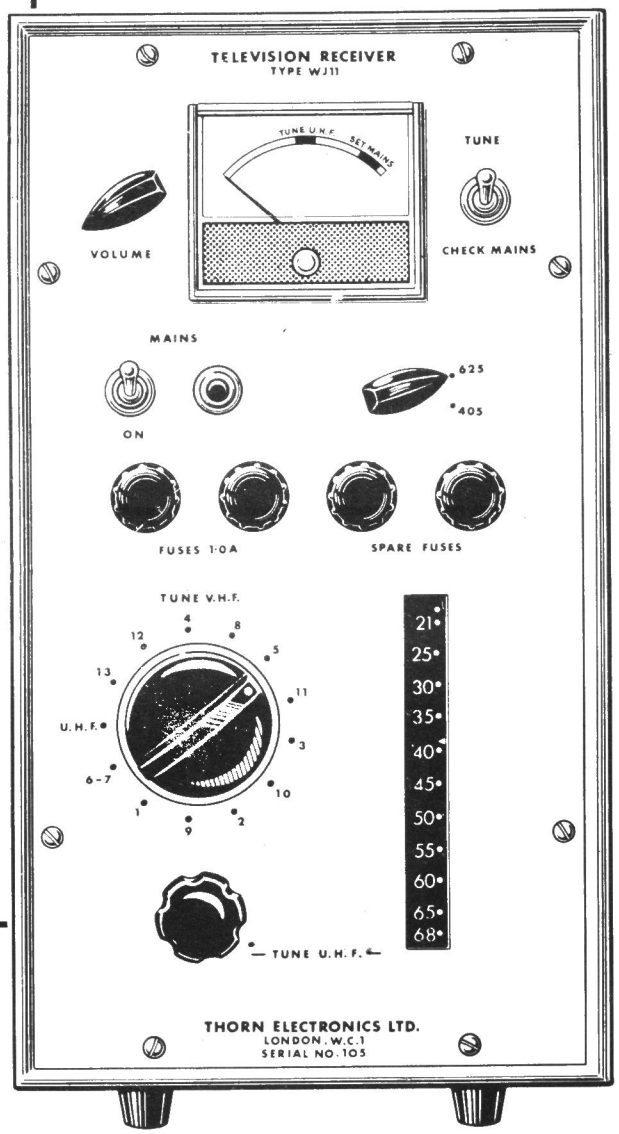
OUTSIDE BROADCAST TELEVISION RECEIVER

types WJ11 & WJ12

OPERATING
and
MAINTENANCE

MANUAL

THORN ELECTRICAL INDUSTRIES LIMITED



THORN ELECTRONICS LTD., Wellington Crescent, New Malden, Surrey.
Tel: MALDEN 8701

CONTENTS

Introduction	Page 3
Specification	Page 4
Circuit Description	Page 7
Operating Instructions	Page 11
Service Notes	Page 13
IF Board Alignment Instructions	Page 17
AFC Discriminator Alignment Instructions	Page 21
Component Schedule	Page 23

ILLUSTRATIONS

Fig. 1 Simplified Block Diagram	Page 6
Fig. 2a VHF Tuner Component Locations	Page 12
Fig. 2b UHF Tuner Component Locations	Page 12
Figs. 3a, 3b Interior Views of Receiver	Page 15
Fig. 4 IF Board Component Locations	Page 16
Fig. 5-10 IF Alignment Waveforms	Page 19
Fig. 11 AFC Discriminator Board Component Locations	Page 20
Fig. 12 Transistor Board Component Locations	Page 22
Fig. 13 General Interior View of Receiver	Page 35
Fig. 14 VHF Tuner Circuit Diagram	Page 36
Fig. 15 UHF Tuner Circuit Diagram	Page 36
Circuit Diagram	

12

INTRODUCTION

The O.B. Receiver is designed around conventional domestic television receiving equipment fitted with VHF and UHF tuners. Additional circuits are incorporated to provide gated AGC and AFC on the UHF band as well as standard level video and audio outputs suitable for feeding video monitors and associated audio equipment.

The receiver is capable of accepting signals in Bands I and III on a 405 line system, and in Bands IV and V on a 625 line system. The VHF turret has thirteen positions, one of which is used for UHF reception, the turret being used as an additional IF amplifier. Eleven of the remaining twelve positions are fitted with coils for Channels 1 to 5 and 8 to 13 inclusive; the twelfth position can be used for Channels 6 and 7 as required. The extra coil is fitted into a clip inside the receiver. An internal monitoring loudspeaker is fitted together with its associated volume control. The receiver employs printed circuit boards throughout and has a self-contained power supply.

The rack mounting version WJ12 is designed for fitting to a standard 19 inch rack. The panel height of this model is 7 inches.

The portable version is housed in a miniature Imlock case and is supplied with a waterproof cover.

SPECIFICATION

Tuning ranges:

VHF	All U.K. Channels 1 to 13.
NOTE:	Coils for Channel 6 or 7 cannot be inserted in the turret simultaneously. The unused coil is fitted in a clip in the receiver.
UHF	All U.K. Channels 21 to 68 continuously tunable.
AFC (UHF only)	Error compression 10:1 approx.
UHF Tuning Meter	Indicated range ±0.5 Mc/s approx.

Systems received:

(1)	British 405 line system, positive vision modulation, AM sound, sound carrier frequency 3.5 Mc/s below vision carrier frequency.
(2)	CCIR 625 line system, negative vision modulation, FM sound (±50 Kc/s peak deviation), sound carrier frequency 6.0 Mc/s above vision carrier frequency.

Outputs:

Video	1V p-p composite video across 75 ohms.
Zo	75 ohms.
Audio	1mW into 600 ohms for 40% modulation depth.
Zo	75 ohms.
Overload point	20mW approx. into 600 ohms.
Sound Monitor	An internal loudspeaker with its own amplifier is provided.

Vision sensitivity:

VHF 405 line	Typical RMS input pd at peak white for 0.5V p-p video out. (Channel 5) 12μV.
	Typical RMS input pd at peak white for 0.7V p-p video out. (Channel 5) 20μV.
	Typical RMS input pd at peak white for 20dB p-p signal to p-p noise out. (Channel 5) 120μV.
UHF 625 line	Typical RMS input pd (sync tips) for 0.5V p-p video out. (Channel 44) 67μV.
	Typical RMS input pd (sync tips) for 0.7V p-p video out. (Channel 44) 98μV.
	Typical RMS input pd (sync tips) for 20dB p-p signal to p-p noise out. (Channel 44) 730μV.

Mains supply: AC mains only; 100V to 125V or 200V to 250V, 50-100 c/s.

Power consumption: 75VA.

Maximum operating temperature: 35°C ambient air temperature.

Dimensions:

WJ11 - Free standing

Width	$7\frac{1}{2}$ in
Height (including feet and carrying handle)	$14\frac{3}{8}$ in
Depth (case only)	18 in
Frontal projections beyond case (knobs etc.)	$\frac{9}{16}$ in
Depth required behind case (plugs etc.)	3 in
Weight	28 lb

WJ12 - Rack mounting

To mount in 19 in standard rack	
Panel height	7 in
Depth behind panel (case only)	$17\frac{3}{8}$ in
Depth behind panel including cable space	$20\frac{1}{2}$ in
Frontal projection beyond rack face (knobs etc)	$1\frac{1}{4}$ in

SIMPLIFIED BLOCK DIAGRAM

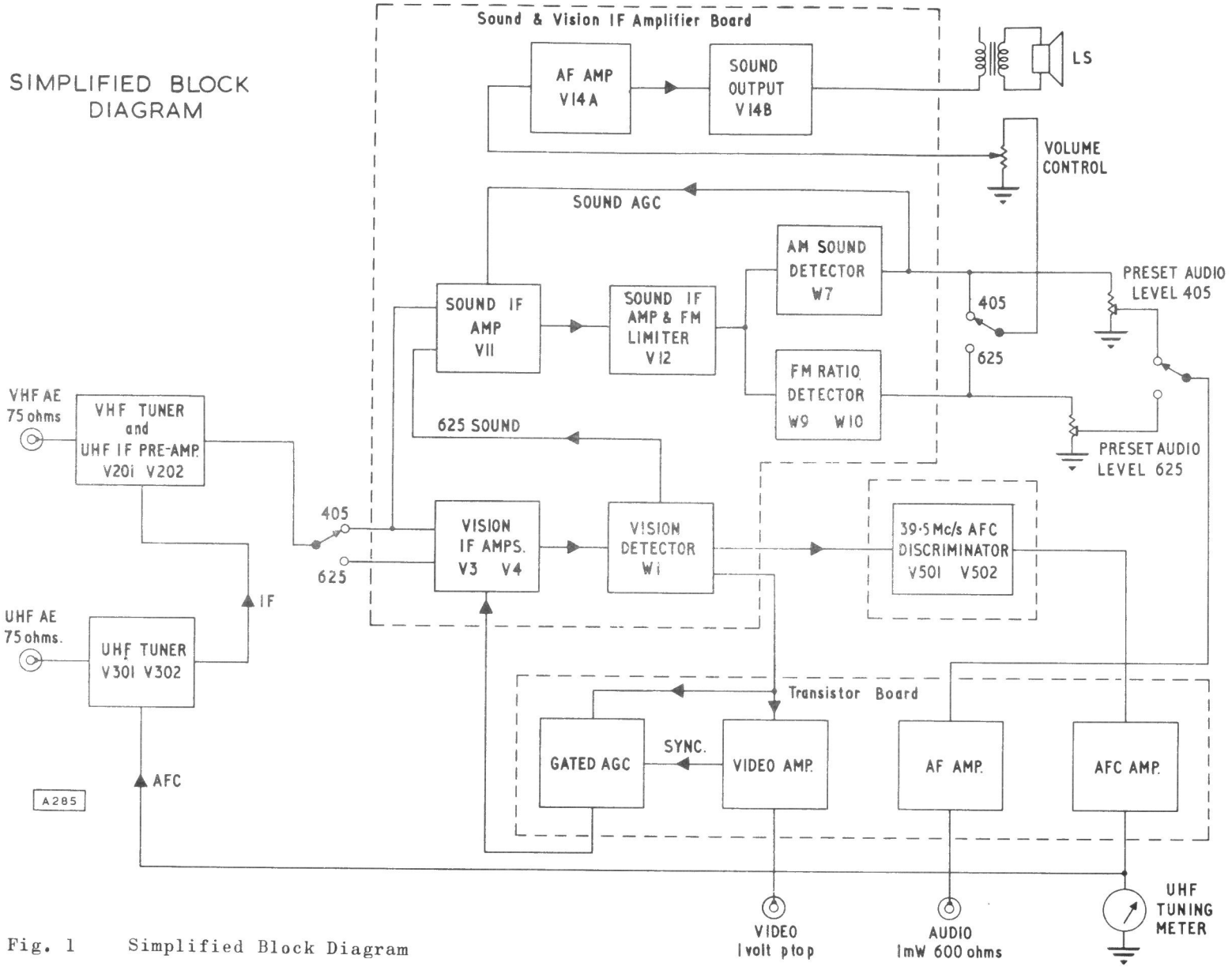


Fig. 1 Simplified Block Diagram

CIRCUIT DESCRIPTION

General

The simplified block diagram shows the VHF and UHF tuners together with the IF board, discriminator board and transistor board. The IF board carries sound and vision IF amplifiers, the detectors, the audio amplifier and the sound output stage for the internal loudspeaker. The AFC discriminator board contains the vision carrier limiter and discriminator circuit. The transistor board has the gated AGC circuits, the video output amplifier, the audio output amplifier and the AFC amplifier. The diagram also shows the interconnections between these units and the switching arrangement for 405 and 625 line operation.

VHF Tuner

The tuner employs a frame grid triode RF amplifier V1, controlled by AGC followed by a triode pentode oscillator and mixer valve V2. The pentode section uses a variable μ mixer enabling AGC to be used on this stage also.

For UHF reception the VHF tuner functions as an IF pre-amplifier, the output from the UHF tuner being coupled into the mixer grid circuit (V2) and the oscillator (V2A) being rendered inoperative.

UHF Tuner

The UHF tuner is a 4-gang tuner and consists of a grounded grid RF triode amplifier (V301) followed by a grounded grid self oscillating mixer valve (C302). The two valves are coupled by a bandpass circuit L304 and L307. The oscillator circuit L310 is coupled into L320, which is connected to a variable capacity diode (W301) to which AFC is applied.

IF Amplifier

The IF amplifier is best described by detailing the functions of the various components under 405 line and 625 line operation.

405 line operation:

Switches S1A and S1B feed the IF signal to the sound and vision amplifiers via the sound take-off coil L21; sound rejector coil L1, C1, C2 and R2; adjacent channel rejector L3, C4, and sound-after-rise rejector L4-C5. The UHF adjacent channel sound IF trap L6-C9 will also effectively reject any sound carrier frequency from the VHF channel 1. The vision IF is amplified by V3 and V4 and detected by W1. The video signal is fed via an IF filter and switches S1C and S1D to the transistor board. L17, C21 and C23 form a sound rejector tuned to 3.5 Mc/s. The frequencies to which the various coils are aligned are shown on the circuit diagram, and are further described in the circuit alignment procedure. The 38.15 Mc/s sound IF is coupled by L22 to a two stage IF amplifier V11 and V12 and detected by W7. Part of the rectified

output developed across potential divider R73, R74 is applied to V11 as AGC bias. The audio signal is fed via switch S2A to the internal audio output amplifier (V14A) and also by the pre-set level controls and switch S2B to the audio output stages on the transistor board.

625 line operation:

The combined vision and sound IF output from the UHF tuner is applied to the VHF tuner which operates as an IF pre-amplifier.

The output from V2B anode is switched to V3 grid circuit by switches S1A and S1B. L2 and C3 form a sound rejector to correct the vision-to-sound ratio. L5 is the common IF grid coil inductively coupled to L6-C9 the adjacent channel sound IF rejector. The IF signal at the anode of V3 is further amplified by V4 and detected by W1. Switches S1C and S1D switch the video signal to the transistor board. Switch S1C also introduces the overload circuit R20-W2.

The 6 Mc/s sound IF is extracted from the video detector circuit by C20 and L15 and applied to the two-stage sound IF amplifier V11 and V12. The screen voltage of V12 (operating as a limiter) is reduced by R104 switched in series with the screen HT feed by switch S2E, V12 grid current providing the necessary limiting action. The output of V12 is transformer-fed to W9 and W10 operating as a ratio detector circuit. The tertiary voltage is taken from the junction of C55 and C57 in series, which shunt tune L30, the transformer primary. The voltage is injected into the secondary L31 at the centre-tap formed by tuning capacitors C56 and C58.

The ratio detector balance can be adjusted for optimum AM rejection by R77; C61 is the stabilizing capacitor with R78 as the detector load. Switch S2A switches the audio signal to the internal sound output stage V14.

AFC DISCRIMINATOR BOARD

The AFC discriminator circuit consists of two valves V501 and V502, the first valve acting as an amplifier, and the second as a limiter feeding the discriminator circuit and diodes W501 and W502. The input to the discriminator is taken from a single turn winding (L18) wound on L10 and feeds to the grid of V501. In the anode of V501 is an inductance L501 tuned by the capacitances of V501 and V502 to 39.5 Mc/s. L503 and L504 together with diodes W501 and W502 form a discriminator circuit tuned to 39.5 Mc/s. The DC output from this circuit is supplied to the AFC amplifier on the transistor board. V502 operates at a low screen voltage to give limiting action.

Since the vision carrier is on the skirt of the IF response, the noise power from the discriminator is unbalanced, being larger on the vision pass band side. The effect of this on a noisy signal would be to detune the UHF tuner. L502 and C503 form a "suck out" circuit (tuned to 37 Mc/s) to reduce the sensitivity on the vision pass band side to give approximately equal noise in the discriminator on either side of the vision carrier. This enables the

discriminator to function at lower signal levels. The DC signal is then fed to the transistor board.

TRANSISTOR BOARD

Video Amplifier

The video input from the detector is connected to transistors VT406 and VT407, which comprise a buffer stage. The signal is DC restored by W410 and fed to the video output stage consisting of two emitter followers, VT409 and VT410. In series with the emitter of VT410 is a variable resistor R434, which together with R435 and R437, can be adjusted to provide an output impedance of 75 ohms. From the emitter of VT410 the signal is also fed to VT412, the sync separator stage.

AGC Circuit

The video input is also connected to VT401, a buffer emitter follower. The signal from the emitter is fed to diode bridge W401, W402, and W403 and W404. This network is biased by diode W405 in such a way that for a negative input voltage (625 line systems) the signal is connected via diode W401 to the base of transistor VT403, and for positive input voltage (405 line systems) the signal is connected via diode W402 to the base of VT402. The reason for this arrangement is that although the polarity of the AC signal is the same - because of the switching arrangement on the video detector output - the DC components of the video signals of the two systems are different. In the 405 line position the DC signal is positive and increases positively with increasing input carrier, and vice versa in the 625 line position. Hence the need to invert the DC component in the 405 line position. This inversion is achieved by connecting the signal to different sides of a long tail pair amplifier VT402 and VT403. VT404 further amplifies the signal from the long tail pair amplifier and overall negative feedback is supplied by R411. The level at which the AGC operates is determined by two pre-set potentiometers, R412 and R407, switched in turn by switch S2G; these two potentiometers provide bias to the DC amplifier. The sync separator VT412 provides positive going pulses during the sync period. These are fed to VT408, which inverts them. The back edge of this inverted pulse, corresponding to the back edge of the synchronising pulse, is used to switch off VT405. Transistor VT405 produces a pulse during the "back porch" period with a time duration determined by C403 and R424. It is "bottomed" except during this pulse period when the collector potential falls negative until caught by the diode W406 at the output of the video amplifier, so producing a pulse proportional to the black level height. This pulse is peak detected in transistor VT411, and a DC signal equal to the pulse height appears at the emitter of VT411 and is used for AGC purposes.

Audio Amplifier

The audio signal from the IF board is connected via preset potentiometers R105 and R106 to switch S2B and is then amplified by the sound amplifier on the transistor board consisting of three transistors, VT413, VT414 and VT415. These transistors forming a feed-back triple; the feed-back path being from the emitter of the VT415 to the emitter of VT413. The feed-back ratio is determined by R446 and R447, and the amplifier is arranged to give a voltage gain of approximately three times. The output signal is taken from transformer T401 to the output socket via a preset potentiometer R415 which sets the output impedance to 75 ohms.

AFC Amplifier

The AFC amplifier consists basically of a feed-back triple VT416, VT418 and VT419 with VT417 inserted in the feed-back path as an emitter follower. The purpose of this extra transistor is to balance the base emitter voltage drop of VT416. The output of the AFC amplifier is used to vary the voltage across the variable capacity diode (W301) in the UHF tuner via capacity (C334), and also supplies the UHF tuning meter. The output of the discriminator is connected via R455 to the base of VT416 and Z401, R453; R454 and R452 forming a biasing network to enable the AFC output voltage to be set to a level of approximately 6 volts., i.e. mid-scale reading on the UHF tuning meter for zero output from the discriminator.

POWER SUPPLY

The power supply gives the following outputs:-

(1) An 80 volt 300 milliamp AC supply for the series heater chain.

(2) A 200 volt HT supply for the valve circuits.

(3) +12 volt and -15 volt power supplies for the transistor circuits.

The mains transformer has a split primary and the voltage selector panel is arranged for mains inputs from 100V to 125V and from 200V to 250V. An additional feature is that the UHF tuning meter can be used to monitor the voltage on the transformer primary, enabling the voltage selector panel to be set to its correct tap.

OPERATING INSTRUCTIONS

Before connecting the receiver to the power supply (AC only), ensure that the receiver Mains Adjustment panel is set for the correct voltage. Check also the mechanical 'zero' of the tuning meter. Separate aerials, with 75 ohm feeders, are required for VHF and UHF reception.

Connect the aerial feeders VHF (Band I and Band III) to the lower aerial socket, and the UHF (Band IV and Band V) to the upper aerial socket. Connect video, audio output leads and mains input lead to their respective sockets.

Switch on receiver and observe that when the "Check Mains" switch is depressed the tuning meter indication lies within the red sector of the scale. No warm-up period is necessary for this check, but any deviation of the meter indication from the red scale sector indicates that the supply voltage is incorrect to that selected on the Mains Adjustment panel; an upscale deviation indicates excessive supply voltage, a downscale deviation a low supply voltage. To readjust the Mains Adjustment panel switch the receiver mains switch to "OFF", remove Mains Adjustment cover plate, reset to correct tapping and replace the cover plate.

The warm-up time of the receiver is about 25 seconds.

For 405 line reception in Band I or Band III, rotate the systems switch to the '405' position and the VHF turret switch to the desired channel. Set the volume control to about 90° from its anticlockwise minimum and adjust the VHF fine tuning control, concentric with the turret switch, for optimum picture and sound.

The tuning meter is inoperative when the systems switch is at '405' and the meter pointer should be within the black mid-scale sector.

For 625 line reception in Band IV or Band V, set the systems switch to 625 and the VHF turret switch to 'U'. Locate signals in the desired channel using the UHF tuning control and scale, tune initially for reasonable picture quality and finally for mid-scale tuning meter indication.

MT6

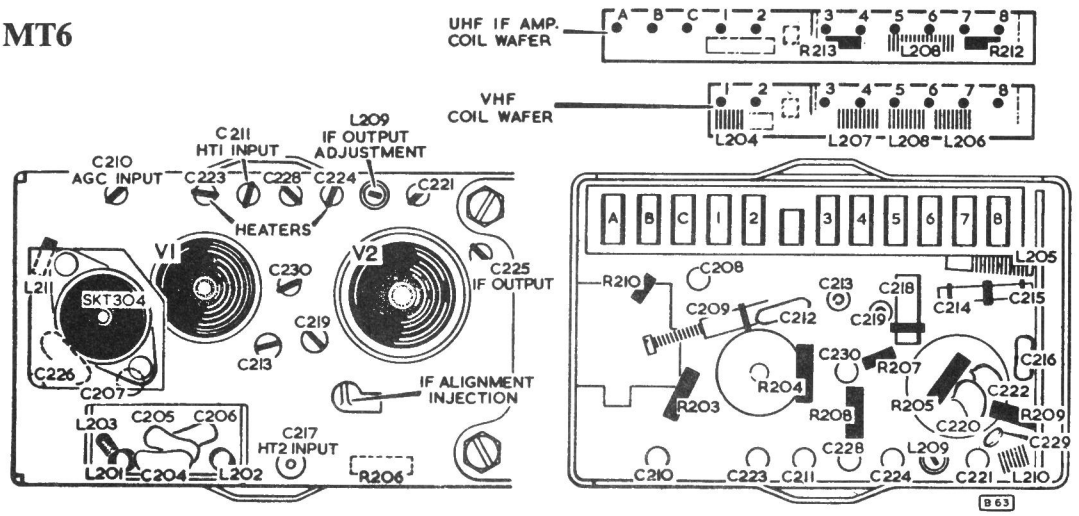


Fig. 2a VHF Tuner Component Locations

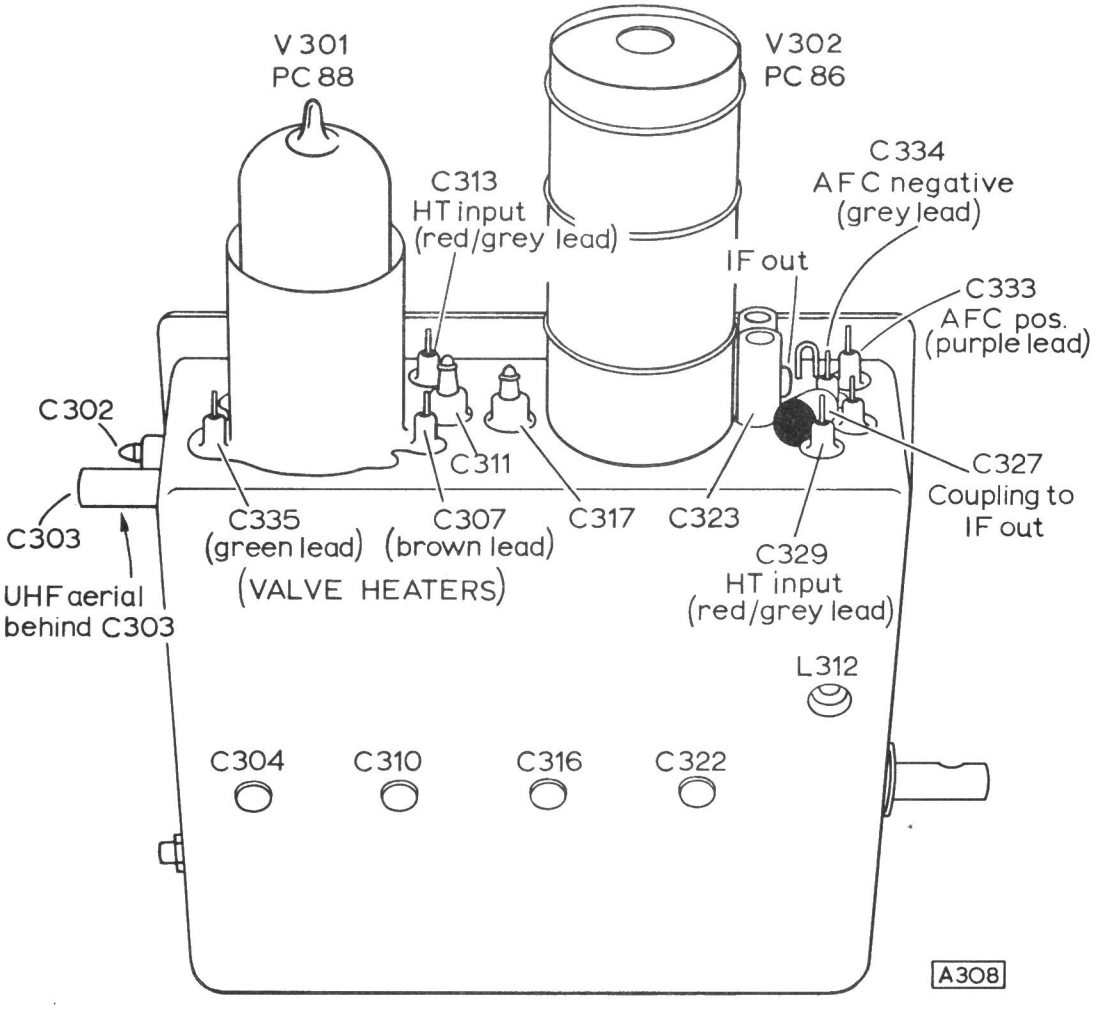


Fig. 2b UHF Tuner Component Locations

SERVICE NOTES

Fuses

Two spare fuses (1A) are mounted in holders on the front panel of the receiver.

Air Inlet Filter (WJ11 only)

This is fitted on the forward end of the receiver underface below a cover-plate held by four 'Camloc' fasteners, and can be removed and cleaned in a detergent solution whenever necessary.

Loudspeaker Mount (WJ11 only)

The loudspeaker mount is held by four 'Camloc' fasteners. The removal of this component and its mount will facilitate access to the speaker transformer, mains transformer, etc.

Channel 6/Channel 7 Coil Change

Only one turret position is available for the coils tuning to Channel 6 or Channel 7. Coils for Channel 7 are usually fitted in the turret. In receiver WJ11 a Channel 6 coil biscuit is clipped inside a cover-tube to the screening cover-plate of the VHF turret tuner; in receiver WJ12, this coil is mounted on the bar carrying the screw fixings for the IF board.

To change the coils, release the Channel 6 coil with its cover tube and remove the turret cover. The latter is retained by two lugs sprung through detents central in the two long edges of the tuner chassis. Rotate the turret switch to give access to the Channel 7 coil. This may now be released by pressing the retaining clip towards the rear end of the coil biscuit. Remove the Channel 6 coil biscuit from its cover tube and insert the tongue at the front end of the coil biscuit, coil inwards, into an aperture in the front disc of the turret and press the coil biscuit down into its retaining clip. Replace the turret cover-plate and push the spare coil biscuit into the cover tube and clip into the mounting position provided.

UHF Tuner

In receiver WJ11 access to the VHF tuner cover-plate may be obtained by removing the air inlet filter in the case bottom; in receiver WJ12 access is through the right-hand side of the receiver frame. The cover-plate of the UHF tuner is a plastic press-on fixing. Avoid damaging the copper foil screening in this plastic cover.

IF Board

The method for releasing the IF board is described for receiver WJ11 in its normal attitude and for receiver WJ12 in an inverted attitude.

Pull forward the rubber grommet retaining the rod link to the slider of the IF board system switch; this allows the link to be disengaged from the switch slider. Remove grommet and link from the receiver. Slacken off two screw fastenings at the outer edge of the IF board, disengage the board from these and withdraw it from the inner retainers holding the inner long edge. The board may now be swung 90° about its outer edge to project at 45° upward and outward from the receiver frame; in this position the 'hinge' edge may be fitted into two spring clips provided on the receiver frame.

When refitting the IF board, ensure, before fastening, that the board is held lengthwise between the end-bars provided and that the inner long edge of the board is correctly inserted in its two retainers.

After fixing the IF board replace the rod link with its grommet retainer.

AFC Discriminator Sub-Unit

This can be withdrawn from the receiver frame main panel by releasing two 'Camloc' fasteners. In receiver WJ11, the withdrawn unit may be hung by the lip at the long edge of the valve platform onto the lower edge of the side-plate aperture.

Transistor Board

This is retained by four 'Camloc' fasteners and may be withdrawn to the extent of the wiring when these are released.

Power Unit

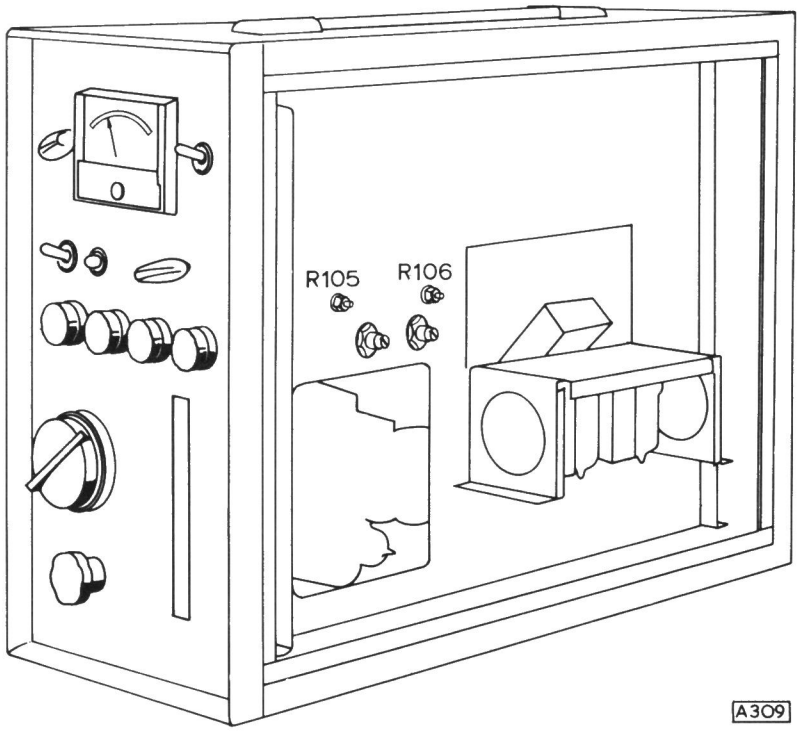
The rectifier/smoothing sub-assembly is retained by two 'Camloc' fasteners in the receiver frame main-plate. The sub-assembly can be withdrawn on its cableform after releasing these fasteners; in receiver WJ11 withdrawal is through the mounting of the transistor board, which must first be released and swung clear; in receiver WJ12 withdrawal is from underneath the receiver.

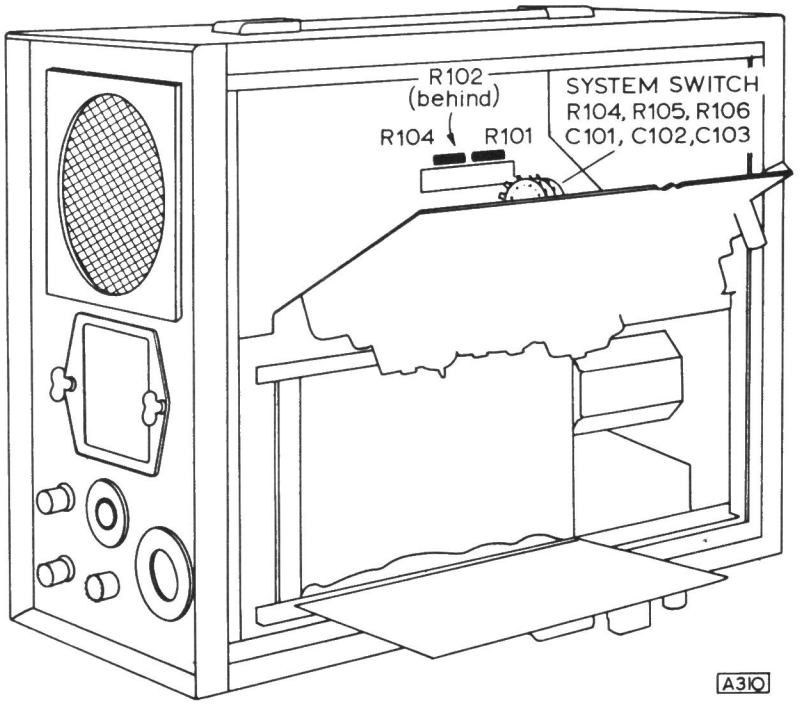
VHF Oscillator Readjustment

Access to the core of any oscillator coil in the VHF turret is as follows. Rotate the turret switch to the appropriate channel, and unclip the front face of the turret tuner knob to expose a ring of apertures bearing channel numbers. Rotate the concentric fine tuner control until an aperture in this lies behind the turret switch knob aperture bearing the number of the channel selected. A $\frac{1}{8}$in diameter grubscrew-driver can be inserted through this numbered aperture, the fine tuner knob, the front panel and the turret chassis into the head of the oscillator coil core. Adjustment must be

made without undue pressure, to prevent the core jumping threads in the coil former.

Replace the turret switch knob face after coil alignment.





Figs. 3a, 3b Interior Views of Receiver

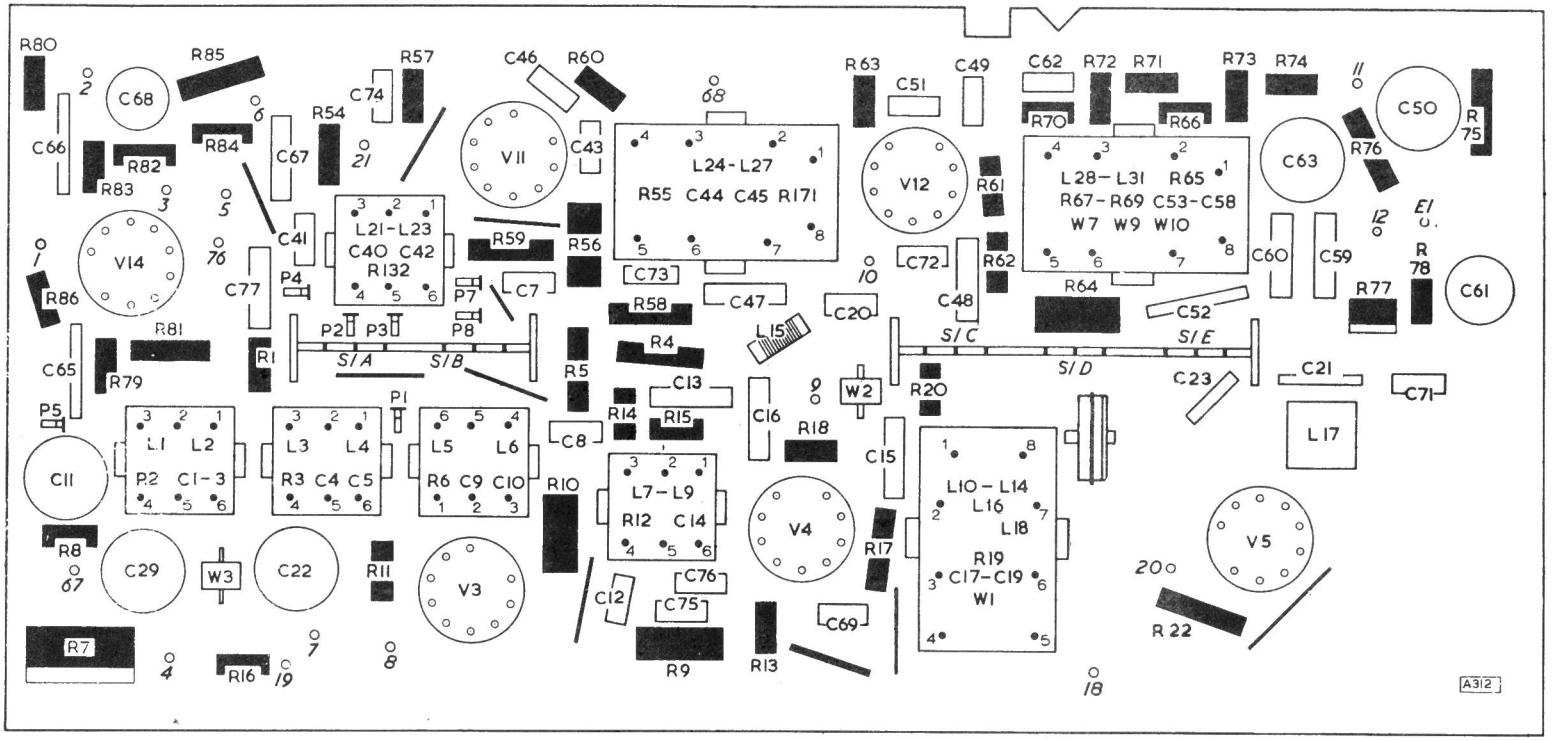


Fig. 4 IF Board Component Locations

IF BOARD ALIGNMENT

Equipment Required

1. A Wobbulator covering 32 - 42 Mc/s in one sweep, and 6 Mc/s ± ½ Mc/s.
2. A Signal Generator covering the same frequency ranges to act as a marker generator and capable of being modulated at 30% 1 Kc/s AM.
3. An Avo Model 8 for the vision indicator and an Audio Output Meter.
4. A bias source of -4.5V.

Connections

Apply -4.5V to the AGC line tag 4 (IF board), having first removed the connection (P406) from the transistor board. Connect the Audio Output Meter in place of the loudspeaker (3 ohms), and the Avo 8 (on 10 volt DC range) across the diode detector load (R22). Inject a 38.15 Mc/s signal, modulated 30% 1 Kc/s AM, from the Signal Generator into the mixer grid (keyhole slot in top of VHF tuner).

Vision Rejectors and Sound IF Procedure

Rotate systems switch to the 405 position and VHF tuner to Channel 3. Turn the volume control fully clockwise and adjust the Signal Generator output to provide half scale indication on the 100 mW range of the Audio Output Meter.

Adjust L29, L28, L25, L24 and L21 for maximum output in that order, until there is no further improvement in output, reducing the Signal Generator output to maintain the output reading to half scale.

Switch the Signal Generator to C/W and turn the volume control anti-clockwise; increase the Signal Generator output until the Avo reads about 3V. Adjust L1 for minimum output. Select the following frequencies and adjust the coils for minimum video output.

L4	-	38.7 Mc/s
L6	-	41.5 Mc/s
L3	-	33.15 Mc/s

Switch to 625 and reverse the connection to the Avo meter. Feed in a 33.5 Mc/s signal and tune L2 for minimum reading. Now connect the WOBBULATOR IF output (terminated) to V4 grid and the WOBBULATOR AF output to the video detector load (R22). Using the Signal Generator output as a marker generator for the two vision carrier frequencies 39.5 Mc/s (625) and 34.65 Mc/s (405). Set the Wobbulator to the sweep frequency 30 - 45 Mc/s and adjust the output to show reasonable amplitude of display and tune L12 and L10 for the response curve shown in Fig. 5.

Connect the Wobbulator output to V3 grid, reducing the output to provide the same display amplitude as before. Adjust L9 and L7 for the curve shown in Fig. 6.

Transfer the Wobbulator output to mixer grid V2B (VHF tuner) and switch receiver to the 405 position. Adjust L5 (V3 grid coil) for the response shown in Fig. 7.

Switch receiver to the 625 position and adjust L209 (V2B anode coil) for the response shown in Fig. 8.

Return to 405 position and check that the 405 line curve is still acceptable. Retune L5 and L209 if necessary to achieve the best approximation to the above curves.

With the system switch in the 625 position observe the 625 IF curve as shown in Fig. 8, remove the can over the UHF mixer and slide a close fitting screening can over the valve. Ensure that it goes down as fas as possible without short-circuiting against the threaded skirt already there.

Connect the terminated Wobbulator output between this can and chassis; this effects a small capacitive coupling into the UHF mixer anode. Select the 'U' biscuit on the VHF tuner and increase the Wobbulator output until a reasonable amplitude of display is obtained. Tune L312 (UHF tuner) and L208 (VHF tuner) for maximum output on 39.5 Mc/s, consistent with the response curve as for the previous 625 curve from the VHF mixer grid.

On all the foregoing adjustments particular attention should be given to obtain the correct response curves with as much gain as possible at the two carrier frequencies. Do not detune drastically in search of a better curve shape and lose overall gain in the process.

625 Sound IF

With the system switch to the 625 position, connect the Wobbulator IF output to the diode detector side of L17. NOTE: The short-circuiting link across top of coil adjacent to L10 is a suitable connecting point. Transfer Wobbulator AF input to junction of R60, C46 (time constant in limiter grid on IF board). Alter the sweep to cover 6 Mc/s and expand to give a reasonable display. Inject a 6 Mc/s CW marker from the Signal Generator and adjust L27, L26 and L23 in that order for maximum response as shown in Fig. 9.

Transfer the Wobbulator AF input to the audio take-off point tag 12 and adjust L31 and L30 for the most symmetrical 'S' curve with the steepest gradient. R77 can also be adjusted to get the 'S' curve symmetrical about the zero line if necessary. See Fig. 10.

R77 can be adjusted as follows.

Inject the 6 Mc/s AM 30% at 1 Kc/s in parallel with the Wobbulator, observing the 'S' curve display above. Adjust the 6 Mc/s output until the sine wave modulation appears on the trace; readjust R77 to minimise this amplitude modulation.

$3\frac{1}{2}$ and 6 Mc/s Video Rejection

Feed in a stationary 405 line picture which has been detuned into sound on vision sufficient to give a weak $3\frac{1}{2}$ Mc/s pattern as shown at video detector

output (R22). Adjust L17 to reduce this pattern to a minimum. Reconnect AGC line to P406.

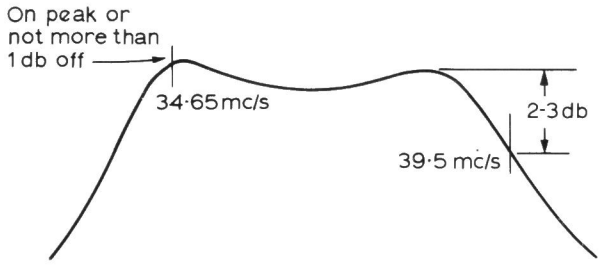


Fig.5

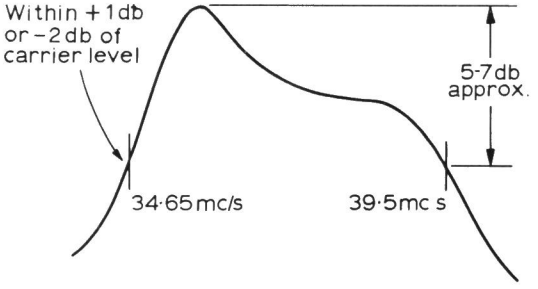


Fig.8

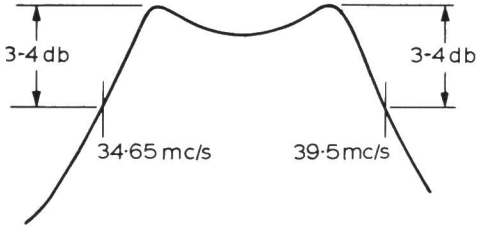


Fig.6

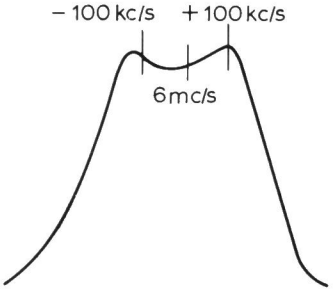


Fig.9

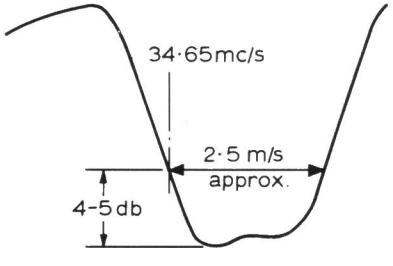


Fig.7

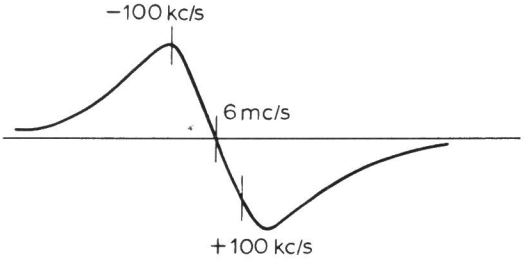


Fig.10 A311

IF Alignment Waveforms

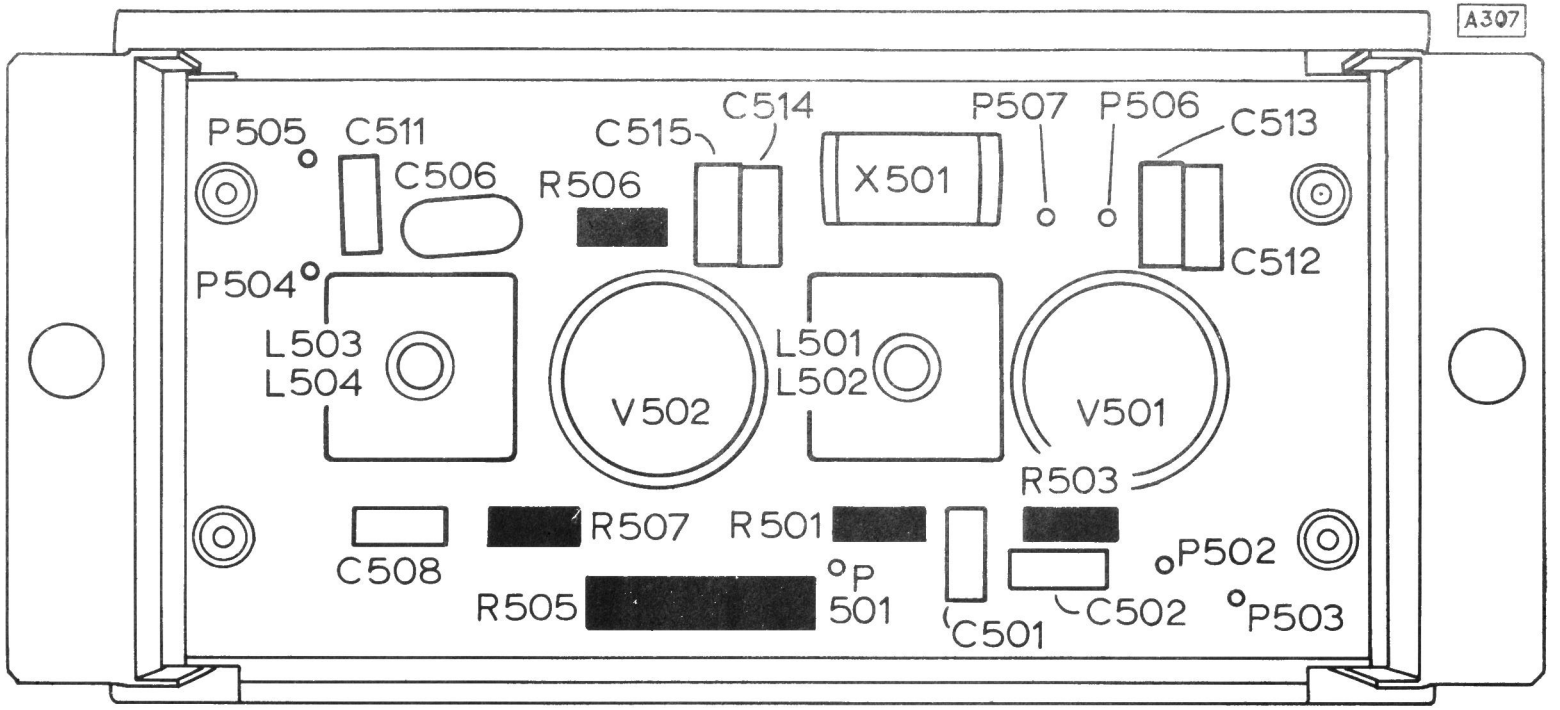


Fig. 11 AFC Discriminator Board Component Locations

AFC DISCRIMINATOR ALIGNMENT

Equipment Required

(1) Signal Generator covering 37-39.5 Mc/s, 100% square wave modulated at 400 c/s and having a DC continuity between output terminals.
(2) AF Oscilloscope.
(3) AFC amplifier and tuning meter (parts of receiver WJ11 or WJ12).
(4) Dummy UHF aerial, 75 ohms impedance.

Connections

Disconnect the vision IF input lead from the AFC discriminator board (pin P502) and replace with input from Signal Generator. Connect Oscilloscope to discriminator output (pin P504). Screw the cores of all discriminator coils to the outer ends of the coil formers.

Initial Alignment

(1) Switch to '625'. Inject 100 mV at 37 Mc/s and adjust L502 for minimum Oscilloscope display.
(2) Inject minimum usable signal at 39.5 Mc/s and adjust L501 for maximum Oscilloscope display, stopping at first maximum reached when advancing core.
(3) Inject 100 mV at 39.5 Mc/s and adjust L503 for maximum Oscilloscope display.
(4) Advance L504 core. Display will first rise to maximum, then fall through zero. Readjust L504 for minimum Oscilloscope display. Disconnect Oscilloscope.
(5) Switch to '405', check mains input adjustment and centre tuning meter indication using R453, transistor board.
(6) Switch to '625' and adjust L504 for centre scale deflection of tuning mete
(7) Disconnect Signal Generator and reconnect vision IF input lead to pin P502

Final Alignment

Using a dummy UHF aerial with the receiver switched to UHF (625), tune the receiver clear of any stray signal. Centre tuning meter on receiver noise adjusting L501 if necessary. Tune the receiver through the whole of UHF range and note extremes of tuning meter readings, disregarding readings due to signal pick-up.

Retrim L502 for best overall meter centering on receiver noise.

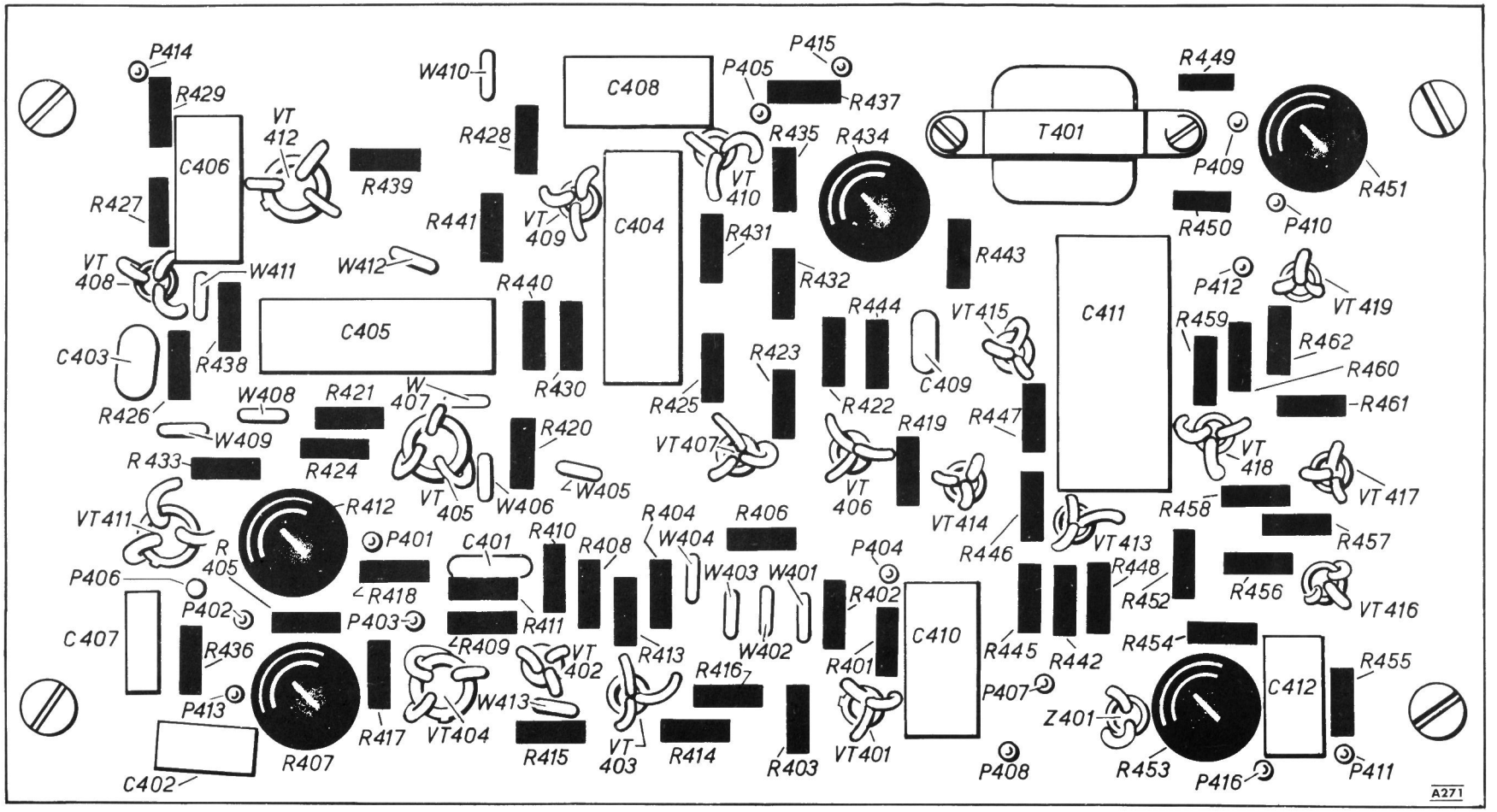


Fig. 12 Transistor Board Component Locations

COMPONENT SCHEDULE

IF BOARD ASSEMBLY

CAPACITORS

All capacitors 350V DC working 20% tolerance unless otherwise stated.

Vision Section

Ref.	Value	Tolerance	Rating
C1	5pF	5%	
C2	5pF	5%	
C3	7pF	5%	
C4	10pF	10%	
C5	10pF	10%	
C7	0.03μF		
C8	300pF		
C9	42pF	10%	
C10	1000pF	-20+80%	
C11	0.5μF		150V
C12	1000pF	-20+80%	
C13	5000pF	-20+80%	
C14	1000pF	-20+80%	
C15	800pF	10%	
C16	5000pF	-20+80%	
C17	5pF	10%	
C18	5pF	10%	
C19	3.3pF	10%	
C20	5pF	5%	
C21	100pF	2%	
C22	0.3μF	-0+20%	150V
C23	200pF	2%	
C29	0.5pF		150V

Sound Section

C40	50pF	10%	
C41	4500pF	-20+80%	
C42	50pF	10%	
C43	4500pF	-20+80%	
C44	100pF	5%	
C45	100pF	5%	
C46	300pF		
C47	5000pF	-20+80%	
C48	1000pF		
C49	4500pF	-20+80%	

Ref.	Value	Tolerance	Rating
C50	0.1μF		
C51	4500pF	-20+80%	
C52	0.03μF	-20+80%	
C53	3.3pF	5%	
C54	20pF		
C55	30pF	10%	
C56	100pF	5%	125V
C57	120pF	10%	
C58	100pF	5%	125V
C59	3900pF		
C60	5000pF	-20+80%	
C61	4μF	Elec	100V
C62	10pF	10%	
C63	0.1μF		
C65	0.02μF	-20+80%	
C66	0.02μF		
C67	3000pF		
C68	50μF	Elec	25V
C69	1000pF	-20+80%	
C71	4500pF	-20+80%	
C72	1000pF	-20+80%	
C73	4500pF	-20+80%	
C74	4500pF	-20+80%	
C75	1000pF	-20+80%	
C76	1000pF	-20+80%	
C77	25pF	10%	

The following capacitors are part of the sound section but are not mounted on the board.

C101	0.04μF
C102	0.04μF
C103	0.05μF

RESISTORS

All resistors $\frac{1}{4}$W carbon, 20% tolerance, unless otherwise stated.

Vision Section

Ref.	Value	Tolerance	Rating
R1	56Ω	10%	$\frac{1}{5}$W
R2	12Ω	5%	$\frac{1}{10}$W
R3	22Ω	10%	$\frac{1}{10}$W
R4	1KΩ		
R5	1KΩ		
R6	12KΩ	10%	$\frac{1}{10}$W
R9	33KΩ	10%	$\frac{1}{2}$W
R10	68KΩ	10%	$\frac{1}{2}$W
R11	33Ω	10%	$\frac{1}{5}$W
R12	27KΩ	10%	$\frac{1}{10}$W
R13	39Ω	10%	$\frac{1}{5}$W
R14	12KΩ		$\frac{1}{5}$W
R15	150KΩ		$\frac{1}{5}$W
R16	100KΩ	10%	$\frac{1}{5}$W
R17	1KΩ		
R18	150Ω	10%	$\frac{1}{5}$W
R20	33KΩ		$\frac{1}{5}$W
R22	2.2KΩ	10%	$\frac{1}{4}$W

Sound Section

R54	1KΩ		$\frac{1}{5}$W
R55	27KΩ	10%	$\frac{1}{10}$W
R56	47KΩ	10%	$\frac{1}{2}$W
R57	47Ω	10%	$\frac{1}{5}$W
R58	4.7KΩ	10%	
R59	680Ω		
R60	47KΩ		
R61	1KΩ		$\frac{1}{5}$W
R62	1KΩ		$\frac{1}{5}$W
R63	180Ω	10%	$\frac{1}{5}$W
R64	470Ω	10%	$\frac{1}{2}$W
R65	47KΩ	10%	$\frac{1}{10}$W
R66	22KΩ	10%	$\frac{1}{5}$W
R67	1.8KΩ	10%	$\frac{1}{10}$W
R68	2.7KΩ	10%	$\frac{1}{10}$W
R69	27KΩ	10%	$\frac{1}{10}$W
R70	4.7KΩ		$\frac{1}{5}$W
R71	4.7KΩ		$\frac{1}{5}$W
R72	68KΩ	10%	$\frac{1}{5}$W
R73	390KΩ		$\frac{1}{5}$W

Ref.	Value	Tolerance	Rating
R74	2.2MΩ		$\frac{1}{5}$W
R75	470KΩ	10%	
R77	5KΩ	Preset lin pot	
R78	27KΩ	10%	$\frac{1}{5}$W
R79	10MΩ		$\frac{1}{5}$W
R80	220KΩ		$\frac{1}{5}$W
R81	150Ω	10%	
R82	680KΩ		$\frac{1}{5}$W
R83	22KΩ	10%	$\frac{1}{5}$W
R84	12KΩ		$\frac{1}{5}$W
R85	150Ω	10%	
R86	3.3KΩ		$\frac{1}{5}$W
R132	22KΩ	10%	$\frac{1}{10}$W
R171	47KΩ	10%	$\frac{1}{10}$W

The following resistors are part of the sound section but are not mounted directly on the board.

R105	200KΩ	Preset lin pot	Plessey type M
R106	200KΩ	Preset lin pot	Plessey type M
R107	500KΩ	Log pot	A.B. Metals (Std. flat)

INDUCTORS AND TRANSFORMERS

Ref.	Function	Part No.
L1,L2	405/625 sound rejector (including R2, C1, C2 and C3)	56079
L3,L4	405 adjacent channel rejector and sound after rise rejector (including R3, C4 and C5)	56080
L5,L6	1st vision IF and adjacent channel rejector (625) (including R6, C9 and C10)	56081
L7,L8,L9	Vision interstage coupling (including C14)	56082
L10,L11,L12	Vision detector coupling	56083
L13,L14,L16	Vision IF filter chokes	
L18	Discriminator coupling (including C17, C18, C19 and W1)	
L17	3.5 Mc/s sound rejector	A/104302
L21,L22,L23	Sound take-off coils (including R132, C40 and C42)	56098
L24,L25,L26,L27	Sound interstage transformer (including R55, R171, C44 and C45)	50685
L28,L29,L30,L31	Ratio and AM sound detector transformer (including R65, R67, R68, R69, C53, C55, C56, C57, C58, W7, W9 and W10)	50686

Note: All cores are iron dust (FRC No. Z 13724/1) except L17 which has ferrite (FRC No. Z 13749)

VALVES AND DIODES

Vision Section

Ref.	Type	Manufacturer
V3	EF183	Mullard
V4	E184	Mullard
W1	0A70 or	Mullard
	GD13	Thorn/A.E.I.
W2, W3	FSY28A	S.T.C.

Sound Section

V11	EF85	Mullard
V12	EF80	Mullard
W7	CG64	Thorn/A.E.I.
W9, W10	CG61	Thorn/A.E.I.

TRANSISTOR BOARD ASSEMBLY

CAPACITORS

Ref.	Value	Tolerance	Manufacturer
C401	10pF	±½pF	Hunts 1106R
C402	0.04μF		Hunts BD16 or BT16
C403	390pF	±10%	Hunts 1510E
C404	0.5μF	150V	Dubilier 700
C405	0.5μF	150V	Dubilier 700
C406	25μF	25V	Hunts PW118
C407	5μF	15V	Waycom Printilist
C408	12μF	25V	Hunts PW117
C409	0.004μF		Hunts DB11
C410	25μF	250V	Hunts PW118
C411	500μF	6V	Hunts PW106
C412	0.22μF	125V	Waycom Tropylfol M

RESISTORS

All resistors, Erie type 9AP2 ±10%, ⅓W, except where shown.

Ref.	Value	Tolerance	Manufacturer
R401	270Ω		
R402	2.2KΩ		
R403	10KΩ		
R404	10KΩ		
R405	22KΩ		
R406	2.2KΩ		
R407	22KΩ	Variable	Plessey MP Dealer
R408	2.2KΩ		
R409	2.2KΩ		
R410	270Ω		
R411	33KΩ		
R412	22KΩ	Variable	Plessey MP Dealer
R413	1KΩ		
R414	2.2KΩ		
R415	100Ω		
R416	270Ω		
R417	100Ω		
R418	2.2KΩ		
R419	270Ω		
R420	2.2KΩ		
R421	100Ω		
R422	18KΩ		
R423	270Ω		
R424	15KΩ		

Ref.	Value	Tolerance	Manufacturer
R425	1.8KΩ		
R426	2.2KΩ		
R427	2.2KΩ		
R428	270Ω		
R429	22KΩ		
R430	4.7KΩ		
R431	100Ω		
R432	820Ω		
R433	100Ω		
R434	2.2KΩ	Variable	Plessey MP Dealer
R435	120Ω	±2% HS	Welwyn C20
R436	47Ω		
R437	220Ω	±2% HS	Welwyn C20
R438	5.6KΩ		
R439	270Ω		
R440	22KΩ		
R441	22KΩ		
R442	2.7KΩ		
R443	150Ω		
R444	2.7KΩ		
R445	18KΩ		
R446	680Ω		
R447	2.2KΩ		
R448	820Ω		
R449	22Ω	±2% HS	Dubilier S27
R450	33Ω	±2% HS	Dubilier S27
R451	560Ω	Variable	Plessey MP Dealer
R452	1.5KΩ		
R453	10KΩ	Variable	Plessey MP Dealer
R454	1MΩ		
R455	120KΩ		
R456	10KΩ		
R457	68KΩ		
R458	270Ω		
R459	100KΩ		
R460	100Ω		
R461	270Ω		
R462	22KΩ		

TRANSISTORS

Ref.	Type	Manufacturer
VT401	C111	S.G. Fairchild
VT402	C111	S.G. Fairchild
VT403	C111	S.G. Fairchild
VT404	2N1131	S.G. Fairchild
VT405	2N1991	S.G. Fairchild
VT406	C111	S.G. Fairchild
VT407	C111	S.G. Fairchild
VT408	C111	S.G. Fairchild
VT409	C111	S.G. Fairchild
VT410	C111	S.G. Fairchild
VT411	2N1991	S.G. Fairchild
VT412	2N1991	S.G. Fairchild
VT413	C111	S.G. Fairchild
VT414	OC201	Mullard
VT415	OC201	Mullard
VT416	OC201	Mullard
VT417	OC201	Mullard
VT418	C111	S.G. Fairchild
VT419	OC201	Mullard

DIODES

Ref.	Type	Manufacturer
W401, W402, W403, W404	OA47	Mullard
W405	OA200	Mullard
W406, W407, W408	OA47	Mullard
W409	OA200	Mullard
W410, W411	OA47	Mullard
W412	OA200	Mullard
W413	OA47	Mullard

ZENER DIODE

Z401	OAZ203	Mullard

AUDIO TRANSFORMER

T401	11200	Hinchley

DISCRIMINATOR BOARD ASSEMBLY

CAPACITORS

Ref.	Value	Tolerance	Type
C501	0.001μF		Hunts BD32
C502	0.001μF		Hunts BD32
C503	30pF	2%	Lemco 1106R
C504	5pF	±½pF	Lemco 1106R
C505	30pF	2%	Lemco 1106R
C506	0.04μF		Hunts BD16
C507	5pF	±½pF	Lemco 1106R
C508	0.001μF		Hunts BD32
C509	10pF	±½pF	Lemco 1106R
C510	10pF	±½pF	Lemco 1106R
C511	0.001μF		Hunts BD32
C512	0.001μF		Hunts BD32
C513	0.001μF		Hunts BD32
C514	0.001μF		Hunts BD32
C515	0.001μF		Hunts BD32

RESISTORS

Ref.	Value	Tolerance	Type
R501	1KΩ	10%	Erie 9AP2
R502	3.3KΩ	10%	Erie 16
R503	270Ω	10%	Erie 9AP2
R504	270KΩ	10%	Erie 16
R505	33KΩ	10%	Erie 10AP
R506	10KΩ	10%	Erie 9AP2
R507	1KΩ	10%	Erie 9AP2
R508	120KΩ	10%	Erie 10AP
R509	120KΩ	10%	Erie 10AP

INDUCTORS

Ref.	Part No.	Ref.	Part No.
L501, L502	B/104610	L503, L504	B/104611

VALVES

Ref.	Type	Manufacturer
V501	EF184	Thorn/A.E.I.
V502	EF80	Thorn/A.E.I.
X501	VA1070	Mullard

METER PANEL ASSEMBLY

RESISTORS

Ref.	Value	Tolerance	Type
R701	100Ω	2% HS	Welwyn C20
R702	100Ω	2% HS	Welwyn C20
R703	150Ω	Variable	Colvern 1106/9S
R704	120KΩ	2% HS	Welwyn C20
R705	120KΩ	2% HS	Welwyn C20

RECTIFIER

Ref.	Rating	Type
W701	1mA	Westinghouse

UHF TUNING METER

0 - 100μA Sifam Instrument Co.

POWER UNIT ASSEMBLY

CAPACITORS

Ref.	Value	Rating	Type
C601	0.1μF	350V	Dubilier 660
C602, C603, C604, C605	100+300+100+100μF		CCL EW106NH13
C606	1000μF	25V	CCl E174/S
C607	1000μF	25V	CCL E174/S
C608	1000μF	25V	CCL E174/S
C609	1000μF	25V	CCL E174/S

RESISTORS

Ref.	Value	Tolerance	Rating	Type
R601	5.6KΩ	10%		Erie 8
R602	10KΩ	10%		Erie 9AP2
R603	330Ω	5%	6W	Erie style R
R604	22Ω	10%	1W	Morganite Y
R605	22Ω	10%	1W	Morganite Y

RECTIFIERS

Ref.	Type
W601	Mullard BY 100
W602	
W603	
W604	
W605	
W606	

MAINS TRANSFORMER

Ref.	Type	Manufacturer
T601	THEM 006A	Transformer Equipment Ltd.

CHOKE

Ref.	Part No.
L601	FRC No. Y23681/1

VHF TUNER (Part No. B/104319)

VALVES

V1	PC97	Tuner biscuit (Channel 6)	W/57314/6
V2	PCF805	(Channel 7)	W/57314/7

UHF TUNER (Part No. B/104320)

VALVES

V301	PC88
V302	PC86

MISCELLANEOUS

Volume Control knob	Bulgin K240
System Switch knob	Bulgin K240
Fine Tuner knob	FRC X55720/2
Mains ON/OFF switch (S101)	Arrow 81850-BT-13-CH
UHF meter switch	Arrow 81358-BT-13-CH
Aerial plug VHF/UHF	Greenpar 27519 B1 GE
Aerial socket VHF/UHF	Greenpar 27516 C7H GE
Video output plug	Cannon S0259/SS
Video output socket	Cannon S0239
Audio output plug	Cannon XLR-3-12SC
Audio output socket	Cannon XLR-3-13
Loudspeaker $6\frac{1}{2} \times 3\frac{1}{2}$ inches	FRC Y16009/3/R.A.3
L.S. Transformer	FRC Z.4055
VHF Tuner plug	FRC Z.20900
Valve retaining clips	
(IF board) - long	Thorn Electronics A/104292/1
- short	Thorn Electronics A/104292/2
Valve retaining clips (Discriminator board)	McMurdo SR7
System switch S2	NSF B/104216
Biscuit guard	A/104624
Fuse holder	Belling Lee L1382
Fuse link (1.0 amp)	K.E. Beswick Anti-singe
Voltage selector and Plug	McMurdo B.279002/A
Fan Unit (115 volts)	A.K. Fans Ltd.
Air Filter	Air Control Installations

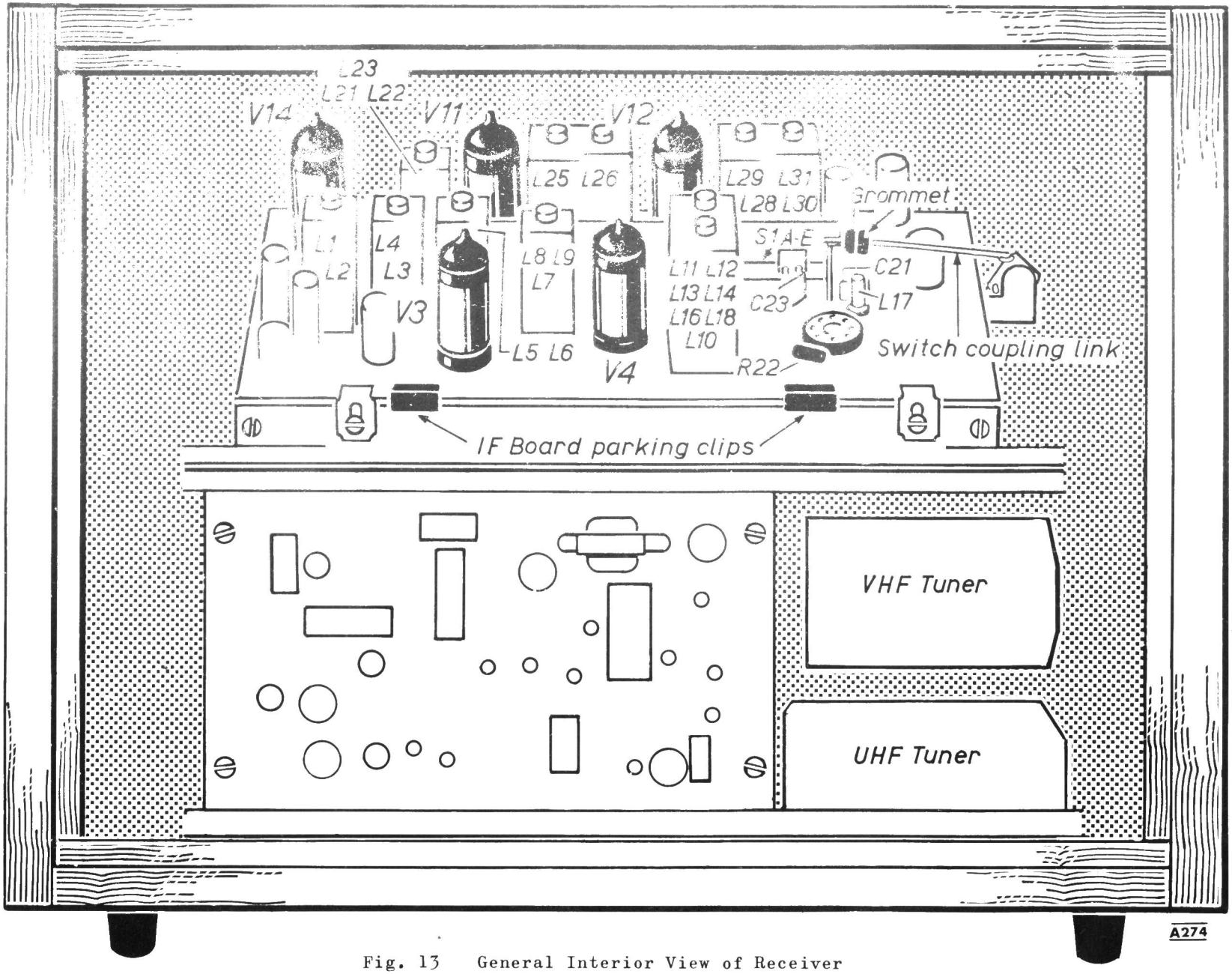


Fig. 13 General Interior View of Receiver

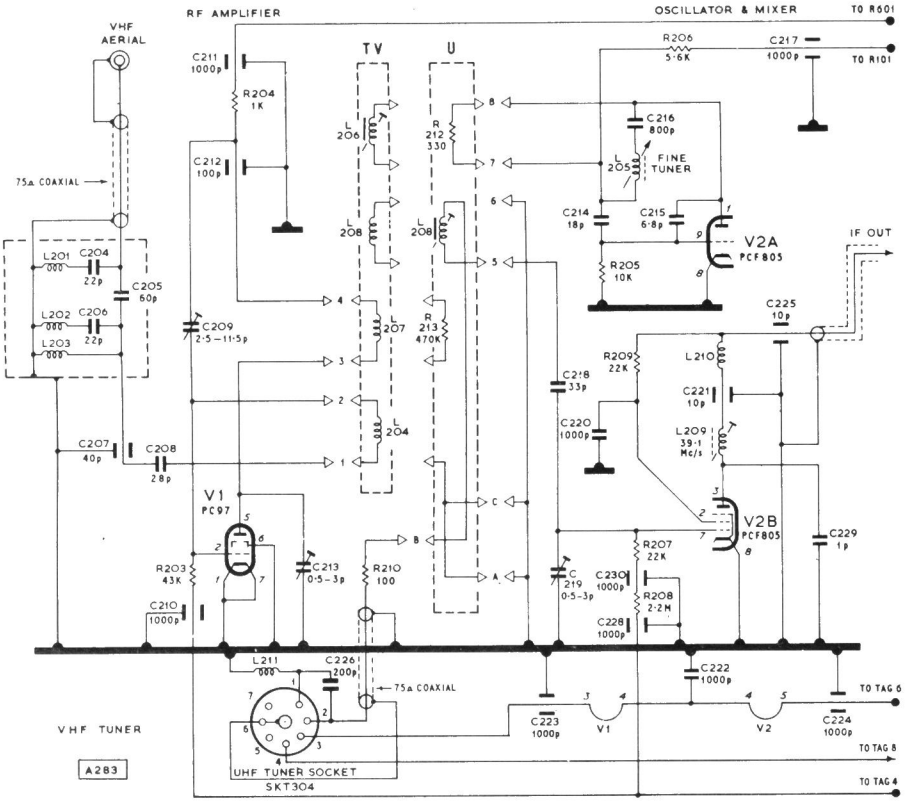


Fig. 14 VHF Tuner Circuit Diagram

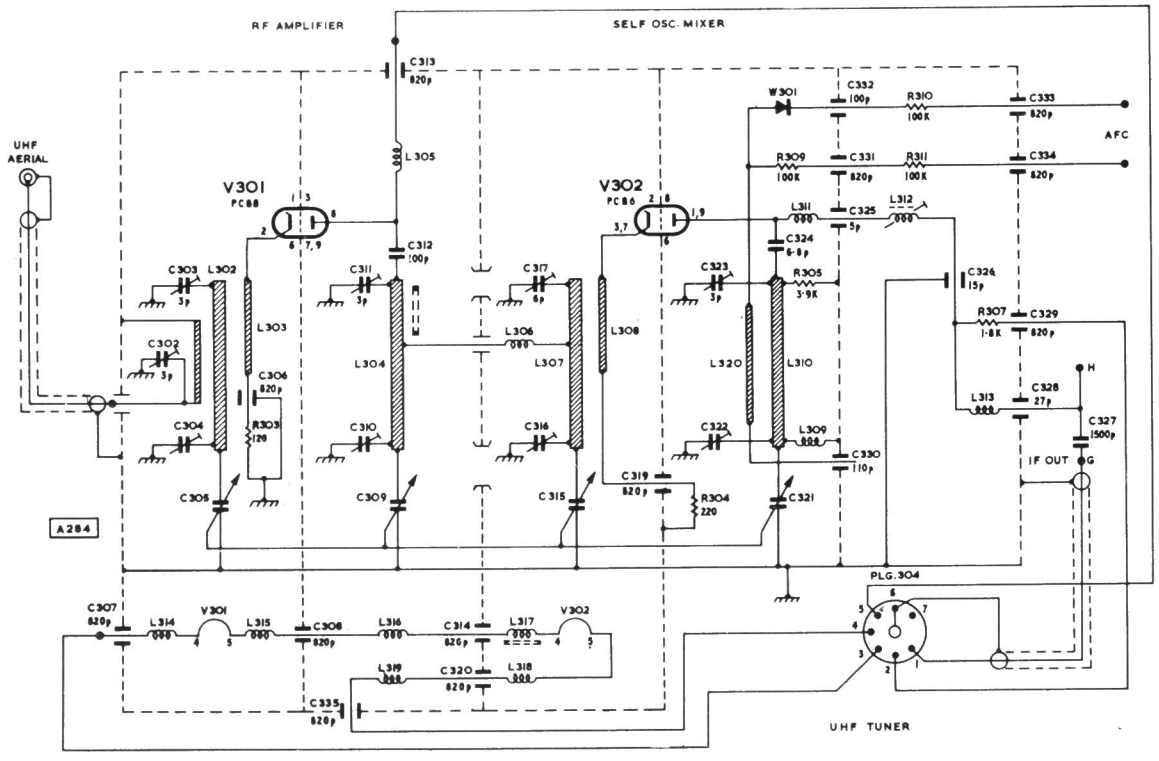
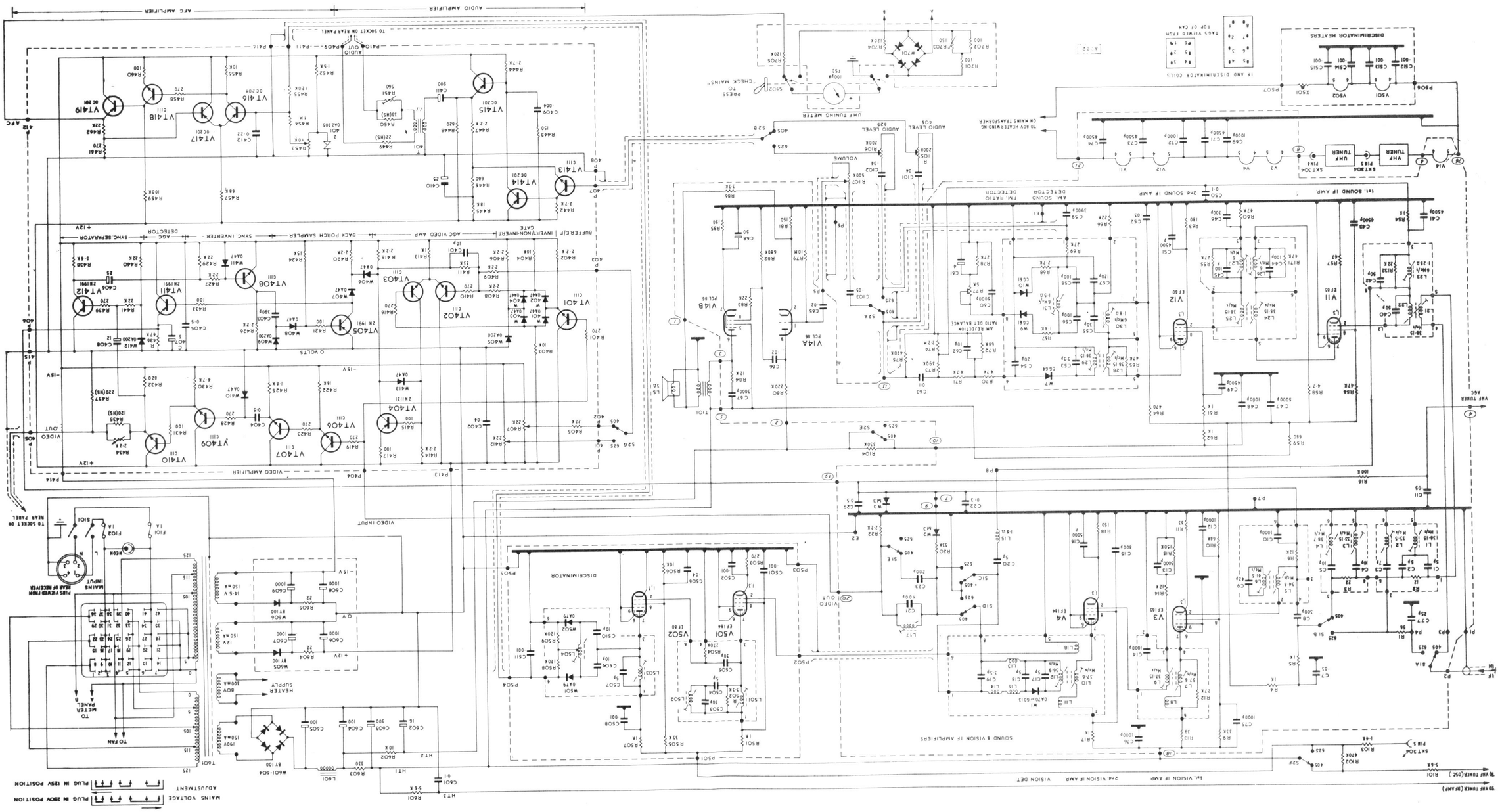


Fig. 15 UHF Tuner Circuit Diagram


AUDIO AMPLIFIER
AFC AMPLIFIER
VIDEO AMPLIFIER
VIDEO INPUT
SOUND & VISION IF AMPLIFIERS
1st VISION IF AMP
2nd VISION IF AMP
VISION DET
1st SOUND IF AMP
2nd SOUND IF AMP
AM SOUND DETECTOR
FM RATIO DETECTOR
AUDIO LEVEL
VOLUME
DISCRIMINATOR
UHF TUNING METER
"CHECK MAINS"
VHF TUNER
UHF TUNER
BUFFER/F | INVERT/NON-INVERT
AGC VIDEO AMP
SYNC INVERTER
BACK PORCH SAMPLER
AGC
SYNC SEPARATOR
DETECTOR
+12V
0 VOLTS
-15V
MAINS INPUT
TO FAN
HEATER SUPPLY
MAINS VOLTAGE ADJUSTMENT
PLUG IN 230V POSITION
PLUG IN 120V POSITION
TO SOCKET ON REAR PANEL
TO 80V HEATER WINDING ON MAINS TRANSFORMER
IF AND DISCRIMINATOR COILS
VIEWED FROM TOP OF CAN
SKT 304
SKT 304 PINS
TO VHF TUNER (RF AMP)
VHF TUNER AGC