive tape (operation (l)).

(r) Turn the TUNING control fully anti-clockwise.

(s) Find the half-way position of the cursor adjuster. This is important. Some little time may be needed to find the position accurately.

(t) Set the pointer against the zero mark on the logging scale and solder the pointer carrier to the drive cord.

(u) Rotate the TUNING control so that the pointer reads 1000 on the logging scale. The vernier dial must now read between 95 and 5.

(v) If it does not, check that the cursor adjuster was set at its mid-point.

(w) Rotate the TUNING control until the vernier dial reads zero. Note the direction of movement of the pointer against the logging scale as this is done. If, for example, the vernier reads 90 with the pointer set at 1000, the pointer must be moved to the right by a clockwise movement of the TUNING control to set the vernier to zero. This indicates that its original setting, when it was soldered, was too far to the left.

(x) Restore the pointer to the left-hand end of the scale, resolder in its new position and check as in (u) above.

(y) Repeat as necessary until correct.

Replacing T1, T3 or T4

12. These transformers have one coil which is moved relative to the other to provide variable coupling. Provided that there has been no alteration in the position of the actuating arm on the shaft of SD, no setting-up will be necessary. The i.f. bandwidth tolerance is sufficient to accommodate small positional errors in the moving coil.

13. Proceed as follows:-

(a) Put the SELECTIVITY switch to the 'narrow' position.

(b) Remove all soldered connections to the transformer.

(c) Remove the split-pin holding the push-rod on to the actuating arm.

(d) Remove the two screws holding the transformer to the chassis.

(e) Lift the transformer from the chassis, guiding the metal end of the push-rod through the hole in the chassis.

(f) Transfer the metal end to the push-rod of the replacement transformer if the original transformer is not repairable.

(g) Replace in the reverse order to that given in (b) to (e).

14. A possible fault on these transformers is the failure of the pig-tail leads to the moving coil. In the case of T3 and T4, a subsidiary fault might be damage to R24 or R26, due to the pig-tail shorting to the transformer case.

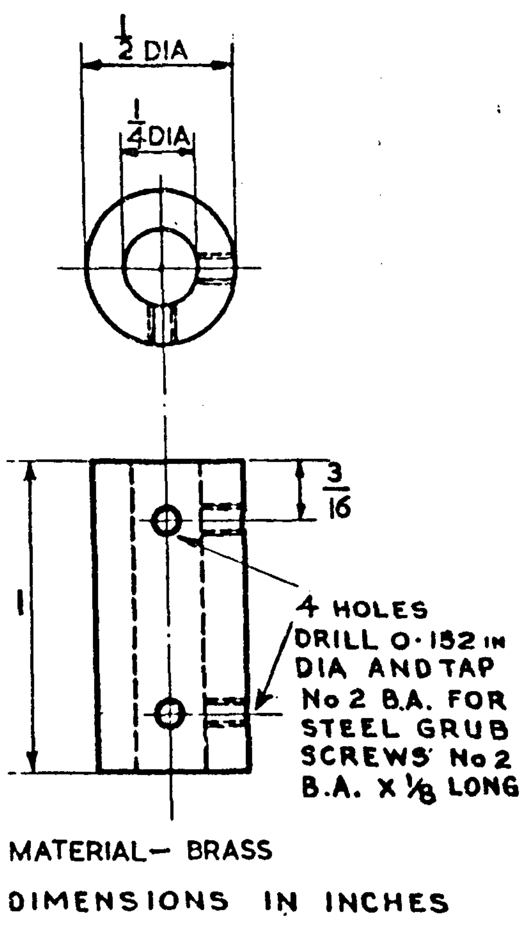


Fig 5 Shaft coupler for wavechange switch

Replacing wafers on SA (wavechange switch)

15. On the first occasion which necessitates renewal of a switch wafer the opportunity should be taken to cut the switch shaft and fit a shaft coupler; this will permit future renewal of wafers SA1 to SA7 without removal of the front panel. The shaft should be cut about 1 in. towards the front panel from SA7 and the coupler (see Fig 5) should be fitted so that the grubscrews are accessible with the switch at positions 1 and 5 (see Fig 2504 for layout). During removal or replacement of either portion of the shaft the switch must be in position 1 to permit free passage of the shaft through the inter-compartment earthing wipers.

Replacing SA1 to SA7

16. (a) Slacken the two grubscrews on the rear end of the coupler and withdraw the shaft as required through the hole in the rear wall of the coil-box.

(b) Note the connections, remove faulty wafer(s) and fit new one(s).

(c) Carefully replace the shaft and tighten the grubscrews.

Replacing SA8 or SA9

17. (a) Remove the front panel (see para 2 to 7).

(b) Slacken the coupler grubscrews nearest the front panel.

(c) Remove the nuts from the two screws securing the click-plate (and SA9 and SA8) and withdraw the click-plate and stub-shaft assembly.

(d) Note the connections, remove the faulty wafer(s) and fit new one(s). Note that SA9 may have a complete spare set of stator and rotor contacts fitted and these can be brought into use by replacing the wafer 180° from its original position so that the spare contact tags line up with the connecting wires.

(e) Refit the click-plate and stub-shaft assembly and tighten the coupler grubscrews.

(f) Refit the front panel.

Replacing wafers on SD (SELECTIVITY switch)

18. The shaft of SD carries the actuating arms of the variable selectivity transformers. Great care must be taken to replace these in the same position along the shaft, to prevent a side thrust developing in the plastic push-rods.

19. Proceed as follows:-

(a) Take out the two No 4 BA screws which retain the shaft bearing plate.

(b) Turn the SELECTIVITY switch to 'narrow'.

(c) Remove the split-pins from the actuating arms of T1, T3 and T4.

(d) Slacken the grubscrews of the three actuating arms.

(e) Slide the three actuating arms and the shaft bearing off the shaft.

(f) Unsolder the leads from the wafer(s).

(g) Remove the wafer(s).

(h) Reassemble the switch in the reverse order to that given above. Ensure that the push-rod actuating arms are held tightly to the switch shaft.

(j) After any repair involving stripping the SELECTIVITY switch, carry out an i.f. bandwidth test (see Table 6).

Replacing the ganged capacitor (C9)

20. (a) Take off the crystal calibrator and lay it on top of the i.f. transformers.

(b) Take out V5 to gain access to the fixing screw in the side of the capacitor cover.

(c) Remove this screw and the four screws on top of the cover.

(d) Lift off the cover. Use the tool shown in Fig 2 to release the h.t. switch.

(e) Use the plate shown in Fig 3 to mount the crystal calibrator and the h.t. switch on the rear cover bracket of C9.

(f) Untie the crystal calibrator pick-up lead.

(g) Unsolder all leads to C9 at the capacitor end, including all anti-oscillation earths.

(h) Remove the two No 2 BA screws holding the front cover bracket of C9 and remove the bracket.

(j) Slacken both grubscrews on the capacitor side of the flexible coupler.

(k) Remove the three No 2 BA brass nuts holding the capacitor fixing flanges.

(l) Slide the capacitor to the rear and lift to remove it completely. Do not disturb the settings of the knurled adjusting nuts.

(m) Transfer the flanges to the replacement capacitor.

(n) Mesh the plates of the replacement capacitor fully and fit it to the chassis.

(o) Rotate the TUNING dial to the low frequency end stop.

(p) Replace the three No 2 BA nuts, but do not tighten them fully.

(q) Slacken the grubscrews on the drive side of the flexible coupler. Check that the coupler may be spun freely on the junction of the shafts. If necessary, reposition C9. Tighten the three No 2 BA nuts.

(r) Tighten the shaft grubscrews.

(s) Replace the cover bracket.

(t) Replace all connections including the crystal calibrator pick-up lead.

(u) Replace the cover and carry out a calibration check (see para 33 and Table 4).

(v) The oscillator end plates may require adjustment of the slotted sections in order to obtain 0.5% calibration accuracy over the band. These adjustments must be made on range 1.

(w) Carry out the normal calibration procedure (Table 4). On range 1 check at 1Mc/s intervals, beginning at the l.f. end of the band. Move the segment next to be disengaged outwards to increase the local oscillator frequency, or inwards to decrease it. Check that the rotor does not short-circuit the vanes at any point.

(x) After each adjustment and before making measurements, replace the cover in order to establish the same stray capacitances.

(y) On completion of the calibration procedure, replace the h.t. switch and the crystal calibrator before finally securing the cover.

Backlash in drive

21. Backlash in the drive may take three forms of which pointer backlash or drive slip is more likely. The third form is only likely when the equipment has been subjected to severe mechanical shock.

Pointer backlash

22. After being in use for some time the pointer may cease to move with movement of the TUNING control, or may move in a jerky fashion, although the vernier drive follows the TUNING knob as before.

23. The probable cause is dust or grease etc on the pointer track-rods. This should be wiped off with carbon tetrachloride. On no account must oil be applied to the track-rods.

Drive slip

24. The vernier dial is driven by being gripped between a fixed and a spring loaded flange on the TUNING knob shaft. The amount of grip may be varied by means of a nut, which varies the pressure on the spring. The nut is held by a grubscrew, which may be seen from below the set by rotating the TUNING control. Do not allow the vernier to be gripped too tightly as this will make the drive very stiff.

25. Another cause of drive stiffness, which may cause apparent (although not actual) backlash, is incorrect positioning of the flywheel on the TUNING shaft. To correct this, rotate the TUNING until the hold in the flywheel lines up with the hole in the bottom edge of the panel. Insert a thin screwdriver, slacken the flywheel grubscrew and reposition the flywheel to give a free-running drive.

Normal backlash

26. The symptom here is that although both the pointer and the vernier are following the movement of the TUNING knob, tuning in a signal from opposite sides produces a different reading on the vernier scale. When this effect exceeds 1° of the vernier scale it should be attended to. Probable causes are:-

(a) Distortion of the flexible coupler.

(b) Ganged capacitor bearing seized or too tight.

(c) Main gear bearing seized or too loose.

ELECTRICAL

ALIGNMENT AND TESTING

General

27. The sensitivity of the receiver is such that no attempt at r.f. or i.f. alignment, or testing, should be made except in an effectively screened cage.

Test equipment

28. The test equipment required is given in Table 1.

Table 1 - Test equipment

Item	Designation	VAOS Part No
1 or 2	Signal generator, No 12 or Signal generator, No 1, Mk 3	Z4/ZD 02674 Z4/ZD 00391
3 or 4	Signal generator, No 13 or Signal generator, No 18	Z4/ZD 3941 Z4/ZD 04302
5	Wattmeter, absorption, a.f., No 1	Z4/ZD 00661
6	Instrument, testing, Avometer, universal, 50-range, Mk 2	Z4/ZD 00207
7	Frequency meter, SCR 211	Z4/ZC 1411
8	Voltmeter, valve, No 3	Z4/ZD 00657
9	Oscillator, beat frequency, No 8	Z4/ZD 00187
10	Oscilloscope, type 13A	Z4/10S/831

I.F. amplifier alignment

Preliminary

29. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
B.F.O.	OFF
CRYSTAL PHASING	OFF
TUNING	h.f. end of scale
Wavechange switch	5
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
SELECTIVITY	'broad'

(b) Remove V4

(c) Remove the cover from the r.f. section of the coil compartment.

(d) Unsolder the lead to the point marked 'X' shown on Fig 2504. Connect a signal generator (D or 75Ω termination) set to 450kc/s, modulated 30% at 300c/s, between this lead and chassis.

(e) Connect the a.f. wattmeter, set to 600Ω, 200mW, to the 600Ω output terminals of the receiver. Plug a pair of headphones into the receiver.

(f) Tune the signal generator over the i.f. range, setting the signal generator output level to give a reasonable receiver output, to ensure that all i.f. circuits are working.

(g) Proceed as detailed in Table 2.

Table 2 - I.F. alignment

Serial No	Action	Observations and remarks
1	Align all i.f. transformers to give maximum audio output in the headphones	
2	Switch the signal generator to c.w.	
3	Put the CRYSTAL PHASING control to the 12 o'clock position	
4	Switch on the set B.F.O. control and set it to one of the white lines	A.F. note heard in phones
5	Put the SELECTIVITY switch to 'narrow'	
6	Tune the signal generator around 450kc/s until the output meter reading suddenly increases	Indicating that the signal generator is tuned to crystal frequency
7	Adjust the signal generator tuning for maximum a.f. output. Reduce the output of the signal generator until the a.f. output is 50mW	If the b.f.o. is not aligned correctly some adjustment of the control may be necessary to avoid being near zero beat
8	Use a completely non-metallic trimming tool for these adjustments	
9	Adjust all the i.f. cores for maximum reading on the output meter	Reduce the signal generator output as necessary
10	Repeat this operation, tuning the signal generator for maximum a.f. output each time, until no further improvement can be made	Input for 50mW output should be 8 to 15μV

Table 2 - (cont)

Serial No	Action	Observations and remarks
11	Use Frequency meter, SCR 211 to measure the actual frequency of the signal generator output. Note this frequency	Frequency must be 450kc/s ±1.5kc/s. If not, the crystal must be changed
12	Turn the B.F.O. and CRYSTAL PHASING controls to OFF. Switch on the signal generator modulation (30% at 300c/s)	
13	Set the r.f. output of the signal generator to 25μV	
14	Turn the A.F. GAIN control to maximum and restore the a.f. output to 50mW by screwing the lower core of T1 (the core nearest the chassis) towards the top of the former	This gives a margin of gain for future curve shaping operations
15	Put the SELECTIVITY switch to the 'broad' position. Starting at 460kc/s, tune the signal generator over the entire i.f. pass-band, noting the general shope of the response curve	The response will be asymmetrical: one peak will be much higher than the other
16	Tune to the lower peak. Slowly and carefully adjust the core of T2 so as to set the a.f. output to the mean of the two peaks	Turn T2 clockwise to raise the low frequency peak and vice-versa
17	Check the response again. Repeat operation 16 if necessary	
18	Put the SELECTIVITY switch to 'narrow'. Tune the signal generator for maximum output. Adjust the lower core of T1 (see operation 14) to give a 50mW a.f. output	
19	Put the SELECTIVITY switch to 'broad'. Check the response again, paying particular attention to the change in response between the highest and lowest points of the 'flat' portion	The level must not change by more than 1.5dB over the 'flat' part of the response
20	Turn the SELECTIVITY switch to the second intermediate position (see Fig 2501b) and sweep the signal generator over the pass-band, when there is a pronounced dip following the low frequency peak	One side of the response curve will fall more steeply than the other
21	Carefully adjust the top (furthest from chassis) core of T1 to give as nearly symmetrical a response as can be judged from the behaviour of the output meter	This is purely a matter of the operator's judgement and, skill in the adjustment can only be acquired with practice

Table 2 - (cont)

Serial No	Action	Observations and remarks
22	Put the SELECTIVITY switch to 'narrow' and readjust the bottom core of T1 to give a 50mW a.f. output with the signal generator tuned for maximum output	
23	Put the SELECTIVITY switch to 'broad' and again check the response. Repeat the adjustments as necessary. Do not attempt to 'fill up the dip' in the response by adjustment of the top core of T1 with the SELECTIVITY switch in the 'broad' position. The indication on the output meter is far too coarse for this to be done successfully	
24	Plot a broad selectivity curve and compare with Fig 6 as a final check. Units in possession of a ganging oscillator (wobbulator) should use this instrument for this alignment.	Due to the inherent non-linearity of the test instrument, the low frequency peak will appear higher than the centre and the high frequency peak
25	The input to each i.f. stage for 50mW output should be approximately as follows:- Grid of V6 - 11mV Grid of V5 - 220µV Grid of V3 - 25µV	
26	Replace V4 and the lead to point 'X' on completion of the alignment	

30. For details of i.f. bandwidth tests, see Table 6.

Set b.f.o. alignment

31. Before proceeding with the r.f. alignment the set b.f.o. must be adjusted so that zero beat can be obtained on a correctly tuned signal with the B.F.O. control in the 12 o'clock position. The procedure is detailed in Table 3.

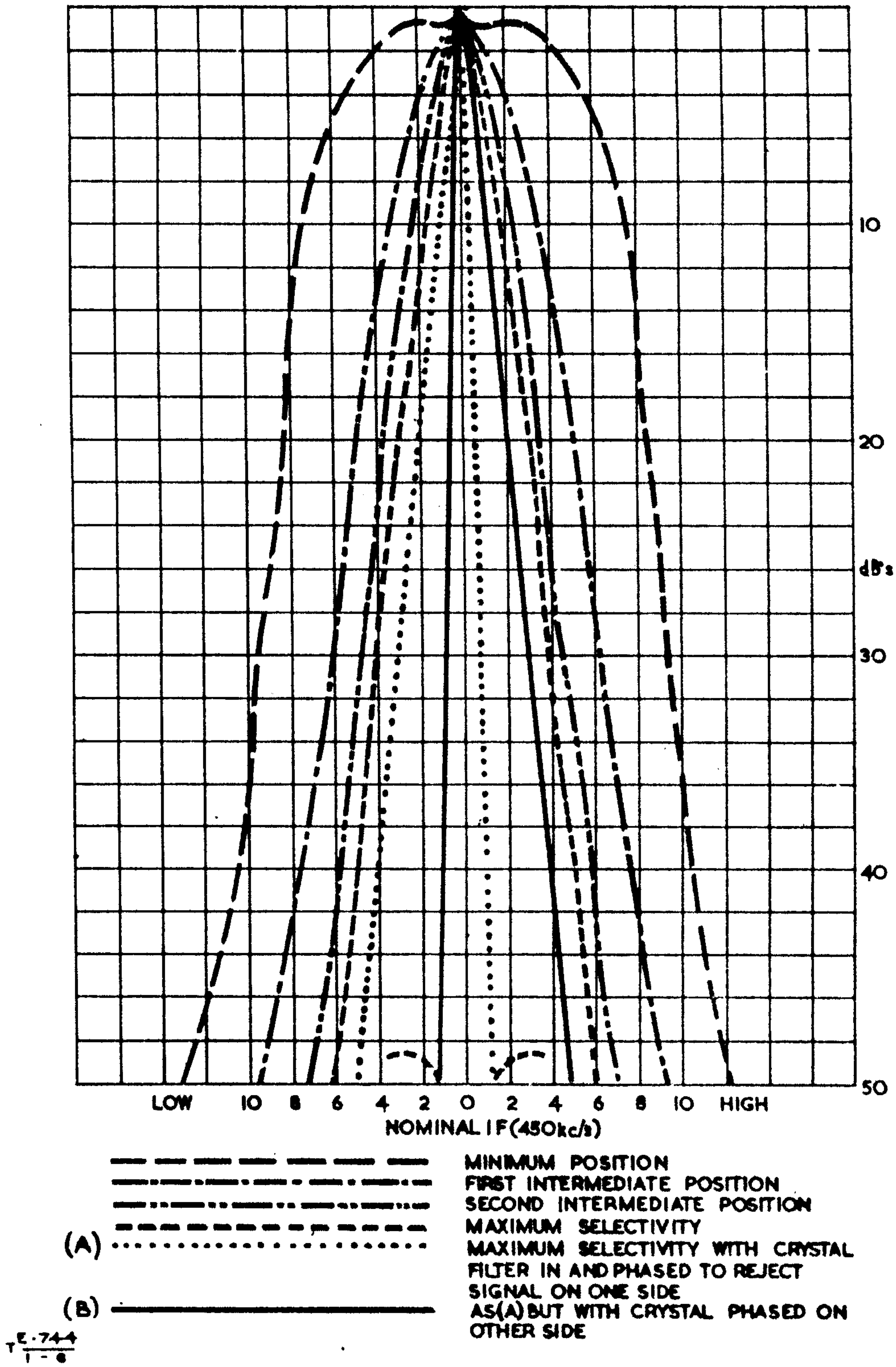


Fig 6 - Typical i.f. response curves

Table 3 - B.F.O. alignment

Serial No	Action	Observations and remarks
1	Remove V4. Set the receiver controls as follows:- R.F. GAIN — maximum A.F. GAIN — maximum B.F.O. — 12 o'clock position CRYSTAL PHASING — OFF TUNING — any position Wavechange switch — 5 A.V.C. — ON N.L. — OFF A.F. FILTER — OFF SELECTIVITY — 'narrow'	
2	Plug in a pair of headphones	
3	Connect the (75Ω or 'D' termination) output of a signal generator set to 450kc/s on c.w. to point 'X' shown on Fig 2504	
4	Tune the signal generator to the peak of the i.f. response using the receiver 'S' meter	Zero beat should be obtained if the b.f.o. is already aligned
5	Adjust the core of T7 for zero beat if the b.f.o. is off frequency	The a.f. tones heard when the B.F.O. control is on either of the white lines should be approximately the same

32. See para 39 for b.f.o. testing.

Local oscillator alignment

33. No attempt should be made to realign the local oscillator until the i.f. and b.f.o. circuits have been tested and if necessary, realigned.

Preliminary

34. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
SELECTIVITY	'narrow'
B.F.O.	12 o'clock position
CRYSTAL PHASING	OFF
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
Wavechange switch	1
TUNING	28Mc/s

(b) Connect Frequency meter, SCR 211 to either of the receiver aerial plugs via a 10pF capacitor.

(c) Plug a pair of headphones into the receiver.

(d) Refer to Fig 2503 for the location of the trimmers and coils mentioned in the following operations.

(e) The oscillator alignment procedure is detailed in Table 4.

Table 4 - Local oscillator alignment

Serial No	Action	Remarks
1	Inject a signal at 28Mc/s from the frequency meter	
2	Tune the receiver to zero beat	
3	Set the cursor adjuster to the mid-point of its travel	Pointer indicates 28Mc/s ±0.5%
4	Set the pointer to 28Mc/s by use of the TUNING control, if the pointer does not indicate 28Mc/s ±0.5%	
5	Adjust C89 for zero beat	
6	Inject a signal at 14Mc/s from the frequency meter	
7	Tune the receiver for zero beat	Pointer indicates 14Mc/s ±0.5%
8	Set the pointer to 14Mc/s and adjust the core of L16 for zero beat, if the pointer does not indicate 14Mc/s ±0.5%	
9	Repeat the adjustment of coil and trimmer until the calibration at the frequencies given is within the tolerance of ±0.5%	
10	Repeat at the frequencies given below, adjusting the trimmer at the high frequency end and the core of the coil at the low frequency end of each range	Tolerance at all check points is ±0.5%

Range	H.F. calibration point	Tol	Trimmer	L.F. calibration point	Tol	Coil
1	28Mc/s	±140kc/s	C89	14Mc/s	±70kc/s	L4
2	12Mc/s	±60kc/s	C90	6Mc/s	±30kc/s	L8
3	5.6Mc/s	±28kc/s	C94	2.5Mc/s	±12.5kc/s	L12
4	2.5Mc/s	±12.5kc/s	C97	1.2Mc/s	±6kc/s	L16
5	1Mc/s	±5kc/s	C100	0.5Mc/s	±2.5kc/s	L20

Table 4 - (cont)

Serial No	Action	Remarks
11	Disconnect the frequency meter	
12	See para 20 for details of moving vane adjustments, if the need to realign was occasioned by the replacement of C9	

R.F. amplifier and mixer alignment

35. No attempt should be made to realign the r.f. and mixer stages until the i.f. and local oscillator stages have been tested and, if necessary, realigned. The alignment procedure is detailed in Table 5.

Preliminary

36. (a) Set the receiver controls as follows:-

A.F. GAIN	maximum
R.F. GAIN	maximum
SELECTIVITY	'narrow'
B.F.O.	OFF
CRYSTAL PHASING	OFF
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
Wavechange switch	1
TUNING	28Mc/s

(b) Connect a signal generator (No 13 or 18) via its 75Ω output termination to one of the receiver aerial plugs. Set the signal generator to give an input to the receiver of 10μV at 28Mc/s, modulated 30% at 300c/s.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω output terminals on the receiver.

Table 5 - R.F. and mixer alignment

Serial No	Action	Remarks
1	Tune the receiver to the signal generator. Adjust the A.F. GAIN to give 50mW a.f. output	
2	Adjust C1, C18 and C35 for maximum a.f. output	See Fig 2503 for location of trimmers
3	Set the signal generator to 13.3Mc/s with modulation as before	

Table 5 - (cont)

Serial No	Action	Remarks
4	Tune the receiver to the signal generator and adjust the cores of L1, L2 and L3 for maximum a.f. output	
5	Repeat operations 1 to 4 until no further improvement can be made	
6	Repeat the alignment on each band at the test frequencies given below	

Range	Frequency	Trimmers	Frequency	Coils
1	28Mc/s	C1, C18, C35	13.3Mc/s	L1, L2, L3
2	12Mc/s	C3, C20, C38	6Mc/s	L5, L6, L7
3	5.4Mc/s	C4, C22, C40	2.6Mc/s	L9, L10, L11
4	2.3Mc/s	C5, C24, C42	1.2Mc/s	L13, L14, L15
5	1Mc/s	C6, C25, C43	0.52Mc/s	L17, L18, L19

Serial No	Action	Remarks
7	Disconnect the signal generator and output meter at the end of the test	

Crystal calibrator adjustment

37. Wrap a lead from the ANT terminal of a Frequency meter, SCR 211 around the power cable leading to the crystal calibrator. Set the frequency meter to 500kc/s. Switch on the set crystal calibrator. The beat note heard in the frequency meter headphones must not exceed 250c/s. If it does, remove the sliding cover from the crystal calibrator trimmer C85 and adjust C85 for zero beat. Workshops in possession of standard wavemeters should use these in preference to a frequency meter for this test. Where possible the use of the standard frequency transmissions (MSF or WWV) can be used to give an accurate check of crystal calibrator frequency.

'S' meter zeroing

38. Turn the R.F. GAIN control of the receiver to maximum and short-circuit aerial and earth. Put the SELECTIVITY switch to 'narrow'. Adjust R60 until the 'S' meter reads zero.

OVERALL TESTING

I.F. amplifier bandwidth

Preliminary

39. (a) Remove V4.

(b) Remove the cover from the r.f. section of the coil compartment.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the receiver output terminals.

(d) Connect a signal generator, set to the band centre frequency noted in Table 2 item 11, between point 'X' (Fig 2504) and chassis. Do not unsolder the lead to point 'X'. Set the signal generator attenuator to 50μV, modulated 30% at 300c/s (400c/s if Signal generator, No 1, Mk 3 is being used).

(e) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
B.F.O.	OFF
CRYSTAL PHASING	OFF
TUNING	l.f. end of scale
Wavechange switch	5
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
SELECTIVITY	'broad'

(f) Adjust A.F. GAIN for 50mW audio output.

(g) The procedure is detailed in Table 6.

Table 6 - I.F. bandwidth tests

<table>
<tr><th>Serial No</th><th>Action</th><th>Test limits</th></tr>
<tr><td>1</td><td>Increase the r.f. input by 3dB. Detune the signal generator on each side of the band centre until the a.f. output is again 50mW</td><td>Difference between the two frequencies so obtained must exceed 9kc/s</td></tr>
<tr><td>2</td><td>Increase the r.f. input by a further 42dB (45dB total). Detune each side of the band centre for a 50mW a.f. output</td><td>Difference between the two frequencies so obtained must not exceed 24kc/s</td></tr>
<tr><td>3</td><td>Repeat the test at each position of the SELECTIVITY switch, to the limits given</td><td></td></tr>
<tr><td></td><td colspan="2">
<table>
<tr><th rowspan="2">Selectivity switch</th><th colspan="2">Bandwidth (kc/s)</th></tr>
<tr><th>-3dB</th><th>-45dB</th></tr>
<tr><td>'Broad'</td><td>greater than 9</td><td>Less than 24</td></tr>
<tr><td>1st intermediate</td><td>greater than 4</td><td>Less than 16</td></tr>
<tr><td>2nd intermediate</td><td>greater than 2.5</td><td>Less than 13</td></tr>
<tr><td>'Narrow'</td><td>greater than 2.0</td><td>Less than 12</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Switch off the signal generator modulation. Put the SELECTIVITY switch to 'narrow' and CRYSTAL PHASING control to the 12 o'clock position</td><td></td></tr>
</table>

Table 6 - (cont)

Serial No	Action	Test limits
5	Connect a valve voltmeter switched to d.c. between the C72 side of R36 and chassis (chassis positive)	
6	Tune the signal generator for maximum output on the valve voltmeter	
7	Set the signal generator output to give 0.5V on the valve voltmeter	
8	Tune off by 1kc/s on either side. Adjust the CRYSTAL PHASING control for maximum rejection. Increase the signal generator output until the valve voltmeter reads 0.5V again	Increase in signal generator output must exceed 55dB

B.F.O. frequency range

40. With the receiver tuned to the crystal as in Table 2, serial No 6, insert a pair of headphones. Switch on the b.f.o. Turn the B.F.O. control each side of the 12 o'clock position. The a.f. output should be within ±3dB over the beat-note range 500c/s to 2.5kc/s.

Signal-to-noise ratio (voice)

41. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
CRYSTAL PHASING	OFF
TUNING	30Mc/s
Wavechange switch	1
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
SELECTIVITY	'broad'
B.F.O.	OFF

(b) Connect a Signal generator, No 13 or 18 to either of the aerial plugs (75Ω output termination). Set the signal generator to 10μV, modulated 30% at 300c/s and tune it to the receiver.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω receiver output terminals. Reduce the a.f. gain of the receiver until the a.f. output is 50mW.

(d) Switch off the signal generator modulation. The output must fall by at least 15dB.

(e) Repeat the test at each of the frequencies given in Table 7, with the same r.f. input and to the same limit.

Table 7 - Signal-to-noise ratio (voice and c.w.)

Range	Frequency (Mc/s)		
1	30	20	12.3
2	12.5	8.5	5.3
3	5.7	3.8	2.5
4	2.5	1.7	1.15
5	1.1	0.75	0.5
Signal-to-noise ratio to be at least 15dB with r.f. input of 5μV (attenuator set to 10μV), on voice and 1μV (attenuator 2μV) on c.w.			

Signal-to-noise ratio (c.w.)

42. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
CRYSTAL PHASING	OFF
TUNING	30Mc/s
Wavechange switch	1
A.V.C.	OFF
N.L.	OFF
A.F. FILTER	OFF
SELECTIVITY	'narrow'
B.F.O.	12 o'clock position

(b) Connect a signal generator to either of the aerial plugs (75Ω output termination). Set the signal generator to 30Mc/s unmodulated, output 2μV.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω output terminals.

(d) Plug in a pair of headphones. Tune the signal generator to the receiver (zero beat). Adjust the B.F.O. control for an a.f. output at approximately 1kc/s. Remove the headphones. Set the A.F. GAIN control for 50mW output

(e) Switch off the signal generator carrier. The wattmeter reading must fall by at least 15dB. Repeat to the same limit and with the same r.f. input, at each of the frequencies given in Table 7.

Image rejection

43. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	maximum
Wavechange switch	1
TUNING	30Mc/s
A.V.C.	OFF
N.L.	OFF
B.F.O.	OFF
CRYSTAL PHASING	OFF
SELECTIVITY	'narrow'
A.F. FILTER	OFF

(b) Connect a signal generator set to 30Mc/s, 10µV, modulated 30% at 300c/s, to either of the aerial plugs.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω output terminals of the receiver.

(d) Tune the signal generator for maximum a.f. output on the receiver. Reduce the a.f. gain of the receiver until the a.f. output is 50mW.

(e) Tune the signal generator to 30.9Mc/s. Increase its output by 40dB. Tune the signal generator for maximum a.f. output on the receiver. Adjust its attenuator until the a.f. output on the receiver is again 50mW. The signal generator output must be at least 30dB above 10µV.

(f) Repeat the test at each of the frequencies given in Table 8.

Table 8 - Image rejection

Range	Signal frequency	Image frequency	Image rejection (min)
1	30Mc/s	30.9Mc/s	30dB
2	12.5Mc/s	13.4Mc/s	40dB
3	5.7Mc/s	6.6Mc/s	65dB
4	2.4Mc/s	3.3Mc/s	80dB
5	1.1Mc/s	2.0Mc/s	80dB

Input 5µV (10µV on attenuator), modulated 30% at 300c/s

A.V.C. response

44. (a) Set the receiver controls as follows:-

A.F. FILTER	OFF
TUNING	any position
Wavechange switch	any position
N.L.	OFF
B.F.O.	OFF
CRYSTAL PHASING	OFF
A.F. GAIN	maximum
R.F. GAIN	maximum
A.V.C.	OFF
SELECTIVITY	'narrow'

(b) Connect a signal generator set at the receiver frequency, with an output of 10μV, modulated 30% at 300c/s, to either of the aerial terminals.

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω receiver output terminals.

(d) Tune the signal generator to the receiver. Adjust the A.F. GAIN for 50mW a.f. output on the receiver.

(e) Put the A.V.C. switch to ON.

(f) Increase the signal generator output by 80dB. The a.f. output of the receiver must not increase by more than 6dB.

(g) Repeat at each setting of the SELECTIVITY switch to the limits given in Table 9.

Table 9 - A.G.C. response

SELECTIVITY position	Maximum rise in output for 80dB change of input
'Narrow'	6dB
2nd intermediate	7dB
1st intermediate	8dB
'Broad'	18dB
Receiver set to 50mW output with input of 5μV (10μV on attenuator) and A.V.C. switch OFF.	

I.F. rejection

45. (a) Set the receiver controls as follows:-

A.F. GAIN	maximum
R.F. GAIN	maximum
Wavechange switch	5
TUNING	480kc/s
A.V.C.	OFF
N.L.	OFF
B.F.O.	OFF
A.F. FILTER	OFF
CRYSTAL PHASING	OFF
SELECTIVITY	'narrow'

(b) Connect a signal generator, set to give 480kc/s, modulated 30% at 300c/s (400c/s if using Signal generator, No 1, Mk 3), to either of the aerial plugs. Set the signal generator attenuator to 10µV (5µV input to set).

(c) Connect an a.f. wattmeter (600Ω, 200mW) to the 600Ω output terminals of the receiver and tune the receiver for maximum a.f. output. Adjust the A.F. GAIN until the receiver output is 50mW.

(d) Tune the signal generator to 450kc/s. Increase its output until a reading is obtained on the output meter. Tune the signal generator for maximum output near 450kc/s. Adjust the signal generator attenuator for a receiver a.f. output of 50mW.

(e) The increase in signal generator attenuator reading must be at least 55dB.

I.F. output

46. (a) Set the receiver controls as follows:-

R.F. GAIN	maximum
A.F. GAIN	any position
TUNING	any position
Wavechange switch	any position
A.V.C.	OFF
N.L.	OFF
B.F.O.	OFF
A.F. FILTER	OFF
CRYSTAL PHASING	OFF
SELECTIVITY	'narrow'

(b) Connect a signal generator set to 10µV, at the receiver frequency and modulated 30% at 300c/s to either of the receiver aerial terminals.

(c) Connect a valve voltmeter via its probe to the i.f. output plug.

(d) Tune the signal generator to the receiver. The i.f. output must be at least 100mV.

Operation of noise limiter

47. No quantitative test on this part of the circuit can be carried out without a noise generator. The following check provides some assurance that the circuit is operating.

48. Move the receiver out of the screened cage. Tune to a noisy part of the band without an aerial connected. Connect a c.r.o. to the 600Ω output terminals. Adjust the c.r.o. gain controls until the noise 'grass' is one inch high. Switch on the noise limiter. The noise height should fall to about a quarter of an inch.

A.F. response

49. (a) Connect an Oscillator, beat frequency, No 8 via a 100kΩ resistor to the P.U. terminals of the receiver.

(b) Connect an a.f. wattmeter (600Ω, 2W) to the 600Ω output terminals.

Note: This Page 27, Issue 2, supersedes Pages 27 and 28, Issue 1, dated 21 Mar 60. These pages have been revised throughout.

c. Set the SELECTIVITY SWITCH to BROAD and the NOISE LIMITER SWITCH to OFF.

d. Turn the AG GAIN to maximum. Set the b.f.o. to 1kc/s and adjust its output to give 1W a.f. output from the set. Keeping the b.f.o. output constant, check the frequency response against the limits in Table 10.

Table 10 - A.F. response

Frequency	Output
1kc/s	0dB = 1W
300c/s - 7kc/s	± 1dB
Below 300c/s	-1dB to -5dB (at 100c/s)
Above 7kc/s	-1dB to -3dB (at 10kc/s)

A.F. filter response

50. a. With the equipment connected as in para 40 and the signal generator modulated 30°/o at 1kc/s using an external b.f.o., tune the b.f.o., to give a maximum a.f. output with the AF FILTER switch to ON. Note this frequency and a.f. output level.

b. Detune the b.f.o. on each side of the peak until the a.f. output is 6dB down on that level noted in para a. above. The difference between the frequencies at which this occurs must be not less than 100c/s.

c. Repeat for a fall in a.f. output of 25dB down on that frequency noted in para a. The difference between the frequencies must not be greater than 250c/s.

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END