technical memorandum Daresbury Laboratory

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VIDEO MONITOR CONVERSION FOR THE FERGUSON TX90

by

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INTRODUCTION

This technical memorandum describes a conversion to allow a domestic television to be used as a video monitor or as a normal off-air receiver at the push of a button.

Television receivers which can be used as monitors having facilities for video and sound input and output are few and far between and are normally expensive to buy. It was therefore considered reasonable to convert a reliable, inexpensive receiver for this purpose.

British made and reliable is the Ferguson Model 37140 which retails between £159 and £169. It has a screen size of 14" and has an option for battery operation. The type of chassis used is the TX90, fig.1.

Consideration should first be given to why we need to use a monitor rather than a normal television. Any source of video information wherever generated from, e.g. computer, video recorder, camera, etc. must supply the television with three types of essential information: the vision signal, a synchronising signal, and, if applicable, colour information. When gathered in this format they are called a composite signal. A video monitor will accept a composite signal without any further additions but a standard television requires a UHF or Ultra High Frequency signal. To meet this requirement the composite signal must be superimposed onto a Radio Frequency carrier and must therefore be passed through a modulator. Most modulators that are fitted in peripheral equipment operate on channels 36 or 37 in the UHF band. These channels are not allocated to broadcasting organisations and are reserved for home entertainment equipment.

When a television receives this signal at the aerial socket it must be demodulated and returned to a composite signal before colour decoding can take place. This process involves many stages of mixing and amplification which can cause a degrading of picture quality, patterning and drifting off tune. Figure 2 shows a block diagram of the signal path through the television. If a composite signal is fed into the receiver after the demodulator as shown, the signal processing stages at the front-end are bypassed and there is no need for the modulator at the signal source.

Patterning and drifting are then eliminated and picture display is greatly improved.

CIRCUIT OPERATION

It is standard practice to provide video and sound input and output sockets on a monitor and the interface described will give these facilities. Button 8 on the channel selector switch is used to change over from normal television to monitor. In this mode off air signals are disabled and external video and sound signals are sourced from the input sockets. Whichever signal selected is also made available at the video and sound output sockets for distribution to line, e.g. for recording or connecting to further monitors.

In the TX90, sound and vision signals are derived from the small signal combination IC type TDA4500. Video signals are then conneected to the luma chroma processing IC UPC1365 and sound is fed to the audio amplifier, see fig.3. The path of the video and sound signals must be broken to allow external inputs when in monitor mode. This is achieved by CMOS switching, which offers low insertion loss and simple changeover control.

When switched to television mode video signals, after processing by the TDA4500, are fed via switch IC1(c) to the video amplifier in the television, see fig.3, and at the same time to the video output socket via TR1 at a standard level of 1 volt peak to peak. Sound signals are also processed in the TDA4500, audio amplitude being controlled by an internal voltage attenuator network prior to leaving the IC. Using this method of volume control prevents audio signals which are not controlled by the volume control from being extracted for external output. It is therefore necessary for the audio output signal to be of a standard level and removed prior to the volume control, which means a small modification to the receiver. This is done by disconnecting the volume control potentiometer from the DC control pin of the voltage controlled attenuator within the TDA4500. Attenuator action is now prevented and maximum audio is available at the output of the IC. External audio signals are now available to be amplified by TR7 and fed to line. The original volume control is now connected in a conventional manner after first AC coupling from the IC output, see fig.4.

When switching to monitor, video input signals must be amplified and switched into the television's existing video circuit and simultaneously off air video signals disabled using further CMOS switching. Sound signals are treated in a similar manner. The action of these switches is controlled by the AV sync time constant switch which is automatically operated when button 8 on the channel selector switch is pressed.

CIRCUIT DESCRIPTION

Refer to fig.5. External video signals are terminated by R20 and are then AC coupled via C5 to a non-inverting amplifier consisting of TR5, TR6 and associated components. TR4 is connected as an emitter follower which allows the video signal to be applied to the main board via IC2(c). TR10 is also fed with a video signal and is used to synch separate and invert field and line synchs, which are then interfaced via IC2(d) to the receiver synch circuits. TR1 is used as a video level corrector and supplies a composite video signal out. Its base derives video signals from off air transmissions when IC1(c) is closed and normal television is displayed on the screen or alternatively when IC2(c) is closed IC1(c) open, video input signals are displayed on screen and also fed to video out.

External audio signals are AC coupled via C1 and amplified by TR2. When IC2(a) is closed this signal is AC coupled to the volume control via C7 and through the receiver audio amplifier to the loudspeaker. When IC2(a) is open IC1(a) is closed which allows normal TV sound through from the TV detector circuit to C7 and the volume control. C8 is connected to the centre point of these two switches allowing either of the selected audio signals to be amplified by TR7 and fed to line out. TR3 acts as a switch to mute television sound when using external audio inputs. IC1(b) switches the tuner unit DC supply off when in monitor mode to prevent any signal breakthrough and IC2(b) switches R11 into circuit for resetting the AGC level.

TR8 and TR9 are connected to form a monostable circuit. When TR9 base is high its collector is low and TR8 collector is high. IC2 has its enable line connected to TR9 collector and IC1 has its enable line connected to TR8 collector. In this condition IC1 is on giving normal TV operation, and

IC2 off. When button 8 of the channel selector is selected, the cathode of D1 goes low grounding the base of TR9. Its collector then goes high and TR8 collector subsequently low. IC1 then switches off and IC2 switches on turning the monitor circuit on.

CONSTRUCTION

Mount components on printed circuit board taking care to observe polarity of electrolytic capacitors and diode. Fit wire links where indicated and fit two IC sockets. Construct aluminium metal bracket as per fig.6 and fit two BNC sockets for video in/out and two phono sockets for audio in/out. This bracket is fitted to the PCB using three M3 buts and bolts. Other types of sockets may be fitted depending on requirements.

Connections to the main board of the television are located along the rear edge of the interface board. Twelve single cables, perferably of different colours for ease of identification, should be fitted using multi-strand 16/0.2 mm or similar. They should initially be cut to about 24 inches long and trimmed accordingly when connected to the main board. it is advisable to tie the cables together into a neat wiring loom.

METHOD OF FITTING

First release the main printed board from the receiver by undoing the self tapping screw holding the control panel to the cabinet front. The board will then slide back to work on. Two different types of printed board have been used during production of the TX90. The modification can be fitted to either version; however connection details are not the same for each type. This means that the board must be identified correctly from the outset.

The original board is coded PC1130 and the number is printed on the copper side of the main board. If the receiver is of more recent manufacture, it will be fitted with board type PC1140. Carry out the simple modifications to the main board by following the appropriate instructions relating to your main board.

PC1130 Conversion

1. Interchange C129 68n with R130 820R (hole spacing is the same). This modification undates the synch circuit in line with the PC1140.

2. Cut track to pin 8 of the tuner, see fig.7 (breaks the DC supply).

3. Remove C174 470n (located near the rear edge of the PCB).

4. Remove wire link marked LK142 (located below IC103).

5. Remove wire link marked LK102 (located above volume control).

6. Remove R114 10K and replace with wire link (located behind the volume control).

7. Cut copper track round the top and middle connections of the volume control to isolate the connections, see fig.8.

PC1140 Conversion

1. Remove wire link marked LK110 (top of board above tuner).

2. Remove wire link marked LK133 (below tuner),

3. Remove C174 470n (located in audio stage rear edge PCB).

4. Remove R158 270R (below IC103).

5. Remove R114 10K (located behind volume control).

Note R31 470R resistor should be fitted in line with the cable marked L106/R126. The preferred way is to mount the resistor vertically into the interface board using the hole marked L106/R126 then soldering the interconnecting lead to the top of it.

Now slide the new interface board into the ready made plastic guides in the centre of the cabinet base. Route the wiring loom from this board along the cabinet base and then upwards to the top of the main receiver PCB and come over the top near the volume control onto the copper track side fanning out the leads to the appropriate connection points shown in fig.9. The photograph of the TX90 PCB shows the method involved but has been exaggerated to easily identify the connections, fig.10. Keeping the wiring loom close to the front of the cabinet will prevent any stray pick-up from the line output transformer. Refit the main board into the cabinet making sure the wiring loom sits neatly above the volume control. Drill two holes of 3.2 mm diameter in the cabinet base which line up with the two 3 mm holes on the front edge of the interface board. Fit 3 mm nuts and bolts to secure the board, fig.11.

TESTING

Switch on the receiver and select a normal TV channel and check that the volume control operates normally. Select button 8 and apply a video and sound signal to the input sockets. Connect another monitor or an oscilloscope to the video and sound output sockets and make sure that external inputs are routed to the output sockets when in monitor mode and when switching over to normal TV these signals now appear at the output sockets. RV1 should be set for the audio line level required, and is normally set about halfway. Cut a hole in the receiver rear to line up with the sockets, and the modification is complete.

CONCLUSION

The prototype monitor has operated reliably for over six months and has been used with the BBC and Commodore 64 computers. It has also been used to record off air television signals and to display camera outputs giving good results.

FOOTNOTE

It should be noted that this conversion cannot be used with TX90 televisions using remote control.

A service manual for the television may be purchased from Thorn EMI, Ferguson Service Division, Lea Valley Trading Estate, Angel Road, London, N18 3BP.

PARTS LIST

Resistors

RV1 Skeleton Preset	2K2	(RS Part No. 184-984)
R7	47R	
R9	68R	
R20	75R	
R21	82R	
R4, R17, R24	120R	
R15	330R	
R2,R31	470R	
R16	560R	All resistors 1/4 watt carbon
R25	1K	
R12	2K2	
R11, R13, R19, R30	5K6	
R1, R14, R18, R28	10K	
R3, R6	33K	
R10. R27	47K	
R22	56K	
R8, R23, R26	100K	
R5	270K	
R29	330K	

Capacitors

C1	0.47 µf	Provision made on PCB for Vert. or Horiz. mounting
C7, C8	1 µf 16 VW Tantilum bead	
C2, C3, C4, C5	10 µf 16 VW Tantilum bead	
C6	470 Mf 16 VW Working (RS Part No.104 499)	

Semi-conductors

TR1,2,3,4,5,6,7,8,9	BC107 or BC108 Transistors
TR5, 10	BC477 or BC478 Transistors
D1	IN4148 or IN916 Diode
IC1, IC2	MC14066 or 4066 CMOS Switch

Miscellaneous

1 - Printeed circuit boards
2 - 14 pin IC holders
2 - BNC sockets
2 - phono sockets
1 - aluminium bracket for phono and BNC sockets
5 - 3 mm nuts
3 - 3 mm screws, 6 mm long
2 - 3 mm screws, 12 mm long

FIGURE CAPTIONS

Fig.1 The receiver to be converted.

Fig.2 Signal path of composite video or r.f. signal.

Fig.3 Block diagram of circuit operation.

Fig.4 Reconfiguration of volume control.

Fig.5 Circuit diagram of interface.

Fig.6 Details of input/output socket mounting bracket.

Fig.7 Tuner modification main PCB.

Fig.8 Volume control modification main PCB.

Fig.9 Interwiring details.

Fig.10 Method of connecting to main PCB.

Fig.11 Completed interface board.

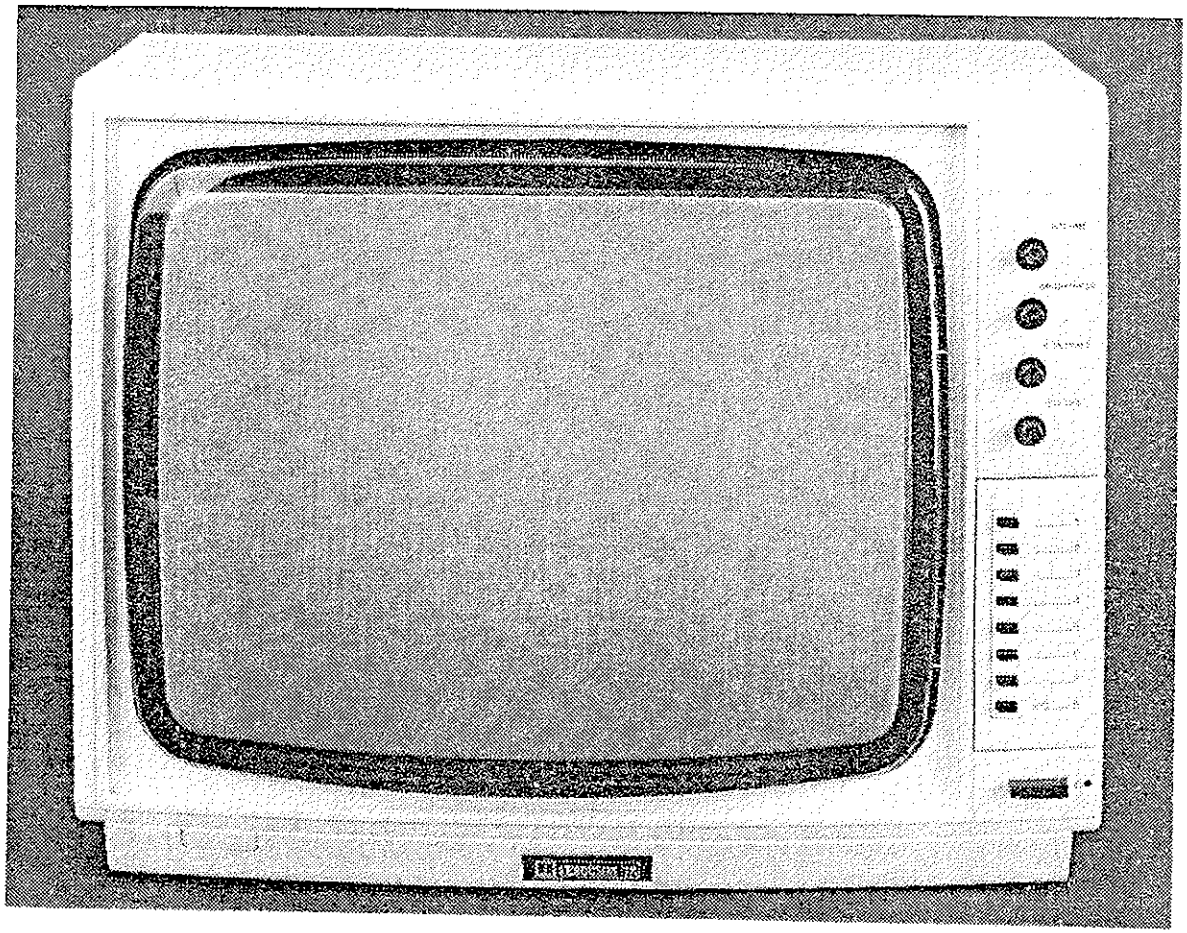
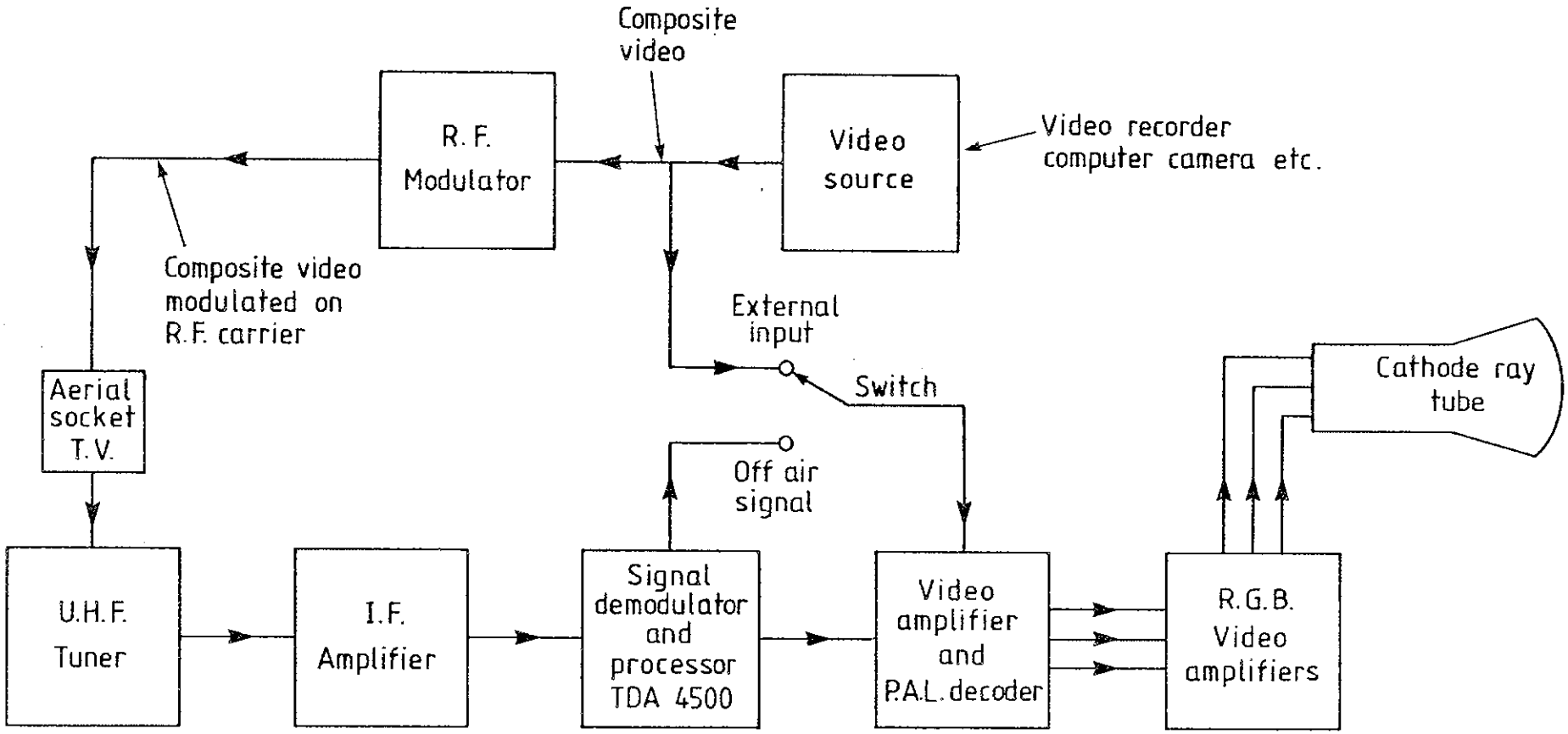


Fig.1



SIGNAL PATH OF COMPOSITE VIDEO OR R.F. SIGNAL

Fig. 2

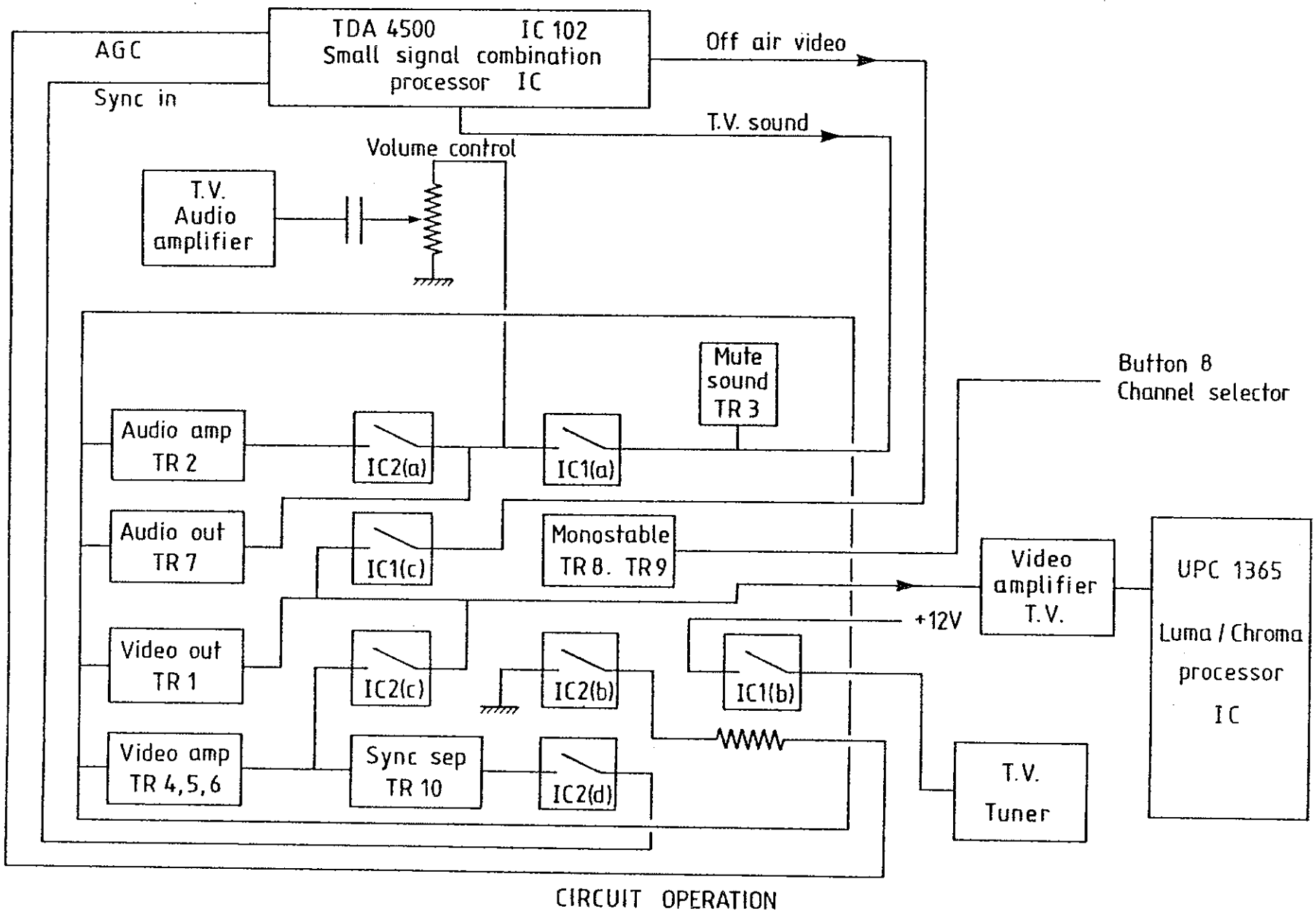
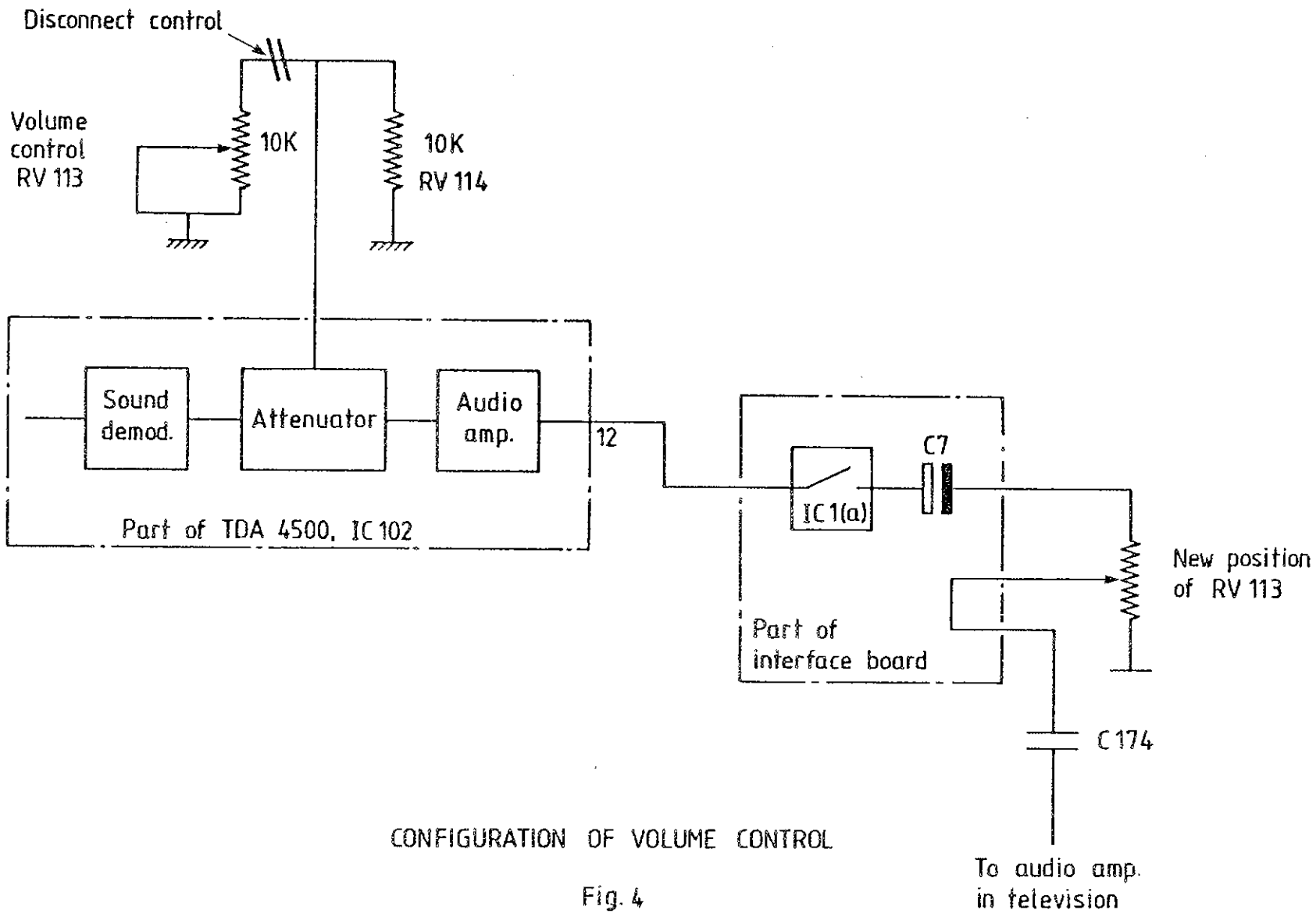
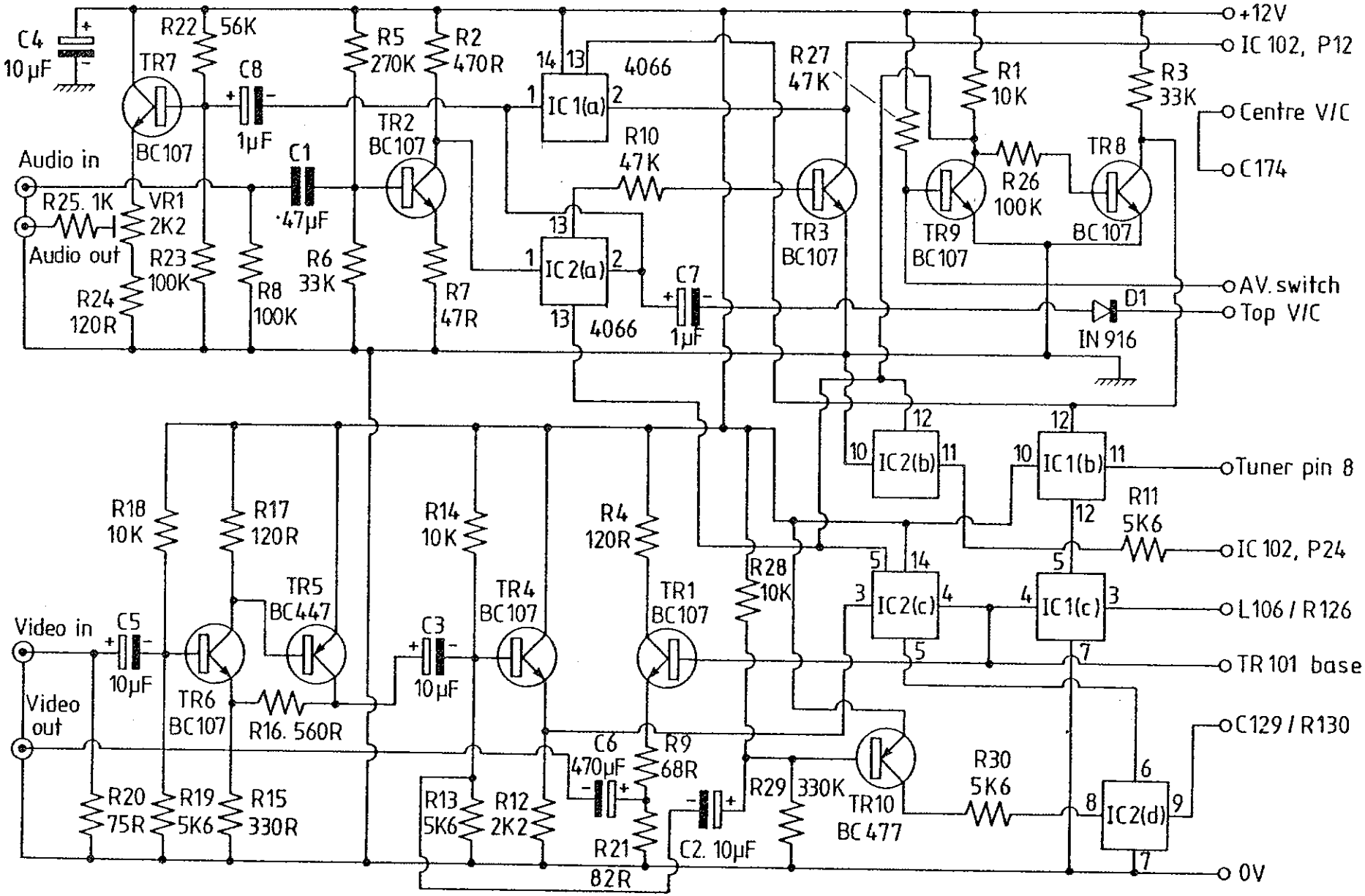

TDA 4500 IC 102
Small signal combination processor IC
AGC
Sync in
Off air video
T.V. sound
Volume control
T.V. Audio amplifier
Mute sound TR 3
Button 8 Channel selector
Audio amp TR 2
IC2(a)
IC1(a)
Audio out TR 7
IC1(c)
Monostable TR 8. TR 9
Video amplifier T.V.
UPC 1365
Luma / Chroma processor IC
+12V
Video out TR 1
IC2(c)
IC2(b)
IC1(b)
Video amp TR 4,5,6
Sync sep TR 10
IC2(d)
T.V. Tuner
CIRCUIT OPERATION

Fig. 3



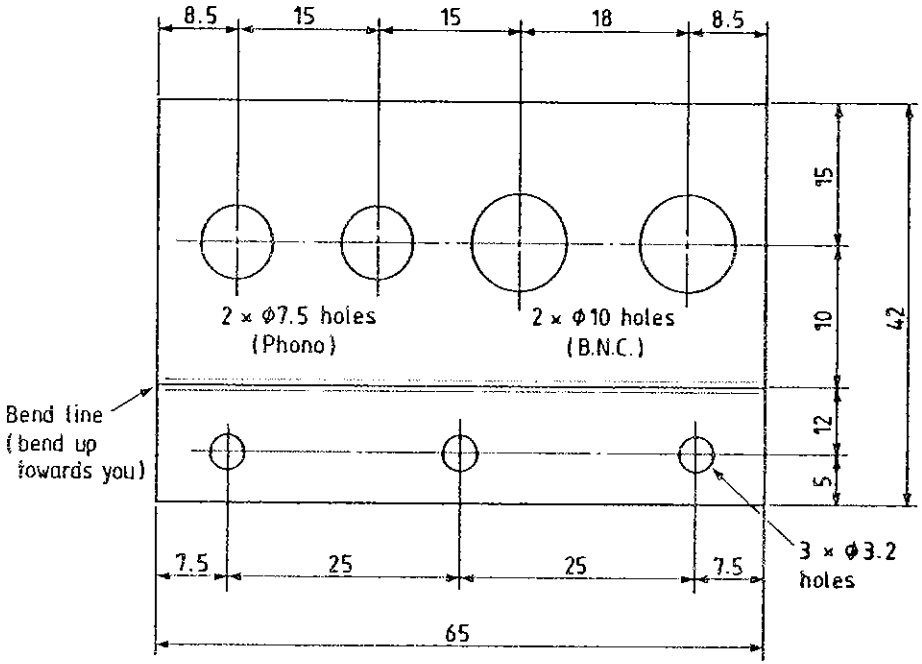
CONFIGURATION OF VOLUME CONTROL

Fig. 4



CIRCUIT DIAGRAM OF INTERFACE

Fig. 5

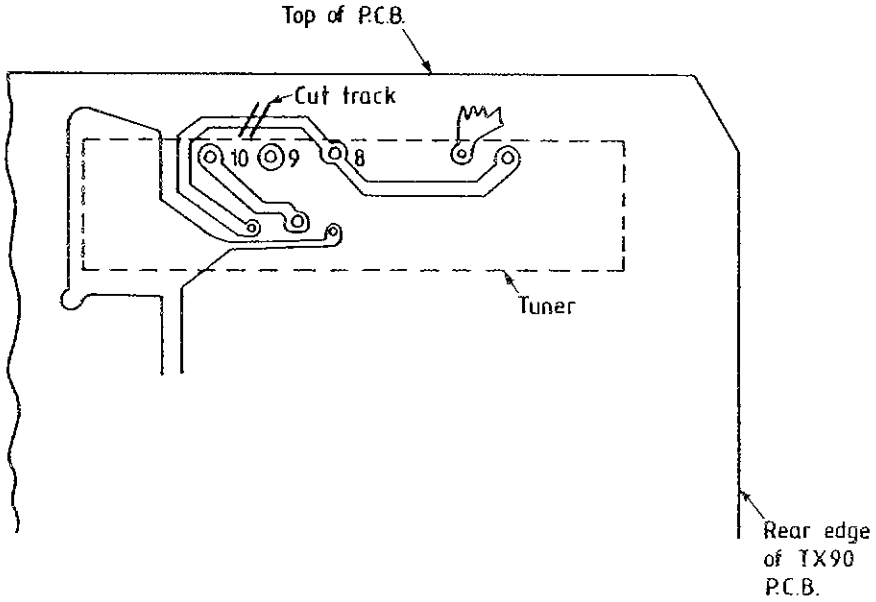


Material 16 s.w.g. Aluminium

All dimensions are in millimetres.

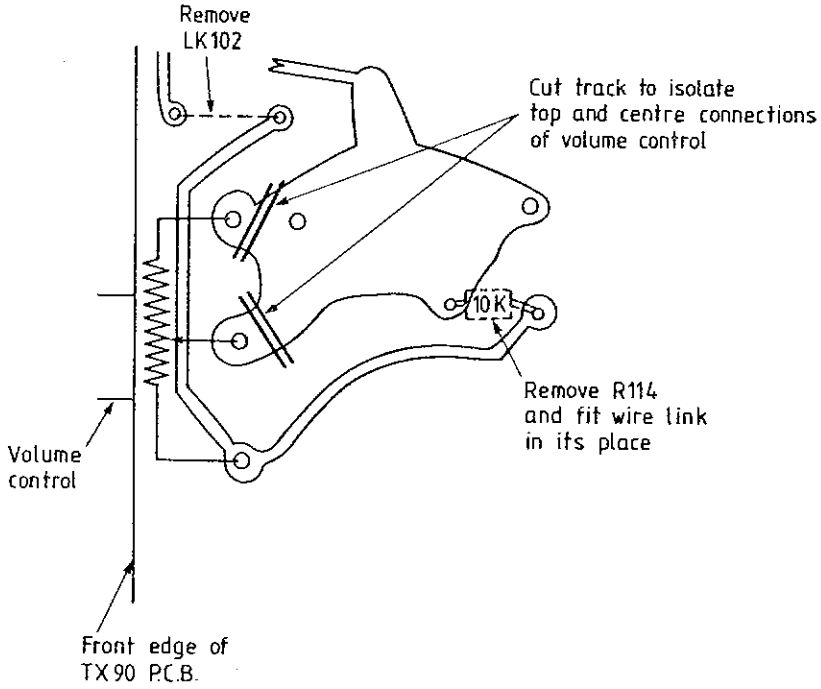
MOUNTING BRACKET FOR IN / OUT SOCKETS

Fig. 6



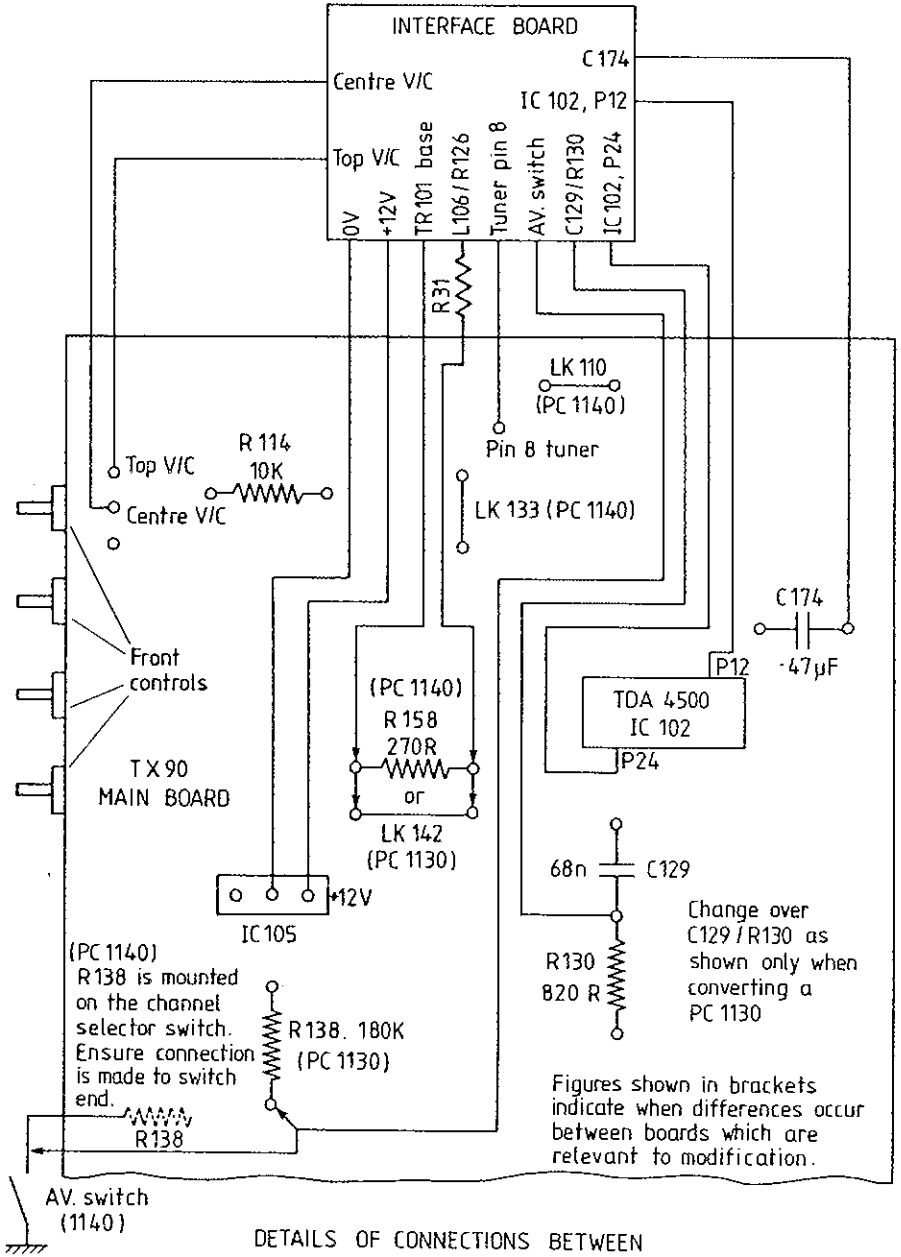
TUNER MODIFICATION PC 1130 P.C.B.

Fig. 7



VOLUME CONTROL MODIFICATION PC 1130 P.C.B.
Viewed from print side

Fig. 8



DETAILS OF CONNECTIONS BETWEEN
INTERFACE BOARD AND TX90 BOARD

Fig. 9

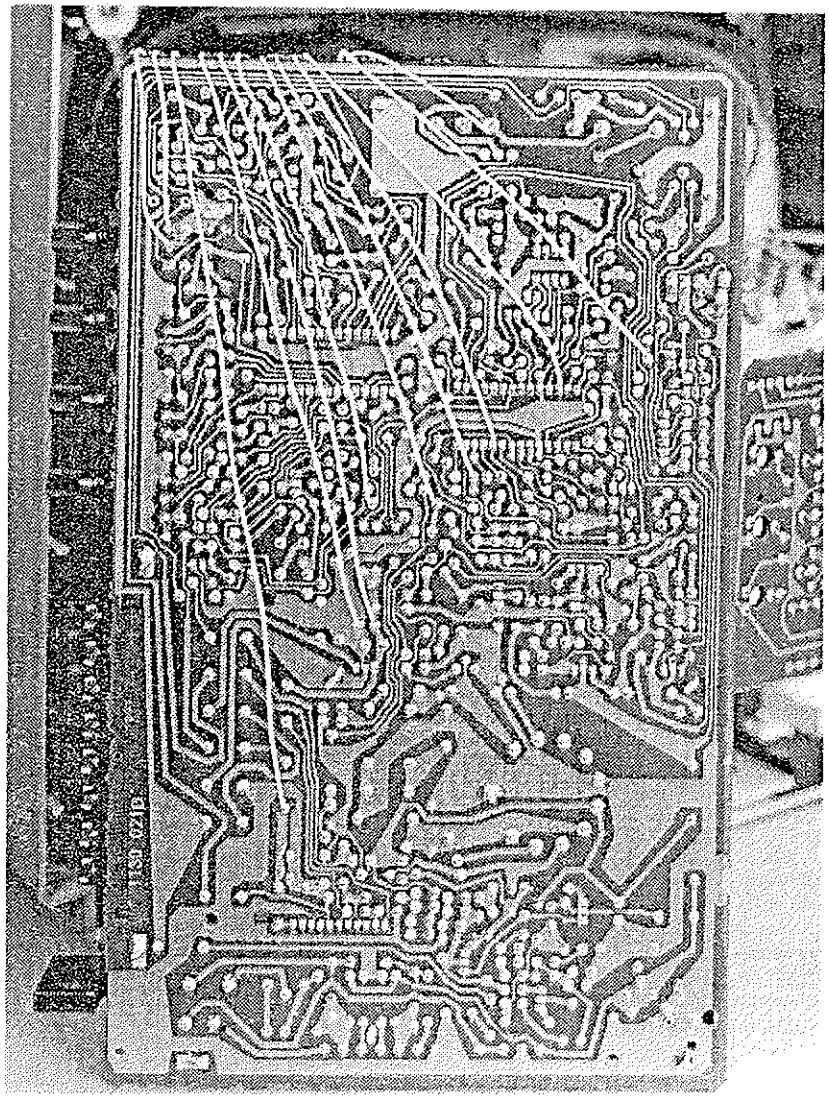


Fig.10

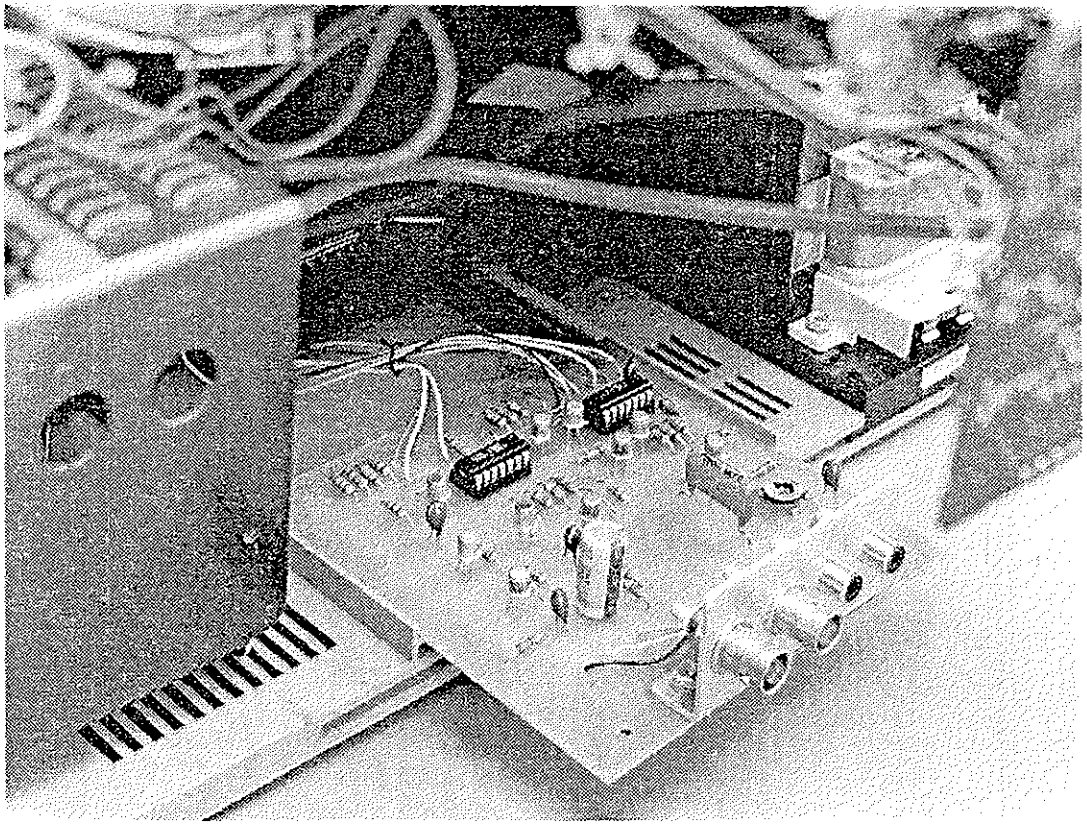


Fig.11