RECEIVER, RADIO, RACAL, TYPE RA17 MK 2 AND RA17L

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

This EMER must be read in conjunction with TELS E 722 Part 2 which contains figures and tables to which reference is made.

Note: This Issue 2, Pages 1 to 29 supersedes Issue 1, Pages 0 dated 21 Jul 63, 01 dated 16 Jul 65, and 1-28, dated 11 Jan 63. The regulation has been revised throughout.

SUBJECT INDEX

SUBJECT INDEX - (cont)

INTRODUCTION

1. Realignment of this receiver, should not be considered until all possible causes of low sensitivity have been eliminated, and should only be undertaken if the prescribed test equipment is available. If alignment becomes necessary only very small adjustment should be required even when sub-units are changed as these are realigned during manufacture. Para 44 to 46 can only be carried out by workshops holding item e. in Table 1. Table 1 lists all the test equipment required to carry out alignment and specification testing of the receiver.

Table 1 - Test equipment

Item	Designation	Part No.	Alternative	Part No
a	Multimeter, electronic, CT429	Z4/6625-99-943-8348	Voltmeter, valve, No 3 equipment	Z4/6625-99-949-0470
b	Signal generator, video frequency, No 1, CT416 equipment No 2	Z4/ZD 04247	Oscillator, beat frequency, No 8, equipment	Z4/ZD 00198
c	Signal generator, set, No 12/2 CT320A	Z4/6625-99-102-8077	Signal generator, No 12	Z4/ZD 02674
d	Signal generator, set, No 18 Mk2 CT402 equipment	Z4/6625-99-103-6633	Signal generator, No 13	Z4/WD 3491
e	Oscillator, frequency swept, CT501	Z4/NIV	Wobbulator Samwell & Hutton type 78M	Z4/00000-01835
f	Counter, electronic, frequency	Z4/6625-99-933-1822	Wavemeter, standard, No 2, Mk 1/2 equipment	Z4/ZD 03772
g	Convertor, frequency, electronic	Z4/6625-99-103-3677		
h	Multimeters, set CT498A	Z4/6625-99-105-7049	Multimeters, Avo, model 9SX, panclimatic equipment	Z4/6625-99-949-1999
j	Signal, generator, set, Marconi type TF1168	Z4/6625-99-949-2964		
k	Attenuator, variable, CT421	Z4/5905-99-972-9733		
l	Wattmeter, absorption, a.f., No 1, CT44	Z4/6625-99-949-0510		
m	Amplifier, wideband	Z4/ZD 04495		
n	Oscilloscope, set, CT436 with probe	Z4/6625-99-102-6694	Oscilloscope, type 13A	Z4/10S/831
o	Capacitor, variable, 14.5pF	Z/5910-99-011-1782		
p	Resistor, fixed, 75Ω 5% 1W	Z/5905-99-021-5109		
q	Panel, test, electrical, Marconi TF1245	Z4/6625-99-103-1083	) Meter circuit, magnification No 1 Mk3	Z4/WD 4024
r	Test oscillator, Marconi TF1246	Z4/6625-99-103-5187	)	
s	Resistor, 4.7kΩ	Z/5905-99-022-2089		

DISMANTLING AND RE-ASSEMBLY

SUB-UNITS

2. The receiver can be quickly dismantled, as described in para 4-15 into the following sub-units.

a. Front panel consisting of:-

(1) Dial escutcheon
(2) Loudspeaker and grill
(3) R.F./A.F. level meter

b. Second variable frequency oscillator (v.f.o-2) consisting of:-

(1) 2-3Mc/s tunable band-pass filter
(2) The associated conversion oscillator (V12)
(3) Third mixer (V11)

c. First variable frequency oscillator (v.f.o-1) consisting of:-

(1) R.F. amplifier (V3)
(2) The first mixer (V7)
(3) The associated conversion oscillator (V5).

d. 100kc/s i.f. unit consisting of:-

(1) Beat frequency oscillator
(2) Crystal filters
(3) L.C. filters
(4) I.F. amplifiers (V14, V16 and V17)
(5) A.G.C. and time constant stages (V18)
(6) Detector and noise limiter (V21)

e. Calibrator unit (V13 and V15)

f. The main chassis consisting of:-

(1) Antenna attenuator
(2) Crystal oscillator (V1)
(3) Harmonic generator (V2)
(4) Harmonic mixer (V4)
(5) 40Mc/s band-pass filter
(6) 37.5Mc/s band-pass filter and associated amplifiers (V6, V8 and V10)
(7) Second mixer (V9)
(8) A.F. output stages (V22 and V23)
(9) Power supplies

3. When replacing sub-units all securing screws must be tightened sufficiently to maintain screening efficiency.

Front panel

4. To remove the front panel:-

a. Remove all the controls.

b. Remove the securing nuts from the speaker and meter switches and push the switches through the panel.

c. Unscrew the eight instrument-head panel fixing screws. The two screws adjacent to the jack sockets are held by nuts on the underside of the chassis so the bottom cover must be removed.

d. Carefully withdraw the panel; unsolder the connections to the speaker and disconnect the meter leads. The panel may now be completely removed.

5. To replace the panel, adopt the reverse procedure to that detailed in para 4. When replacing the B.F.O. NOTE control ensure that the red mark on the shaft is uppermost so that zero beat is obtained when the pointer indicates zero.

Second variable frequency oscillator (v.f.o-2)

6. To remove the v.f.o-2:-

a. Remove the bottom cover and unsolder the three connections on the four way tag strip in compartment 6 (see Tels E 722 Part 1, Fig 1).

b. Remove the front panel (para 4).

c. Withdraw the crystal-calibrator unit after removing the knurled screw, slacken the knurled nut and disconnect the coaxial cable.

d. Release the cable cleat securing the dial lamp cable and unclip the lamp.

e. Disconnect the v.f.o-2 coaxial cable from the main chassis. The r.f. plug PL5 is fixed and must be released from the rear bracket.

f. Unscrew the v.f.o-2 cover and remove the three retaining screws.

g. The v.f.o-2 may now be withdrawn by twisting clockwise and carefully easing out. Do not remove the MC/S dial unless it is damaged as this will affect the calibration.

7. Before replacing the v.f.o. unit, clean the wormwheel and the split gear on the ganged capacitor shaft thoroughly and then apply, with a brush, a thin coating of Molybdenum disulphide grease (Part No 9150-99-942-5132) to the wormwheel. Ensure that the side-cover is in place before the v.f.o. is secured to the chassis.

Film scale

8. To remove the film scale:-

a. Rotate the KILOCYCLES control until the tuning mechanism reaches the 100kc/s end stop. If the scale is being replaced with the v.f.o. on the chassis remove the front panel as in para 4.

b. Hold the two gears situated above the film bobbins and remove the plate carrying the fibre idler gear.

c. Allow the two gears to unwind slowly and then remove the film scale.

9. To fit the film scale:-

a. Pass the 1000kc/s end around the drive sprocket and wrap the end around the split pin on the inner bobbin. Rotate this bobbin until most of the film is wound.

b. Drop the other end of the film round the split pin on the other bobbin then rotate this bobbin clockwise until the film is taut.

c. Wind the gears in opposite directions for approximately one turn, and, while holding the gears under tension, re-engage the idler gear.

d. Secure the plate by the two fixing screws and then check the calibration in accordance with para 30.

Ganged capacitor

10. To remove the ganged capacitor:-

a. Remove the film scale as in para 8 to avoid damage.

b. Unscrew the remaining cover-plate and the under chassis screen.

c. Unsolder the capacitor connections.

d. Remove the drive gear and collet.

e. Unscrew the three fixing screws holding the capacitor to the bracket while ensuring that the anti-backlash gears are loaded.

11. Replace the capacitor in the opposite sequence to that detailed in para 10 then check the following points:-

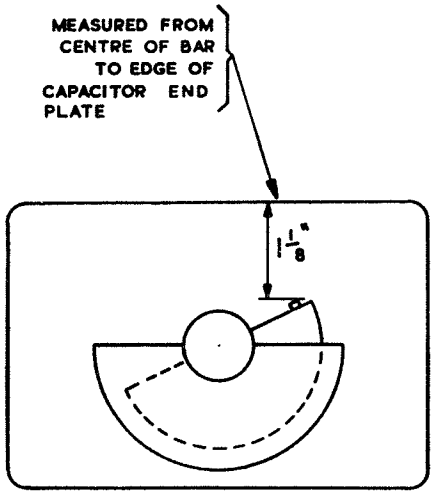

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Fig 1 - Adjustment of ganged capacitor

a. Set the film scale against the mechanical end stop at the 1000kc/s end of the scale and check that the capacitor is set as shown in Fig 1. The KC/S cursor should be in line with the MC/S cursor.

b. Check that the distance from the cursor to the extreme end of the scale, adjacent to the 100kc/s point, is approximately 0.5 in. Should this distance vary appreciably from 0.5 in. carefully lift the scale from the drive and move it round to the required position.

c. After replacement of the capacitor, v.f.o-2 will have to be re-aligned in accordance with para 30.

First variable frequency oscillator (v.f.o-1)

12. To remove the v.f.o-1:-

a. Remove the front panel (see para 4), the bottom cover and the screens from sections 3, 8 and 13 (see Tels E 722 Part 1 Fig 1).

b. Unsolder the connecting wires from the two turret lugs situated in compartment 3 adjacent to compartment 9, the lead to the turret lug in compartment 8, the pin connections in compartment 5 and the screened cable in compartment 13 which passes through the grommet in the main chassis.

c. Unscrew the three fixing screws on the top of the unit.

d. If v.f.o-2 is still fitted to the chassis, remove the right-hand gusset plate to allow v.f.o-1 to be lifted free.

Replacement of the chain

13. Hold chain tension sprocket down towards the chassis and fit the 63-link chain round the two chain wheels. When releasing the tension sprocket ensure that the chain is held under tension.

100kc/s i.f. strip

14. To remove the 100kc/s i.f. strip:-

a. Remove the left-hand gusset plate adjacent to the unit.

b. Unsolder the leads to the 4-way and 12-way tag strips and the 100kc/s output plugs. Disconnect the coaxial lead to v.f.o-2.

c. Remove the six screws securing the unit to the main chassis.

d. If the front panel is still fitted, remove the I.F. GAIN control on the b.f.o. assembly to gain access to one of the six securing screws.

Beat frequency oscillator

15. If the i.f. strip and front panel are still on the chassis proceed as follows:-

a. Remove the front panel (see para 4), left-hand gusset plate and bottom cover.

b. Disconnect the leads from the IF GAIN control.

c. Remove the screw securing the cable cleat situated adjacent to L81 on the underside of the i.f. strip.

d. Disconnect the red/white lead of the b.f.o. cableform from the terminal on the 12-way tag strip and withdraw this lead from the cableform.

e. Disconnect brown leads from pin 4 of V18 and the yellow leads from pin 9 of V21.

f. Remove the three No. 6 BA screws and shock-proof washers to release the b.f.o. unit from the i.f. unit.

TESTING AND RE-ALIGNMENT

GENERAL

16. Before commencing re-alignment of the receiver remove the gusset plate adjacent to the 100kc/s i.f. strip. Paragraphs 44-46 are only to be attempted by workshops holding an Oscillator, frequency swept, CT501 or similar equipment.

Adjusting multimeter input capacitance

17. In certain tests it is necessary to adjust the multimeter input capacitance to 12pF and this is carried out as follows.

a. Using the Meter circuit, magnification (Q meter) and its associated 0.2µH coil, set the frequency to 30Mc/s and adjust the capacitor for resonance.

b. Solder the variable capacitor (item o) across the multimeter terminals and then connect the combination across the CAPACITOR terminals on the Q meter.

Total multimeter capacitance = C_o-C
C = Initial Q meter capacitance
C^o= Final Q meter capacitance

c. Adjust the trimmer until the multimeter capacitance is the value required.

AUDIO STAGES

18. Set the controls as follows:-

A.F. GAIN to max.
I.F. GAIN to min.
A.F. LEVEL to max.
B.F.O. off.
LIMITER off.
SPEAKER to OFF.

19. Connect the Signal generator, video frequency, No 1 to the junction of R135 and C218, and the a.f. wattmeter across the required output terminals. The audio stages should be checked as follows:-

a. With an input of 0.3V at 1000c/s the output power at the 3Ω terminals should exceed 45mW on the 2.5Ω range on the a.f. wattmeter.

b. With an input of 0.35V at 1000c/s the output power at the 600Ω terminals, with the A.F. LEVEL control set at maximum should exceed 10mW on the 600Ω range on the a.f. wattmeter.

c. Vary the frequency over the range 350c/s to 8kc/s, keeping the input constant, and check that the output power does not fall by more than half (ie 3dB).

100KC/S I.F. FILTERS

Conditions

20. Remove V12
System switch to MAN
I.F. GAIN to max.
METER switch to R.F. LEVEL
B.F.O. off
LIMITER off
SPEAKER off

First and second i.f. amplifiers

21. Connect the Signal generator, TF1168, adjusted to 100kc/s (crystal checked), via a 0.1μF capacitor, to the grid of V16 (pin 1). Adjust C191 to obtain maximum indication on the panel meter. The signal generator output required for 100μA deflection should be approximately 400mV. Change the generator connections from V16 to the grid of V14 (pin 1) and connect a 4.7kΩ damping resistor across L72. Adjust C179 and C195B to give maximum indication on the panel meter. Remove the 4.7kΩ resistor from L72 and connect it across L73. Adjust C171 for maximum indi-

cation on the meter. Remove the 4.7kΩ resistor. The generator output should be approximately 1mV, for 100μA deflection on the meter.

22. Tune the generator through the passband and note the double peak response. The peak separation should be between 5kc/s and 5.6kc/s (approximately 9kc/s on RA17L) and be symmetrical about 100kc/s. If the peak amplitudes differ, slight re-adjustment of C195B will compensate for this. The 6dB bandwidth should be approximately 9.5kc/s (14kc/s on RA17L).

100kc/s L.C. filter
(Fig 2 and 3)

23. Connect the generator, set to 100kc/s (crystal checked), via a 0.1μF capacitor to pin 5 of V12 valve base. Remove the L.C. filter can. Link R77 to C153 and R80 to C158, then replace the filter can.

24. Set the bandwidth on the receiver to 1.2kc/s. Increase the generator output until an indication is shown on the meter. Adjust C162, C158, C153 and C147 in this order several times until maximum output is obtained, reducing the signal generator output as necessary. Remove the links and replace the filter can. Tune the signal generator for maximum deflection on the panel meter and check that the frequency is 100kc/s ±100c/s.

25. Check that the 8kc/s, 3kc/s and 1.2kc/s (13kc/s, 6.5kc/s, 3kc/s and 1.2kc/s on RA17L) bandwidths and sensitivity figures agree with those given in Table 2. The 13kc/s 66dB bandwidth can only be checked using the Signal generator No 12/2 (set to 1V) and the attenuator, variable, CT421. Set the variable attenuator for 100μA level on the meter and reduce attenuation by 66dB, taking steps to protect the meter. Tune either side of 100kc/s to the frequencies (checked on the counter) which restores the 100μA level. Typical response curves are shown in Fig 2 and 3.

Table 2 - L.C. filter, sensitivity and bandwidth figures

Switch position kc/s	Sensitivity μV		Overall bandwidth 6dB down		Overall bandwidth 66dB down
	RA17 Mk 2	RA17L	Min kc/s	Max kc/s	Max kc/s
1.2	150	225	0.950	1.2	8
3.0	140	160	2.85	3.3	15
8.0	180		7.6	8.4	20
6.5		200	6.5	7.8	22
13.0		350	12.3	14.3	28

Crystal filter
(Fig 2 and 3)

26. Connect the Signal generator, TF1168, crystal checked at 100kc/s via 0.1μF capacitor to pin 5 of V12 valve base. Set BANDWIDTH switch to 750c/s (300c/s on RA17L). Tune slowly through the passband and observe the crystal responses. Care must be taken as these are very sharp. Retune the generator to the mean of these responses and adjust C110 and C148 for maximum output. Tune the generator through the passband and ensure that the peak-to-trough ratio does not exceed 3dB (ie 1.4:1) and that the peaks are approximately equal in amplitude. It may be necessary to repeat these adjustments several times to obtain the best response.

27. Having completed the initial adjustments, follow the procedure detailed in Table 3, making the required adjustments using information listed in Columns A, B and C for bandwidth settings of 750, 300 and 100c/s respectively. For RA17L columns B and C only apply; sensitivity figures given in brackets apply to RA17L only.

Table 3 - Alignment of crystal filters

	Operation	Bandwidth 750c/s A	300c/s B	100c/s C	Units
1	Set the signal generator to 100kc/s (crystal checked) and adjust output for 100µA on panel meter Tune the generator to:- (Column A for 750c/s)	101.25	101.025	100.925	kc/s
2	Increase the output by 66dB				
3	Adjust the phasing capacitor to obtain minimum deflection (ie point of rejection)	C120	C119	C118	
4	Increase the generator frequency slowly and check that the meter reading does not exceed 100µA (this ensures that there are no spurious responses outside the required passband).				
5	Slowly decrease the generator frequency until 100µA is obtained on the meter and check that the frequency is not greater than:-	101.125	100.9	100.8	kc/s
6	Set the signal generator to:- Increase the output until the deflection on the panel meter is 100µA. Note generator setting and reduce to 100µV	101.125	100.9	100.8	kc/s
7	Tune the signal generator to 98kc/s and reset the generator output to value noted in 6				
8	Gradually increase the frequency until the deflection on the panel meter is 100µA. This should occur at a frequency not less than:-	98.875	99.1	99.2	kc/s
9	Slowly decrease the generator frequency and ascertain that the meter reading does not rise above 100µA. Reduce the signal generator output to 100µV				
10	Set the signal generator to 100kc/s (crystal checked) and adjust output for 100µA. The signal generator attenuator setting should not exceed:-	210	150(200)	120(150)	µV
11	Increase the signal generator output by 6dB and check the bandwidth for a 100µA level is within:- Mid frequency must be within 25c/s of 100kc/s	700-800	270-330	80-120	c/s
12	Protect panel meter (signal generator well off tune) and increase output by a further 60dB and check the 66dB bandwidth does not exceed:- Reduce signal generator output to 100µV.	2.2	1.7	1.4	kc/s

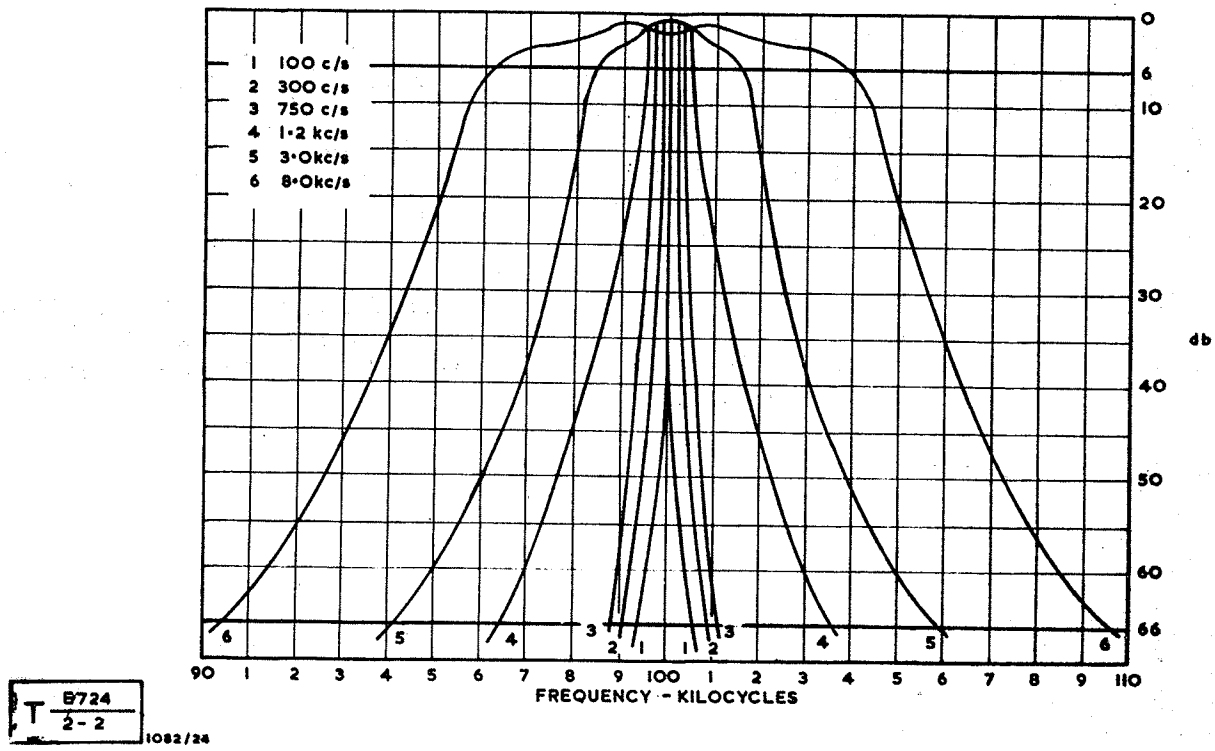

Fig 2 - Typical selectivity curves for 100kc/s filter (RA17 Mk2)

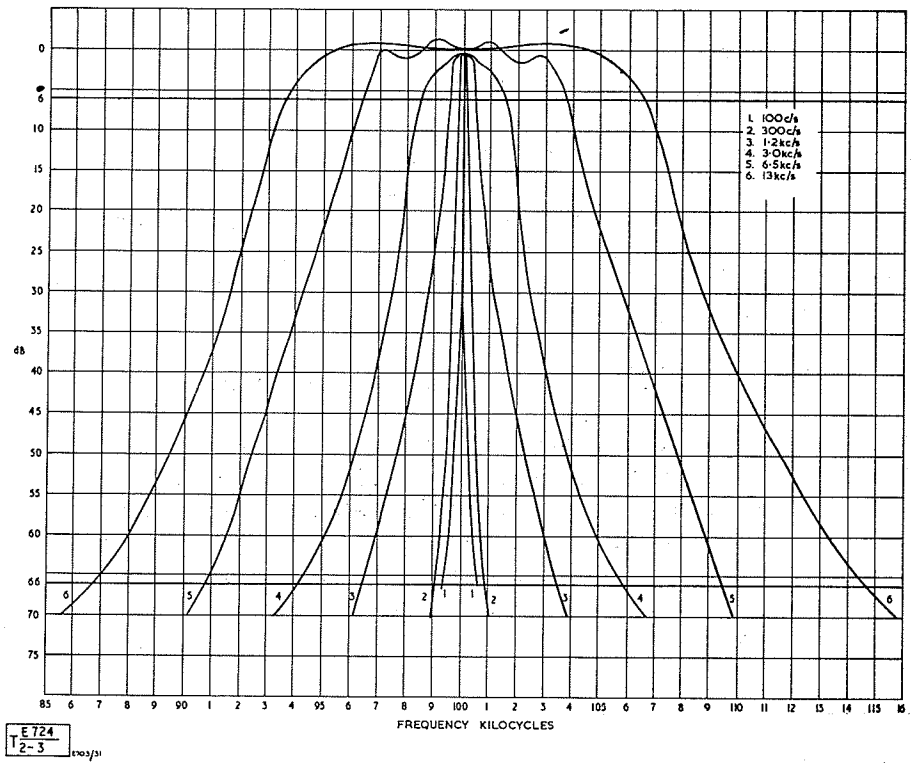

Fig 3 - Typical selectivity curves for 100kc/s filter (RA17L)

NOISE LIMITER

28. Remove V12 and set the system switch to MAN; I.F. and A.F. GAIN controls to max and the METER switch to R.F. LEVEL. Connect the Signal generator, No 12/2, set to 100kc/s c.w. via 0.1μF capacitor, to the grid of V14 (pin 1). Connect the Y1 plate of the Oscilloscope, CT436 to the slider of the A.F. GAIN control RV2. Adjust the generator output to produce 100μA deflection on the panel meter. Switch to amplitude modulation and adjust to 30% mod. Adjust the time base on the oscilloscope to produce a steady trace.

29. Switch on the limiter and check that the waveform displayed on the oscilloscope is clipped (ie, the bottom of the waveform should become almost flat) when the modulation depth is between 30% and 35%. Switch off the limiter, disconnect the signal generator and replace V12.

SECOND V.F.O. (V.F.O-2)

30. a. Conditions:-

System switch to CAL.
KC/S cursor in line with MC/S cursor (ie central).
B.F.O. off.
I.F. GAIN to max.
BANDWIDTH switch 3KC/S.

b. Procedure:-

(1) Set the KC/S scale to zero (OKC/S) and adjust trimmer C136 for zero beat note in the loudspeaker. Note C136 is obscured by V16.

(2) Set the KC/S scale to the zero beat point which is nearest to the 1000KC/S position and lock the drive mechanism.

(3) Adjust the position of the film scale as follows, if necessary, to produce correct calibration. Grip both sides of the film in order to create a loop which will allow the film to slide round the drive sprocket. The sprocket is on the left when facing the receiver hence movement of the scale will have to be to the left.

(4) Repeat (1) to (3) until calibration is correct.

31. The calibration of the v.f.o. should now be checked at the 100kc/s intervals. If the error at any point exceeds 1kc/s, very slight repositioning of the KC/S cursor (eg, 1kc/s) and subsequent recalibration should correct the error. If this does not correct the error, carefully adjust the two outer plates of the rotor of the oscillator section of the ganged capacitor to correct the calibration. This should not be necessary unless the capacitor unit has been replaced. The oscillator section, C139, is the second from the rear of the v.f.o-2 chassis.

BEAT FREQUENCY OSCILLATOR (B.F.O.)

32. Set the system switch to CHECK B.F.O. and the METER switch to R.F. LEVEL.

Switch the b.f.o. 'on' and set its dial to zero. Adjust C201, if necessary, to obtain zero beat. Check that the meter deflection exceeds 100μA.

33. If the b.f.o. frequency control knob has been removed, adjust C201 to obtain zero beat with the identification mark on the shaft uppermost. Replace the knob so that the pointer indicates zero.

34. For the RA17L the B.F.O. range must exceed ±7.8kc/s and accuracy of calibration must be within ±20%.

SECOND MIXER STAGE (V9)

35. Set the controls as follows:-

System switch to MAN
I.F. GAIN to max
BANDWIDTH switch to 3KC/S
MEGACYCLES dial to 20
METER switch to R.F. LEVEL

36. Remove the 1Mc/s crystal and connect the Signal generator, No 12/2 set to c.w., to test point 3 (TP3). The alignment frequencies to be used are 2.2Mc/s and 2.9Mc/s which correspond to 800 and 100 respectively on the KC/S scale. Adjust C122, C125, and C128 at 100 and L57, L58 and L59 at 800. Repeat as necessary until alignment is correct at both ends of the band. The signal generator output required for 100μA deflection on the meter should not exceed 7.0μV.

37. Finally check with the signal generator set to 2.5Mc/s, corresponding to 500 on the KC/S scale, that the input does not exceed 7.5μV for 100μA deflection on the meter.

Image rejection

38. Set the controls as in para 35 and the signal generator to 2.2Mc/s. Tune the KILOCYCLES control for maximum deflection on the panel meter. Adjust the signal generator output for 100μA deflection and note the generator output. Increase the signal generator frequency by 200kc/s (ie, set the frequency to 2.4Mc/s) and then increase the output by 60dB. Check that when the signal generator has been adjusted slightly for maximum output that the panel meter deflection does not exceed 100μA.

39. Repeat the procedure detailed in para 38 at a carrier frequency of 2.9Mc/s and an image frequency of 3.1Mc/s (ie, 2.9Mc/s +200kc/s = 3.1Mc/s).

37.5MC/S FILTER AND AMPLIFIER

40. Remove V9, V5 and the 1Mc/s crystal. Set the system switch to MAN and check that all screening covers are in place. Connect the Multimeter CT429 shunted to 12pF, (see para 17) to TP3. Connect either the Signal generator No 18 or 13 to TP1 and set it to 37.5Mc/s, checked against the counter. If a sweep generator is available for aligning the 40Mc/s filter, adjust L50, C90, C81, C72, C63, C55, C45, C35, C24, L28 and L33 in that order, several times, to obtain maximum reading on the Multimeter. If a sweep generator is not available do not adjust L50 as this affects the 40Mc/s filter.

41. When the filter has been peaked, adjust the signal generator output for 1V deflection on the multimeter. Increase the signal generator output by 6dB, tune the signal generator either side of 37.5Mc/s until the deflection is again 1V. Measure these frequencies on the counter and note the overall bandwidth.

42. Reduce the output and reset the signal generator to 37.5Mc/s. If using the signal generator No 18 proceed as in a , or if using the signal generator No 13 proceed as in b:-

a. Signal generator No 18:

Disconnect the output lead from the signal generator and insert the Amplifier wideband on its x10 range, between TP1 and the signal generator. Set the signal generator output for 1V deflection on the multimeter. Detune the signal generator and increase its output by 40dB. Tune the signal generator either side of 37.5Mc/s until the deflection on the multimeter is again 1V. Measure these frequencies on the counter and note the 40dB bandwidth.

b. Signal generator No 13:

Disconnect the output load from the signal generator and insert the attenuator, variable, CT421 between TP1 and the generator. Set the signal generator output to 1V and adjust the attenuator variable for 1V deflection on the multimeter. Detune the signal generator and reduce the variable attenuator setting by 40dB. Tune the signal generator either side of 37.5Mc/s until the deflection on the multimeter is again 1V. Measure these frequencies on the counter and note the 40dB bandwidth.

Table 4 - Specification limits for 37.5Mc/s filter

a.	For 1V at TP3 the input should not exceed 2.8mV.
b.	Overall bandwidth at 6dB down should be between 230kc/s and 300kc/s with centre frequency not more than 20kc/s from 37.5Mc/s.
c.	Overall bandwidth at 40dB down should not exceed 750kc/s with centre frequency not more than 25kc/s from 37.5Mc/s.

43. If the gain of the filter is found to be low the test figures given in Table 5 should help to isolate the fault.

Table 5 - Test figure for 37.5Mc/s filter

Input	Frequency	Input voltage	Output at TP3	Conditions
Grid V10	37.5Mc/s	40mV via 0.1μF	1V	V5, V9 and 1.0Mc/s Crystal removed
Grid V8	37.5Mc/s	25mV via 0.1μF	1V	

Trimmer C108

44. Trimmer C108 is adjusted to reduce interaction between the 37.5Mc/s filter and

40Mc/s filter but adjustment must not be carried out unless a wobbulator is available for re-aligning the 40Mc/s filter. Rotate trimmer C88, the final trimmer in the 40Mc/s filter, through 360° and check that the multimeter reading (1V) at 37.5Mc/s does not deviate by more than ±0.3V. If this deviation is exceeded trimmer C108 requires resetting. Minimum deviation usually occurs with C108 approximately in its mid position.

40MC/S BANDPASS FILTER

45. This filter consists of eight overcoupled tuned stages and no attempt to align should be made without a suitable sweep generator and an accurately calibrated visual display. It is possible, using a Signal generator No 18, to carry out limited checks on the filter (para 49) but the trimmers must never be readjusted unless item (e) in Table 1 is available.

46. The alignment procedure is as follows:-

a. Remove V9, V5, 1Mc/s crystal, and the crystal-calibrator unit.

b. Connect the Oscillator, frequency swept, CT501 output to TP2 and connect the input socket of the sweep generator to the V9 valve holder using the B9A adaptor provided.

c. Switch on the receiver and adjust the output from the sweep generator set to a centre frequency of 40Mc/s, for a suitable trace on the screen. With the sweep generator switched to LIN amplifier a trace similar to Fig 4 should be seen with 6dB points between 600 and 700kc/s either side of the 40Mc/s marker. With the sweep generator switched to LOG amplifier a trace similar to Fig 5 should be seen and the 26dB points should not exceed ±1.3Mc/s either side of the 40Mc/s marker. If these tests do not produce the required results the filter will require realigning as follows:-

(1) Switch to LIN and adjust carrier output for a suitable trace.

(2) Switch on the ±650kc/s marker pips.

(3) Carefully adjust all the trimmers except C88 until the correct bandwidth 6dB down has been obtained. Only slight adjustment of the trimmers should be necessary but it is important to ascertain the effect of each one since each may influence a different part of the overall response.

(4) Finally adjust C88 until the peaks are of equal amplitude and the peak-to-trough ratio is approximately 2dB.

(5) Switch the sweep generator to LOG.

(6) Switch on the 1Mc/s marker pips and check that the 26db points are not greater than ±1.3Mc/s either side of the 40Mc/s marker. If it is found that they are not symmetrical, careful readjustment of the trimmers will be required to produce symmetry. Care must be taken to ensure that the 6dB points remain symmetrical and a curve similar to Fig 5 should be obtained.

(7) If difficulty is experienced in meeting these limits check the setting of L50 as described in para 39.

47. On completion of para 46 adjustments check that the overall gain of the stage is greater than 1.5. If this gain is found to be low, check V7 and its associated components. As a double check carry out tests as given in Table 6. If the output is still low repeat the alignment procedure (para 46).

48. When the alignment is complete replace V5, V9 and the 1Mc/s crystal.

Checking the 40Mc/s filter using a signal generator

49. If a sweep generator is not available, limited checks on the 40Mc/s filter can be made with a Signal generator No 18 or No 13. Frequencies must be set using the counter. A graph of frequency in Mc/s against output in dB, using the peaks either side of 40Mc/s as the reference level, is then plotted. The trimmers must on no account be adjusted without the sweep generator.

50. Remove V5, V9 and the 1Mc/s crystal. Connect the signal generator to TP2 and the wideband amplifier feeding the multimeter to TP3, making sure that the leads to the filters are as short as possible. Set the wideband amplifier to x10, the multimeter to a suitable range, the signal generator to 40Mc/s and adjust the output to give a deflection of 1V on the multimeter.

51. Vary the frequency either side of 40Mc/s to find the frequencies at which maximum output occurs (note these frequencies). If the peak amplitudes differ use the larger one as the reference level and set its amplitude to 1.5V.

52. Readings as detailed in Table 6 are taken. Ensure that the signal generator carrier level is kept constant and all frequency settings are checked against the counter.

53. This method of checking the 40Mc/s filter will only give the 6dB points accurately, the 26dB points can only be found by extrapolation and they will not be accurate. If the alignment of the filter is suspected the equipment must be backloaded to a workshop which has a sweep generator.

Table 6 - Frequency settings for checking the 40Mc/s filter

Frequency Mc/s	38.75	39	39.25	39.5	39.75	40	40.25	30.5	40.75	41	41.25
Multimeter deflection Vf											
20 Log $\frac{1.5}{Vf}$											

1MC/S CRYSTAL OSCILLATOR (V1)

54. Connect the multimeter, on the 3V a.c. range, to plug PL2 and adjust L2 for maximum output. This should be greater than 1.5V. Feed the output from PL2 to the counter and adjust C2 to 'pull' the crystal to the correct frequency. This adjustment must not be attempted unless a frequency standard is available with an accuracy of at least three parts in 10^7.

FIRST V.F.O. (V.F.O-1)

55. Check that the mechanical end stops operate before the capacitor end stops at both ends of the band. If not, slacken off the mechanical end stop on the MC/S dial shaft and set the tuning capacitor C76 to maximum capacity, ie, against its own end stop. Ensure that the zero calibration mark on the MC/S dial coincides with the cursor. Move the dial very slightly from the end-stop of the capacitor and tighten the mechanical end stop against the pin.

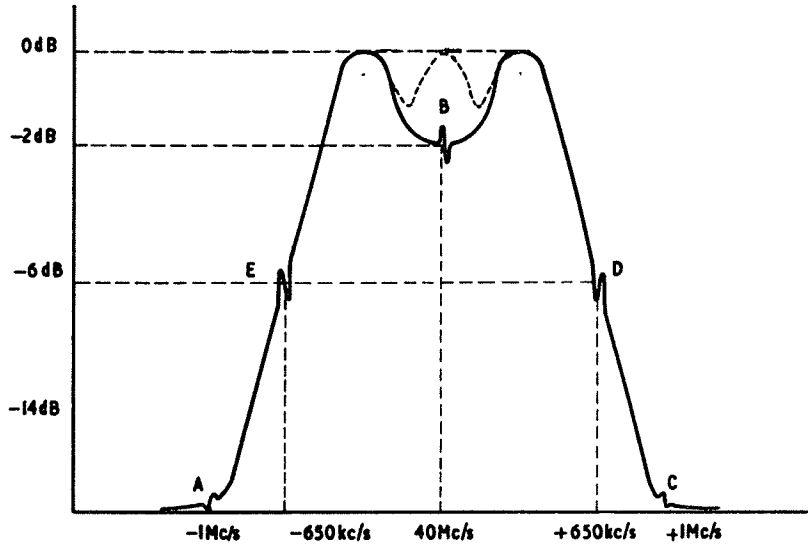

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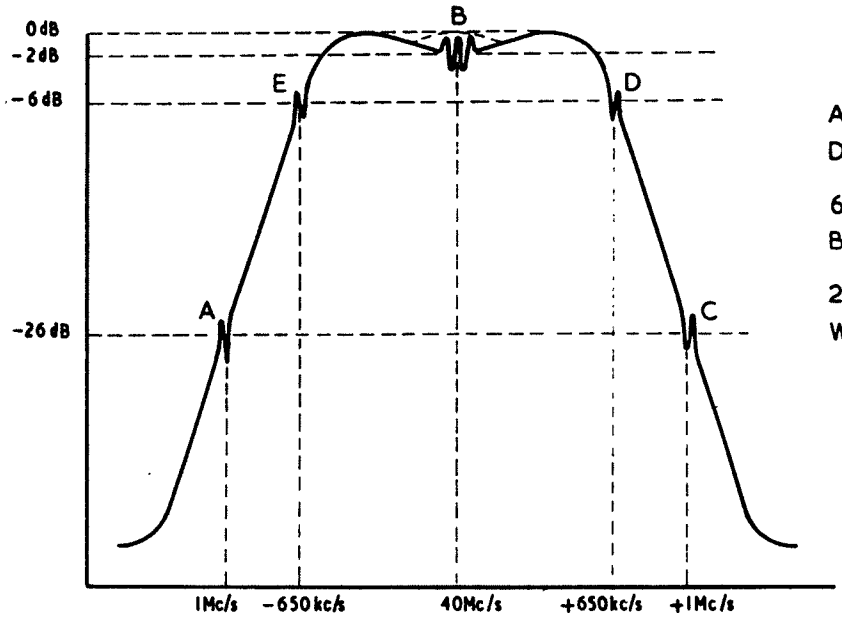
Fig 4 - Response of 40Mc/s filter (LIN)



AB&C 1Mc/s MARKER PIPS
D&E 650kc/s MARKER PIPS

6dB POINTS MUST LIE BETWEEN 600kc/s & 700kc/s

26dB POINTS MUST NOT BE WIDER THAN ± 1·3 Mc/s

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Fig 5 - Response of 40Mc/s filter (LOG)

56. Remove the 1Mc/s crystal, and V12. Couple the counter and convertor loosely to V7 by coiling the input lead round the valve base. With the MC/S dial set to zero adjust L36 until the counter indicates 40.5Mc/s Set the MC/S dial to 29 and adjust C77 for 69.5Mc/s on the counter. Repeat adjustments as necessary and then check that each 1Mc/s mark on the dial corresponds (within the thickness of the calibration mark) to a frequency of 40.5 plus dial reading. Remove the first mixer valve V7 and connect the Multimeter, CT429 shunted to 12pF (see para 17) across TP2 and earth. Tune over the range of the MC/S dial and check that the multimeter indicates not less than 1.5V. Replace the 1Mc/s crystal, V7 and V12.

SECOND MIXER DRIVE

57. Remove the second mixer valve V9 and connect the multimeter, shunted to 12pF, (on to 30V a.c. range) across TP3 and earth. Tune the receiver through each megacycle calibration point. The output at each point should be not less than 2V. The outputs at the 28Mc/s and 29Mc/s points should be equalized by careful adjustment of C7.

ANTENNA COILS

58. The cores of the antenna coils L4-L9 should be adjusted so that the frequency ranges indicated, plus a small overlap, can be tuned by the AE TUNE capacitor C18. If it is found that there is no overlap the following paragraphs give the setting up procedure.

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59. Remove V5 and V7. Connect the multimeter shunted to 12pF across TP2 and earth. Connect the signal generator to the AE INPUT terminal. Set the ATTENUATOR to MIN and the AE TUNE control to maximum capacity. Select the frequency range required and tune the coils L4-L9 to peak at the frequencies given in Table 7.

Table 7 - Lower frequency limit for antenna coils (RA17 Mk 2)

AE RANGE MC/S	Signal generator setting for 0.5V on the multimeter	
	Frequency Mc/s	Output in mV
0.5-1.0	.45	10
1.0-2.0	.92	14
2.0-4.0	1.83	18
4.0-8.0	3.5	25
8.0-16.0	7.25	31
16.0-30.0	14.5	56

60. Set the AE TUNE control to minimum capacity and retune the signal generator for maximum output. The approximate frequencies are given in Table 8.

Table 8 - Upper frequency limit for antenna coils (RA17 Mk 2)

AE RANGE MC/S	Signal generator setting for 0.5V on the multimeter	
	Frequency Mc/s	Output in mV
0.5-1.0	1.15	9.0
1.0-2.0	2.26	12.5
2.0-4.0	4.8	12.5
4.0-8.0	10	20
8.0-16.0	20.8	25
*16.0-30.0	31	40

*Note:- On this range it will be found that maximum output is obtained when the AE TUNE control is turned a few degrees from minimum. This is because the 30Mc/s low pass filter cuts off rapidly at frequencies above 31Mc/s

61. Table 7 and 8 figures are only given as a guide and it may be found necessary to repeat the adjustments on each band several times to obtain a reasonable overlap. Table 11 gives test figures for the antenna circuit on WIDEBAND.

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62. Remove V5, V7 and the screening cover from around C18A/B and connect 1kΩ resistors across the secondary section (C18B). Set the AE TUNE control to approximately 7/8ths of its travel in a clockwise direction and the other controls as follows:-

AE ATTENUATOR to MIN
AE RANGE MC/S to 0.5-1
SYSTEM SWITCH to MAN
IF GAIN to max.

63. Connect the Multimeter, CT429 shunted to 12pF (see para 17), between TP2 and chassis. Connect the signal generator to the AE INPUT socket and set the frequency to 0.5Mc/s. Remove the top core from transformer L9 and adjust the primary core for maximum deflection on the multimeter.(the position of this core should be such that it tunes at a point nearest the bottom of the transformer).

64. Remove the 1kΩ resistor from the secondary section and connect it across the primary section of C18. Refit the top core and adjust it for maximum deflection on the multimeter. Remove the 1kΩ resistor.

65. Set the signal generator for 1Mc/s and adjust the AE TUNE control for maximum deflection on the multimeter. Adjust trimmer C232 also for maximum deflection. Repeat the procedure for the AE RANGE MC/S settings given in Table 9. Sensitivity figures are given in Table 10, and Table 11 gives test figures for antenna circuit on WIDEBAND.

Table 9 - Antenna alignment frequencies (RA17L)

AE range Mc/s	Frequency Mc/s	Inductor	Frequency Mc/s	Capacitor
0.5-1	0.5	L9	1	C232
1-2	1	L8	2	C233
2-4	2	L7	4	C234
4-8	4	L6	8	C235
8-16	8	L5	16	C236
16-30	13 (with C18) (at max)	L4	30	C237

Table 10 - Antenna sensitivity for 0.5V at TP2 (RA17L)

AE range Mc/s	Signal generator setting for 0.5V on multimeter			
	Frequency Mc/s	Output mV	Frequency Mc/s	Output mV
0.5-1	0.5	12	1	12
1-2	1	14	2	14
2-4	2	20	4	20
4-8	4	24	8	32
8-16	8	44	16	32
16-30	16	44	30	60

Table 11 - Test figures for antenna circuit on WIDEBAND

Input	Frequency	Min output	Conditions
180mV to AE terminal	3.5Mc/s	At least 0.5V at TP2 with multimeter shunted to 12pF	AE RANGE WIDEBAND AE ATTENUATOR to MIN V5 and V7 removed
		At least 0.5V at TP3 with multimeter shunted to 12pF	AE RANGE WIDEBAND AE ATTENUATOR to MIN V5 and V7 replaced. 1.0Mc/s crystal removed. MEGACYCLES scale at 3

AE ATTENUATOR

66. Set the controls as follows:-

System switch to MAN
I.F. GAIN to max
BANDWIDTH switch to 3KC/S
METER switch to R.F. LEVEL
AE ATTENUATOR to MIN

67. Connect the signal generator to the antenna socket and set the output to 3.5Mc/s at 1μV. Tune the receiver for maximum indication on the panel meter and adjust the I.F. GAIN control for 50μA deflection.

68. Set the AE ATTENUATOR switch as detailed in Table 10, column (a) and at each position increase the signal generator output until the meter again indicates 50μA. Check that the increase in signal generator output for individual attenuator steps agrees with column (b) and that the overall increase agrees with column (c).

Table 12 - AE ATTENUATOR accuracy

AE ATTENUATOR (a)	Individual steps (b)	Total attenuation (c)
Position 1	13±2dB	13±2
Position 2	8±2dB	22±2
Position 3	8±2dB	31±2
Position 4 (MAX)	8±2dB	39±2

COILS L51 AND L52

69. Set the receiver to 750 on the KC/S scale and tune to every MC/S point to check that no spurious signals are heard in the speaker.

70. If spurious signals are present, detune the coils by screwing the dust cores out as far as possible then gradually screw in both cores simultaneously until the spurious signal disappears.

CRYSTAL CALIBRATOR

71. Should no output be obtained from this unit when the system switch is set to CAL and the KC/S scale set to a 100kc/s check point, or if spurious responses are obtained over the kilocycles range, carry out the following adjustment.

72. Set the KC/S scale to a 100kc/s point and check the tuning of L70 by carefully rotating the core a half-turn either side of the setting. If the signal does not appear, restore the core to its original position and repeat the check with L75. If an output is obtained, the cores of L70 and L75 should be set to the centre of the range of adjustment over which a clean signal is produced.

73. To align L70 and L75, if para 72 adjustments fail to produce an output, it will be necessary to remove the unit and make up an extension cable so that the unit may be operated outside the receiver.

74. Remove V13 and connect the multimeter to grid 3 (pin 7). Inject a 900kc/s c.w. signal, from the Signal generator, No 12/2 to the grid of V15 (pin 1) and adjust L75 for maximum indication on the multimeter. Disconnect the multimeter and the signal generator, replace V13 and remove V15. Connect the signal generator to grid 1 (pin 1) of V13 and the multimeter to the grid 1 (pin 1) of V15. Set the signal generator to 100kc/s c.w. and adjust L70 for maximum indication. Disconnect the multimeter and the signal generator. Replace V15 and the coaxial connector to SKT2.

75. The output should be approximately 0.2V measured between pin 6 of the octal plug (PL2) and earth.

OVERALL PERFORMANCE TESTS

STABILITY

RA17 Mk 2

76. Overall drift should be less than 1500c/s during the first three hours and thereafter less than 150c/s per hour at all frequencies under normal operating conditions.

RA17L

77. After a warm up period of 2 hours the overall drift should be less than 50c/s per hour at all frequencies under normal operating conditions.

SENSITIVITY

RA17 Mk 2

78. For a 20dB signal-to-noise ration with BANDWIDTH switch set to 3KC/S, the input required on c.w. is 1.0μV and for m.c.w. 3.5μV at 30% mod.

RA17L

79. For an 18dB signal-to-noise ratio with BANDWIDTH switch at 3KC/S the input required on c.w. is 1μV and m.c.w. 3μV at 30% mod.

C.W. signal-to-noise

80. Connect the a.f. wattmeter across the 3Ω output terminals and set the controls as follows:-

AE ATTENUATOR to MIN.
I.F. GAIN to max.
A.F. GAIN to max.
AE RANGE MC/S to 1-2
MC/S dial to 1
METER switch to R.F. LEVEL
System switch to MAN.

81. Connect the signal generator, set to 1.5Mc/s at 1μV output, to the AE INPUT socket. Tune the KILOCYCLES and AE TUNE controls for maximum deflection on the panel meter. Set the B.F.O. switch to ON and adjust the B.F.O. NOTE control for maximum a.f. output. Using the I.F. GAIN control set the output level to 100mW. Switch off the carrier and note the a.f. output. The ratio between the two readings should be 20dB (18dB RA17L).

M.C.W. signal-to-noise

82. With conditions as in paragraph 80 connect the signal generator, set to 1.5Mc/s modulated to a depth of 30% to the AE INPUT socket and adjust output to 3.5μV (3μV for RA17L). Tune the KILOCYCLES control for maximum a.f. output. Using the I.F. GAIN control set the output level to 100mW. Switch off the modulation and the a.f. output should fall by 20dB (18dB RA17L).

B.F.O. STABILITY

83. Conditions as in paragraph 80. Feed a 1μV c.w. signal to the AE INPUT socket and adjust the KILOCYCLES control for maximum deflection on the panel meter. Switch on the B.F.O. and tune the B.F.O. NOTE control for zero beat in the speaker. Increase the input to 1mV; the frequency of the b.f.o. should not change by more than 100c/s.

OVERALL A.F. RESPONSE

RA17 Mk 2

84. With conditions as in paragraph 80 and BANDWIDTH switch set to 8KC/S feed a 10MC/s signal, externally modulated by a 1kc/s signal to a depth of 30% to the AE INPUT socket. Tune the KILOCYCLES control for maximum output, set the signal generator to 3.5μV and adjust the I.F. GAIN for 100mW. Vary the modulation frequency over the range 250c/s to 3500c/s and the output power should not fall below 50mW. It is important to keep the modulation depth constant while doing this check.

RA17L

85. Conditions as in para 80 and BANDWIDTH switch at 13kc/s. Feed a 10Mc/s signal, externally modulated by a 1kc/s signal to a depth of 30%, to the AE INPUT socket. Tune the KILOCYCLES control for maximum output and set the generator to 3μV and adjust the I.F. GAIN for 100mW. Vary the modulation frequency over the range 250c/s to 6kc/s and the output power should not change by more than ±4dB. It is important to keep the modulation depth constant while doing this.

SEPARATE I.F. OUTPUT

86. Set the controls as follows:-

AE ATTENUATOR to MIN
I.F. GAIN to max.
AE RANGE MC/S to 2-4
METER switch to R.F. LEVEL
System switch to A.V.C.
A.V.C. switch to SHORT.

87. Feed a 1μV c.w. signal into the AE INPUT socket and tune for maximum indication on the panel meter. Connect a 75Ω resistor across one of the I.F. OUT plugs and measure the voltage developed across it: The output voltage should be not less than 100mV.

CROSS MODULATION

88. Set up the apparatus as shown in Fig 6 and controls as follows:-

AE ATTENUATOR to MIN.
BANDWIDTH to 3KC/S
AE RANGE MC/S to WIDEBAND
I.F. GAIN to max.
MC/S dial to 3.
System switch to A.V.C.
Wanted signal f1, to 3.5Mc/s (modulated 30%) at 2mV, checked against the counter.
Unwanted signal f2, to 3.51Mc/s (modulated 30%) checked against the counter.

89. Tune the receiver to f1, and adjust the A.F. GAIN control for an output of 100mW. Switch off the modulation. Leaving the receiver controls unaltered, switch on f2 modulated to a depth of 30% and increase the generator output voltage until the a.f. power output is 100μW ie, 30dB down on wanted signal which is equivalent to 1% mod of wanted signal. The ratio between the two signals is the cross modulation level for this AE ATTENUATOR setting. Interference signal f2 must not be less than 12.5mV, ie, 16dB above wanted signal F1.

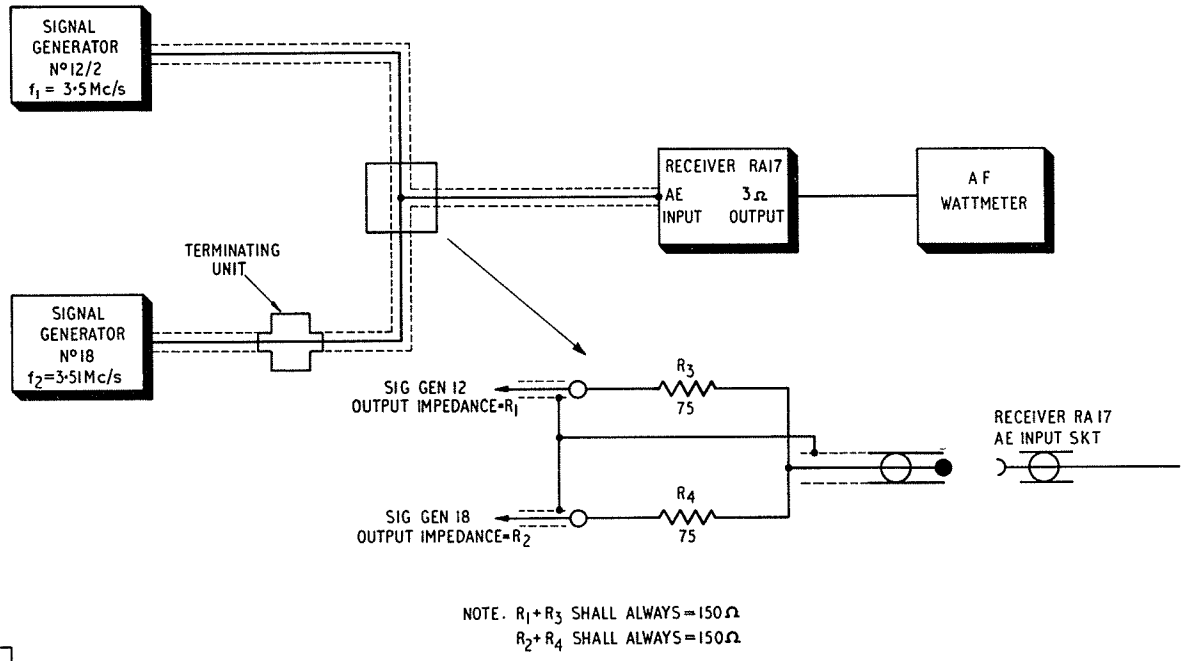

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Fig 6 - Cross modulation check, test equipment and connections

CHECKS FOR SPURIOUS RESPONSES

90. The conditions of test are:-

AE INPUT socket no connection
System switch to MAN.
B.F.O. on
BANDWIDTH to 3KC/S.
AE ATTENUATOR to MIN
AE RANGE MC/S to WIDEBAND
A.F. wattmeter across 3Ω output terminals.

91. Spurious responses are measured relative to receiver noise and should be less than 1dB above the noise. When a response is located, detune the receiver from it just sufficiently to render the beat note inaudible. Adjust the I.F. GAIN to provide a convenient noise level, say 1mW, on the a.f. output meter. Retune the receiver to the spurious signal for maximum output. The dB rise in audio output is then a measure of the spurious signal level relative to receiver noise.

92. If it is found that the test does not come within 1dB, reference should be made to para 96-104 which give the main causes of spurious break through.

AUTOMATIC GAIN CONTROL

93. Set the controls as follows:-

AE ATTENUATOR to MIN.
BANDWIDTH to 3KC/S
AE RANGE MC/S to WIDEBAND
I.F. and A.F. GAINS to max.
System switch to A.V.C.
METER switch to R.F. LEVEL

RA17 Mk 2

94. Connect the signal generator to the AE INPUT socket. Set the generator output level to 3.5μV at 10Mc/s amplitude modulated to a depth of 30%. Connect the a.f. wattmeter across the 3Ω terminals and adjust the A.F. GAIN control for an output of 100mW. Increase the signal generator output by 60dB and check that the audio output does not rise by more than 6dB.

RA17L

95. Connect the signal generator to the AE INPUT socket. Set the signal generator level to 1μV at 3.5Mc/s amplitude modulated to a depth of 30%. Connect the a.f. wattmeter across the 3Ω terminals and adjust the AF GAIN control for 10mW. Increase the signal generator output by 100dB (100mV) and the power output must not exceed 50mW.

SPURIOUS RESPONSES

General

96. In this receiver precautions against internally generated spurious responses are essential. The various sections of the receiver have been carefully screened and the power supplies to various stages have been filtered. It is essential to ensure that the bonding surfaces between screens are clean and that all securing screws are tight. Any reduction in the screening efficiency will result in spurious signals being generated. The main causes of such signals are:-

a. 37.5Mc/s break-through from second mixer V9 to the third mixer V11.

b. Break through of 1.0Mc/s harmonics.

c. V.F.O-1 harmonics

d. Break through of b.f.o. harmonics

e. Responses at 2.55 and 3.05Mc/s due to second v.f.o. break through.

97. It must be noted that when the MC/S dial is at zero and the KC/S scale within a few kc/s of zero, a very strong spurious signal will be heard. This is inherent in all the receivers and is caused by the 40Mc/s band-pass filter allowing the 40.5Mc/s from v.f.o-1 to reach the 2nd mixer valve V9 where it is converted into a 3Mc/s signal which is accepted by the 2-3Mc/s band-pass filter. This 3Mc/s signal is mixed with the 3.1Mc/s from v.f.o-2 and the 100kc/s difference frequency passes through the 100kc/s i.f. strip. The slight mistuning of v.f.o-2 produces the beat note or spurious signal.

37.5Mc/s break through

98. This response will be indicated by a beat note which varies rapidly in frequency with respect to the KC/S scale, ie, a change of 1kc/s on the scale results in a much larger change in the note. It will also move along the KC/S scale if the MEGACYCLES control is adjusted slightly. This response may be eliminated by slight adjustment of the 37.5Mc/s trap (L52 at second mixer anode).

Break through of 1Mc/s harmonics

99. These break through signals appear at 0 and 1000 on the KC/S scale at each setting of the MC/S dial and are generally more prominent with wideband input. These may be eliminated by efficient screening. If the response is dependent upon the setting of the MC/S dial, the 1.0Mc/s harmonics are probably breaking through to the first mixer stage. If it is independent of the MEGACYCLES setting it is due either to break through of the second or third harmonic to the second or third mixers. To determine which stage, remove the second mixer valve V9.

V.F.O-1 harmonics

100. Spurious responses may occur at 4.5, 5.5 and/or 17.5Mc/s, if C42A and/or C194A are open circuit. These responses are caused by the harmonics of the first v.f.o. breaking through to the second mixer stage and beating with the harmonics of the 37.5Mc/s heterodyne voltage.

B.F.O. harmonics

101. These responses may occur at 100kc/s intervals between 1.0 and 1.5Mc/s when

the b.f.o. frequency is 100kc/s and the receiver antenna input is tuned. Improvement in b.f.o. screening should eliminate spurious responses.

Second v.f.o. break through

102. Responses may occur at 2.55 and 3.0Mc/s with tuned antenna input. Check that the v.f.o. chassis is well bonded to the main chassis and that the fixing screws are tight.

103. A failure in any one of the capacitors C66, C92, C96, C98, C103 or C104 may result in increased end-of-band responses which will disappear when the MEGACYCLES control is detuned.

104. Failure of C117, C154, C155, C207, C208 or C214 can result in increased end-of-band responses or b.f.o. harmonic break through. Detuning the MEGACYCLES control will have no effect.