technical memorandum Daresbury Laboratory

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DOMESTIC TV WHICH IS SWITCHABLE TO RGB COMPUTER GRAPHICS

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INTRODUCTION

Although standard resolution RGB monitors are becoming less expensive they still cost considerably more than the average domestic television receiver although they contain far less components.

To combine both TV and RGB monitors together could be an advantage, particularly with the large amount of home computers being used in this country. The majority of these computers can display colour graphics and normally have the option of generating video information superimposed on a radio frequency carrier and connected to the television aerial socket or an RGB higher definition signal which may be connected to a special high definition RGB monitor.

The direct RGB method of interface gives far better quality pictures over the r.f. method avoiding spurious patterning, poor definition and drifting off tune.

It is a well known fact that PAL signal decoding reduces the video bandwidth to less than 6 MHz in a standard television receiver, whereas the standard television tube can produce signals with bandwidths up to 6 MHz or even more depending on the type of tube. This is why better quality pictures are produced with direct RGB by not using the PAL decoder.

To use a domestic receiver for broadcast transmissions and RGB colour graphics involves a large amount of internal switching which would increase the cost of manufacture and would not be viable.

However there is now a more simple alternative which may be considered.

Most domestic television manufacturers now produce sets which will display data derived from off air teletext transmissions or alternatively viewdata systems. In either case the data from off air or off line transmissions is decoded into three primary colours, Red, Green and Blue which are amplified and drive the cathode ray tube colour display.

A television receiver fitted with either of these options may display

normal programmes, data only, or superimpose using simple switching techniques. Figure 1 shows the basic block diagram of the signal processing stages when using teletext including simple changeover switching. By substituting a teletext decoder for a computer derived RGB signal and improving the changeover switching, most televisions can be made to operate as a good quality RGB monitor and still retain the ability to receive normal television programmes. Various component manufacturers are providing integrated circuits which will operate as signal decoders, RGB amplifiers and electronic switches all in one single package. The commercial chassis selected for interfacing uses a Mullard TDA 3560 and contains all these facilities.

By using the TDA3560, PAL decoding is carried out in the normal manner on the incoming television signal but further RGB signals may be applied to the IC to superimpose over the off air picture such as Teletext. A further facility exists so that incoming signals to the IC may be disabled and only RGB text displayed. In this mode the RGB signals pass in and out of the IC with negligible bandwidth limitation, but can be switched between off air programmes or RGB inputs by controlling the data enable pin. As shown in fig.2 the TDA3560 will allow external RGB signals from Teletext or Viewdata equipment but can also accept external data from computers if interfaced correctly.

Various tests have shown that pictures displayed using these input ports compare favourably with "direct to cathode" RGB inputs and by the push of a switch, off air TV programmes or external data can be displayed.

The following article shows how signals can be interfaced to the Ferguson TX9 chassis using this principle. The chassis can be identified by the type of luma chroma IC which is located int the centre of the printed board under the neck of the CRT.

Signals from most computers have a video signal amplitude of 0.7 V peak to peak Red, Green and Blue. Mixed sync signals are 2 V peak to peak negative going. These signals expect to be terminated in 75 Ω at the monitor input.

The TDA3560 will accept direct RGB signals at 1 V peak to peak at a maximum input impedance of 150 Ω.

CIRCUIT DESCRIPTION

It was considered necessary to include emitter follower transistors to buffer and protect the IC input circuitry from damage caused by misuse of input signals. The interface consists of three identical emitter follower stages for Red, Green and Blue TR1 A, B and C. Each stage is fitted with a preset emitter resistor for setting up signal levels RV1 A, B and C, fig.3.

When using data inputs on the TDA3560 the receiver contrast control is non-operative and emitter preset controls are adjusted to give a contrast level which is compatible with off air pictures when the receiver is switched over. Mixed synchronising signals are connected to an inverter stage TR2 to give a positive going output. A VMOS FET TR3 couples these signals via C4 to C5 to the TX9 sync input. When TV is selected TR3 is switched off isolating computer synchs from Television synchs. The data enable pin on the TDA3560 requires a high via R12. D2 switches the TX9 sync separator to AV sync mode to improve the synch performance.

It was found in practice that when data enable had been selected, spurious signals from off air programmes were visible at low level which is unacceptable. TR4 is used as a switch to short out the AGC line and prevent this effect. A 12 V power source is required to operate, and this supply is readily available from the TV chassis via a select switch. When voltage is applied, off air programmes are disabled and data and sync inputs are enbabled and vice-versa.

CONSTRUCTION

All components selected for the interface are readily available and are mounted on a single-sided printed board, (fig.4).

Input signals may be connected via BNC plugs and sockets keeping the input leads as short as possible, alternatively by using a DIN plug and socket which now appears to be the popular home computers RGB connector.

Red, Green, Blue and sync output signals should be connected to the

receiver chassis using miniature coaxial cable (RG174 50 Ω) which should have the screened outers earthed at both the interface and chassis ends, see fig.5. Other interconnecting leads are multistranded conductors (16/0.2 mm) pvc covered. All cable ends should be fitted with push on connectors where fitted to the main chassis, alternatively these leads may be soldered to the main chassis connector pins and sleeved. Figure 6 indicates the connecting points when using either PC1040 or PC1044 printed board. All connections to the PC1044 are push on, enabling the interface to be fitted within minutes. When using PC1040 all connections with the exception of +12 V are push on. The 12 V lead does not have a convenient pin available and must be soldered into PL5.5 with the existing lead still inplace. The printed circuit board is mounted together with the DIN socket and on/off switch onto an aluminium plate which mounts with four screws to the rear of the cabinet, see figs.7 and 8. An isolated mains supply must be used with this modification and a toroidal transformer is cheap and readily available. When converting a 14" receiver an 80 VA transformer is suitable and can be mounted with a single bolt to another aluminium plate as shown in fig.9 which will slide into the ready made sliders normally used for the remote control board and fitted on the lefthand side of the cabinet when viewed from the rear. Alternatively if a remote PCB is already in use the transformer may be mounted directly on the rear. When a 20" or 22" large screen set is converted a 120 VA transformer should be used and will fit on a right angled bracket behind the tuner draw, see fig.10.

The transformer should be connected after the mains on/off switch and should feed PL2.3 and 4 on the main PCB, see fig.11 and all cables tied together neatly.

All interconnecting cables from the interface board should be 24" long including coaxial cables.

An alternative for switching TV/RGB can be the channel select button marked "AV" which is neater and cheaper than using a separate switch on the rear panel. Figure 12 shows how the present AV facility may be moved to the net button to retain AV when using a video recorder and the now spare button relabelled and used for RGB switching.

TESTING

Linear signals were fed to the RGB input and a greyscale wedge was displayed using a Phillips pattern generator and RGB decoder. Each preset on the interface board RV1 A, B and C were set to provide a good greyscale with adequate contrast compatibility when switching over to TV. When using a computer to drive the interface, signal levels were higher in the case of the BBC microcomputer about 2 V p-p and each preset was turned down by a small proportion giving excellent results.

CONCLUSION

Many home and commercially manufactured computers offer direct RGB output signals as well as UHF signals and there is no comparison between the two methods of interface. Direct RGB is superior and should be used by the more discerning user who needs a good quality display at low cost.

With further small modifications the interface could be adapted for other types of television chassis using a similar data insert system.

FIGURE CAPTIONS

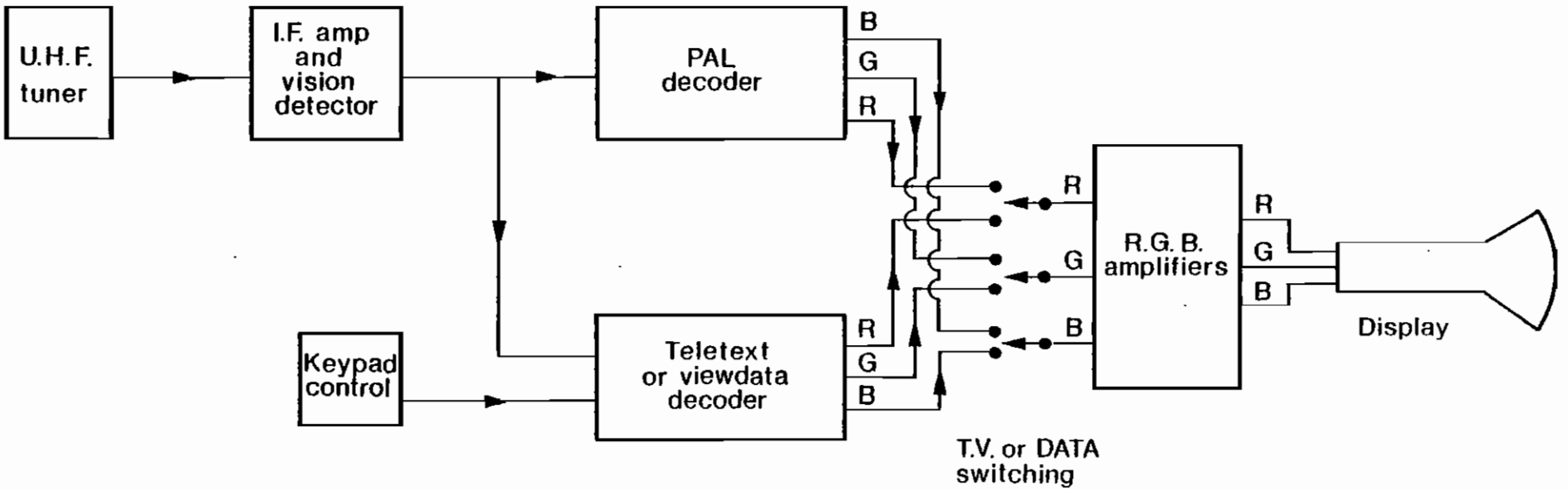

U.H.F. tuner
I.F. amp and vision detector
PAL decoder
B
G
R
Keypad control
Teletext or viewdata decoder
R
G
B
T.V. or DATA switching
R
G
B
R.G.B. amplifiers
R
G
B
Display

Fig.1

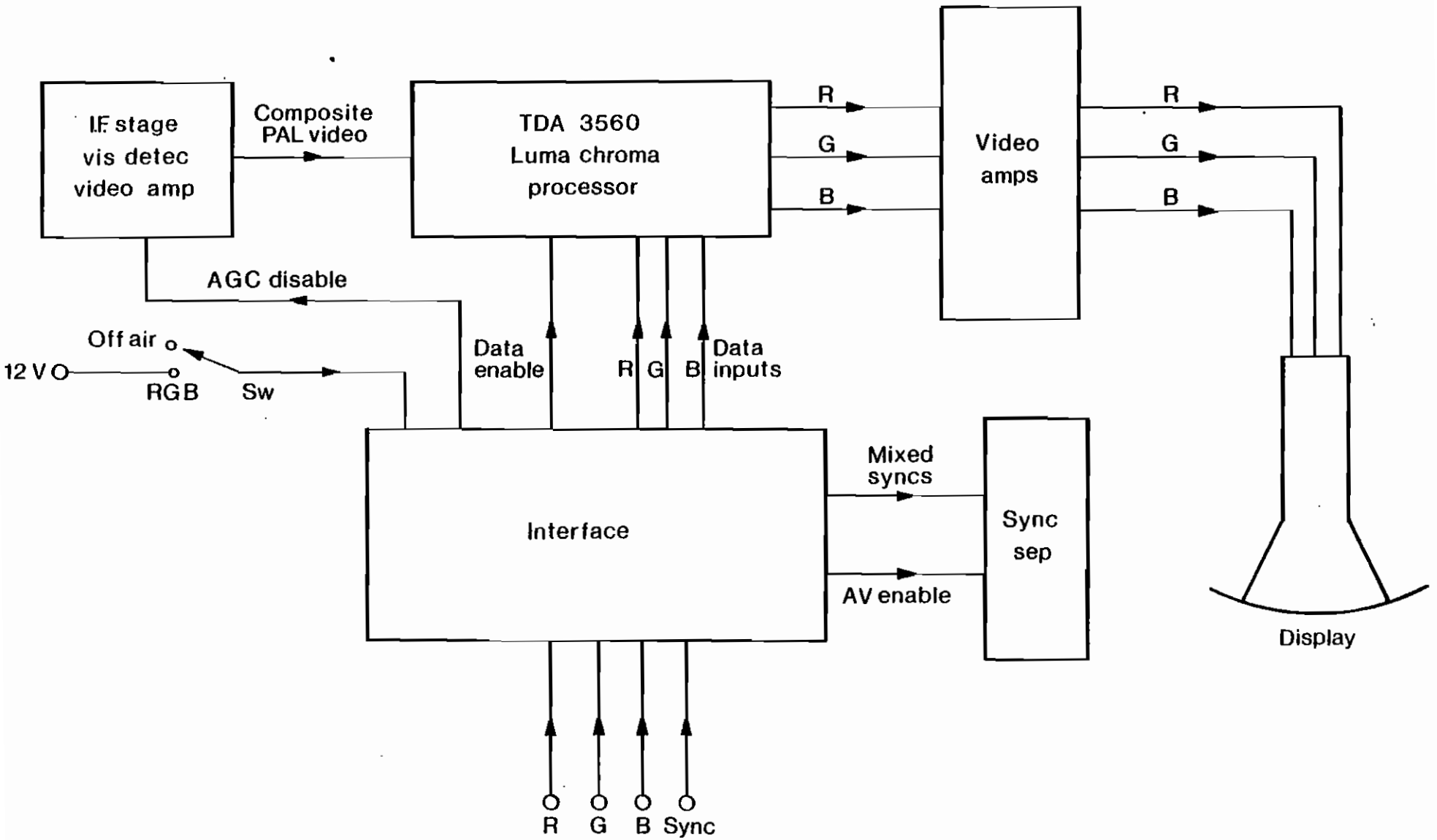

I.F stage
vis detec
video amp
Composite
PAL video
TDA 3560
Luma chroma
processor
R
G
B
Video
amps
R
G
B
AGC disable
Off air
12 V
RGB
Sw
Data
enable
R G B
Data
inputs
Interface
Mixed
syncs
AV enable
Sync
sep
Display
R G B Sync
Signal inputs
Linear or TTL levels

Fig. 2

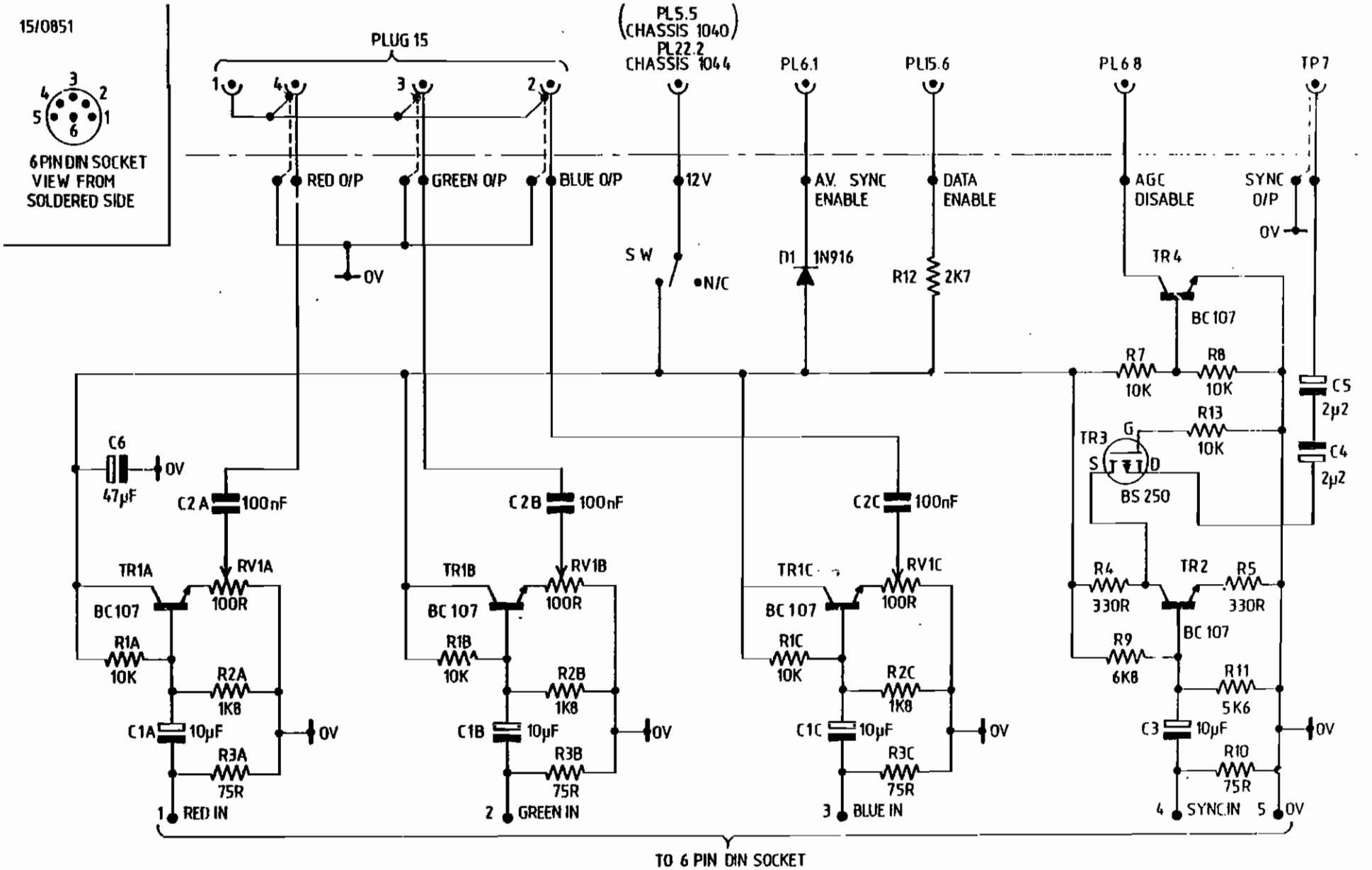

15/0851
6 PIN DIN SOCKET VIEW FROM SOLDERED SIDE
PLUG 15
PL5.5 (CHASSIS 1040)
PL22.2 CHASSIS 1044
PL6.1
PL5.6
PL6.8
TP7
RED O/P
GREEN O/P
BLUE O/P
12V
A.V. SYNC ENABLE
DATA ENABLE
AGC DISABLE
SYNC O/P
0V
S W
•N/C
D1 1N916
R12 2K7
TR4
BC 107
R7 10K
R8 10K
C5 2µ2
C4 2µ2
R13 10K
TR3
BS 250
C6 47µF
C2A 100nF
C2B 100nF
C2C 100nF
TR1A
TR1B
TR1C
RV1A 100R
RV1B 100R
RV1C 100R
R4 330R
R5 330R
TR2
R9 6K8
R11 5K6
R10 75R
R1A 10K
R1B 10K
R1C 10K
R2A 1K8
R2B 1K8
R2C 1K8
C1A 10µF
C1B 10µF
C1C 10µF
C3 10µF
R3A 75R
R3B 75R
R3C 75R
1 RED IN
2 GREEN IN
3 BLUE IN
4 SYNC IN
5 0V
TO 6 PIN DIN SOCKET

Fig.3

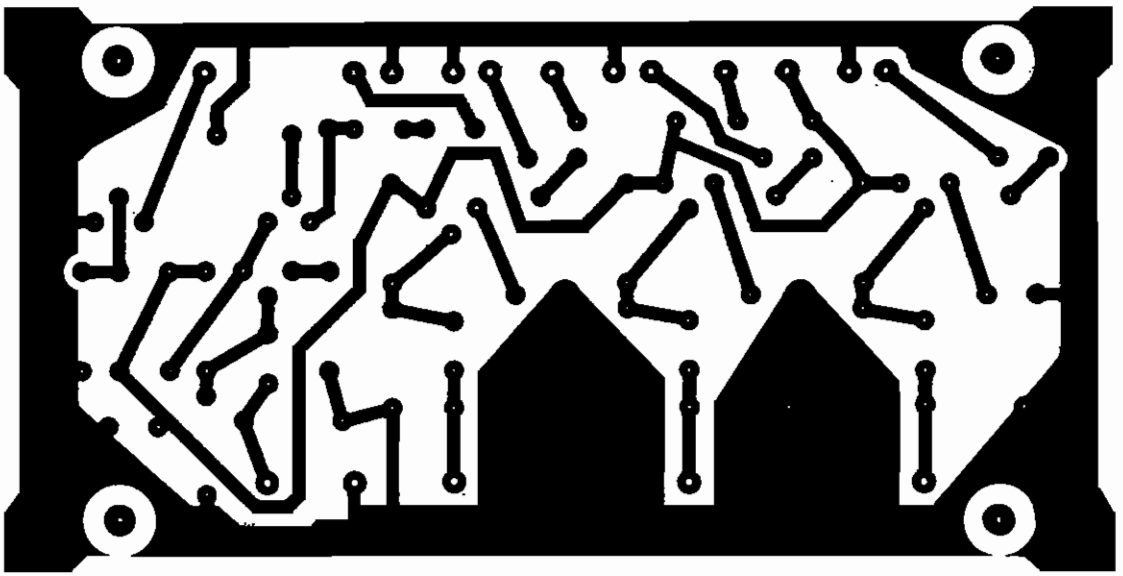


Fig.4

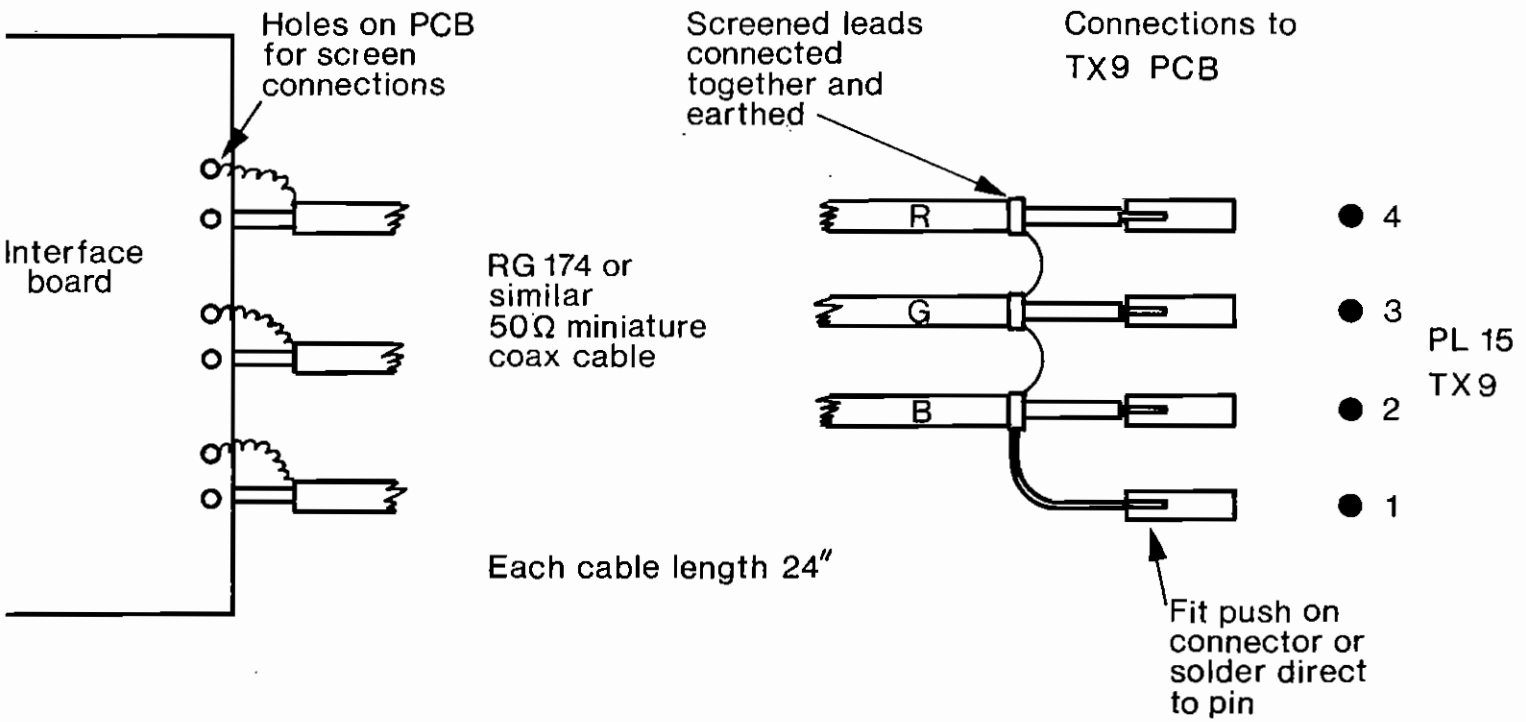
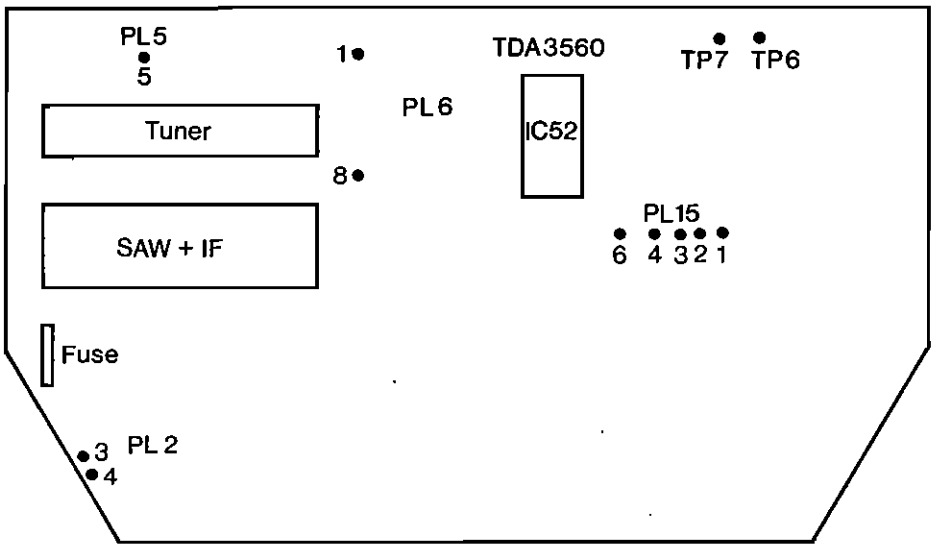
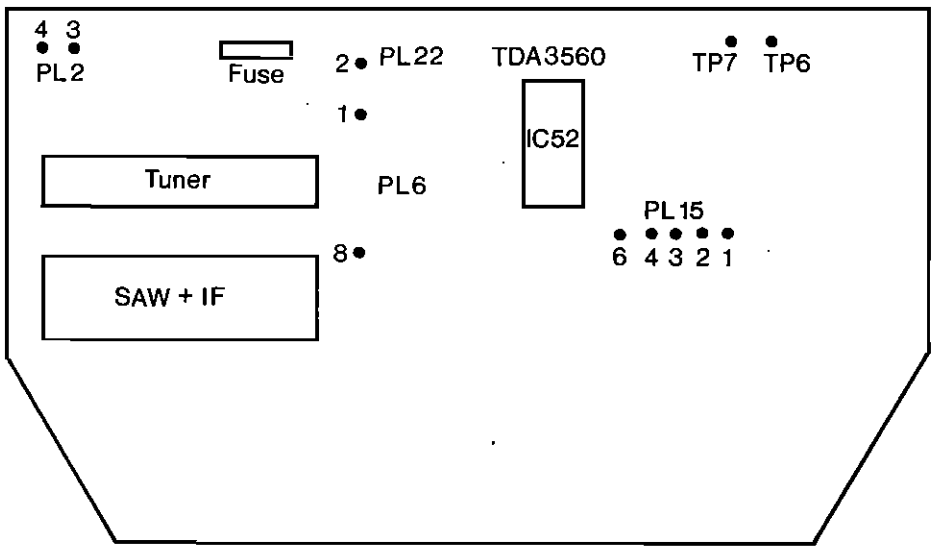

Holes on PCB for screen connections
Interface board
RG 174 or similar 50Ω miniature coax cable
Each cable length 24″
Screened leads connected together and earthed
Connections to TX9 PCB
R
G
B
4
3
2
1
PL 15 TX9
Fit push on connector or solder direct to pin

Fig. 5



PC1040 board



PC1044 board

Fig.6

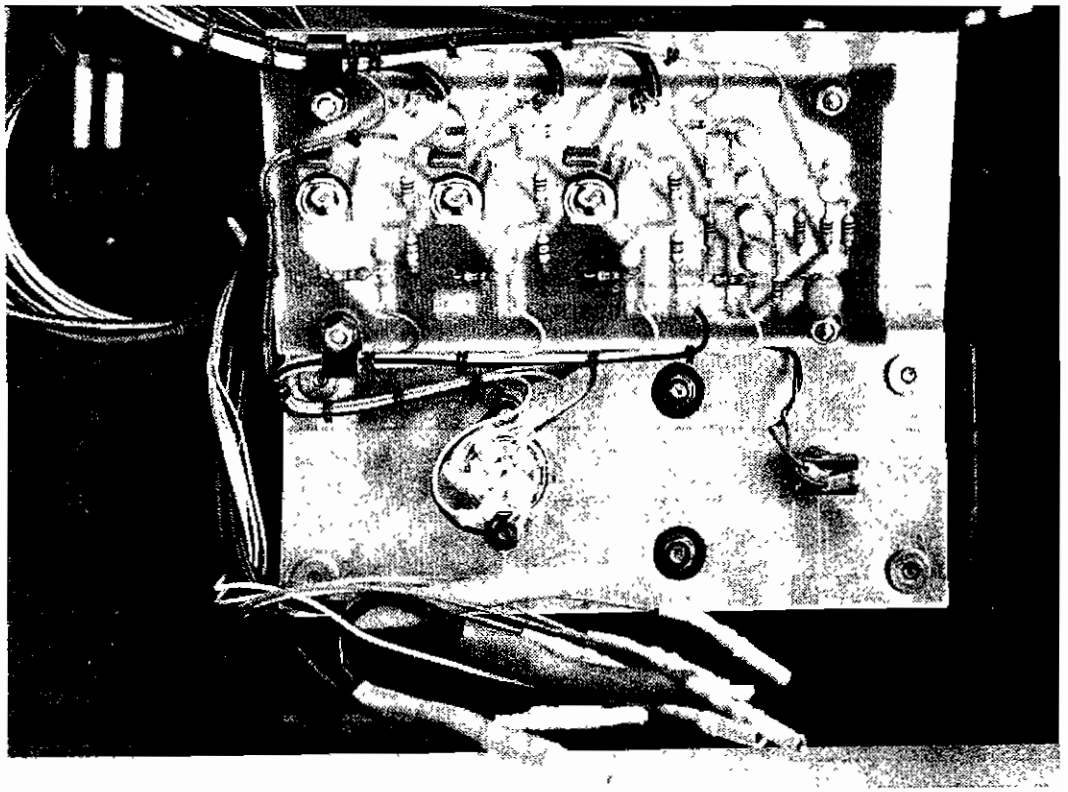


Fig.7

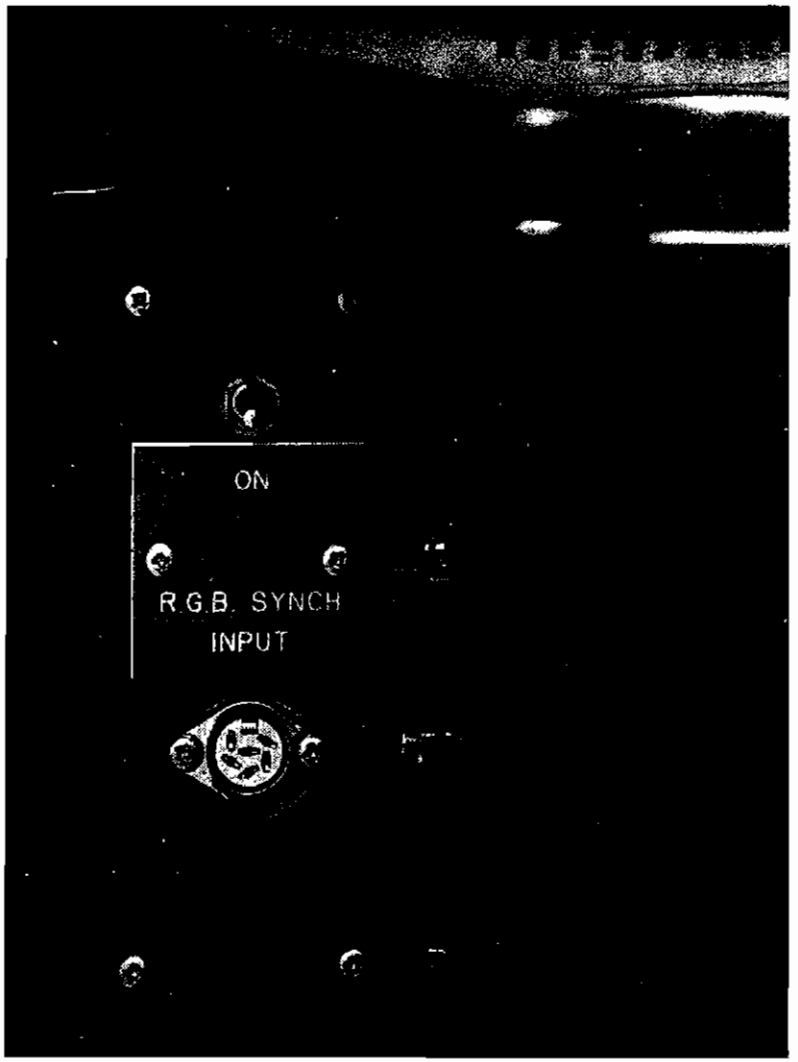


Fig.8

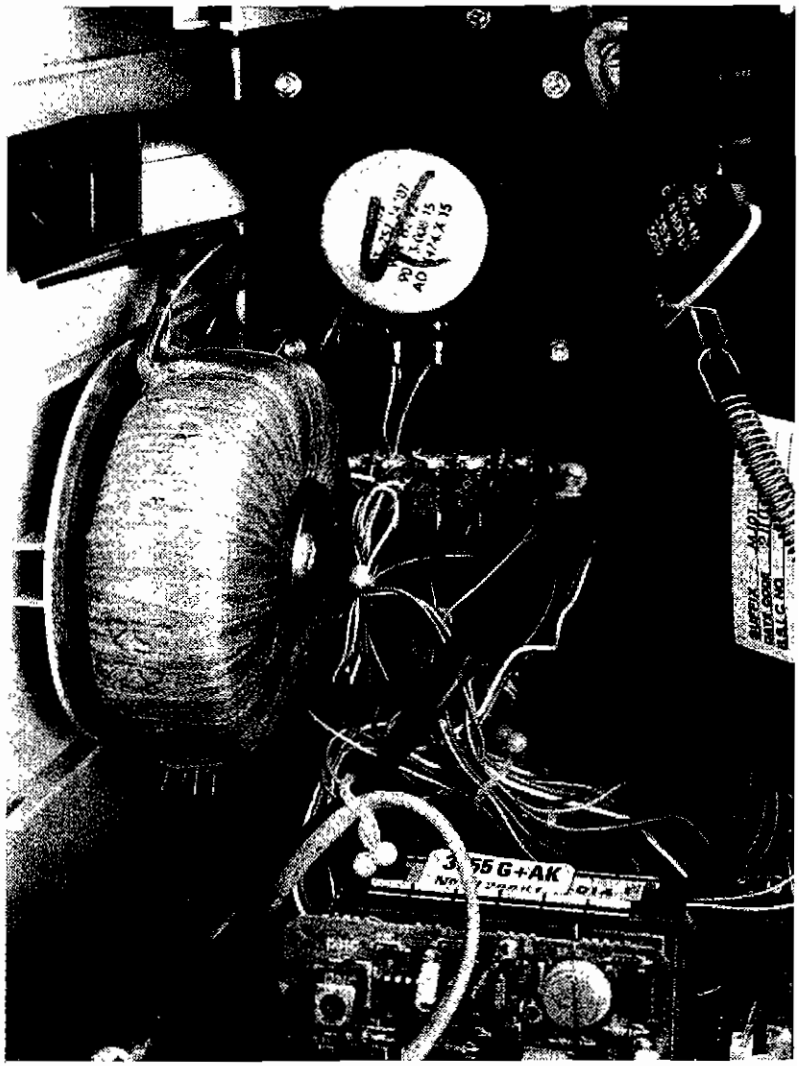


Fig.9

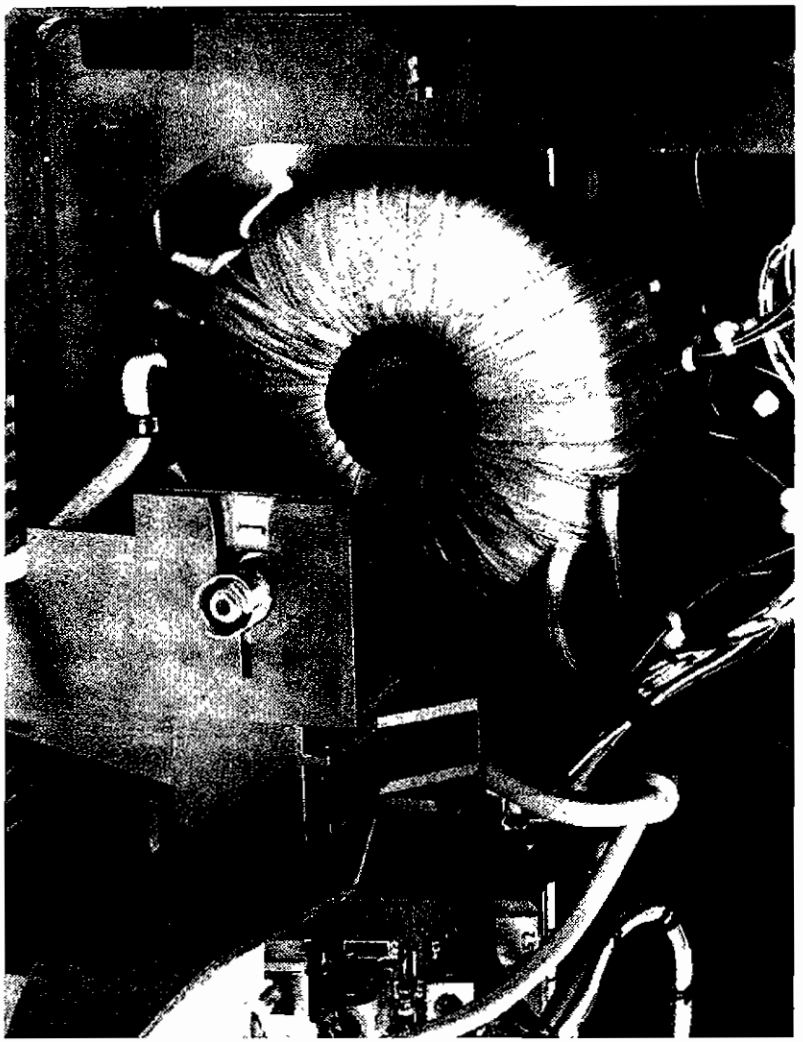
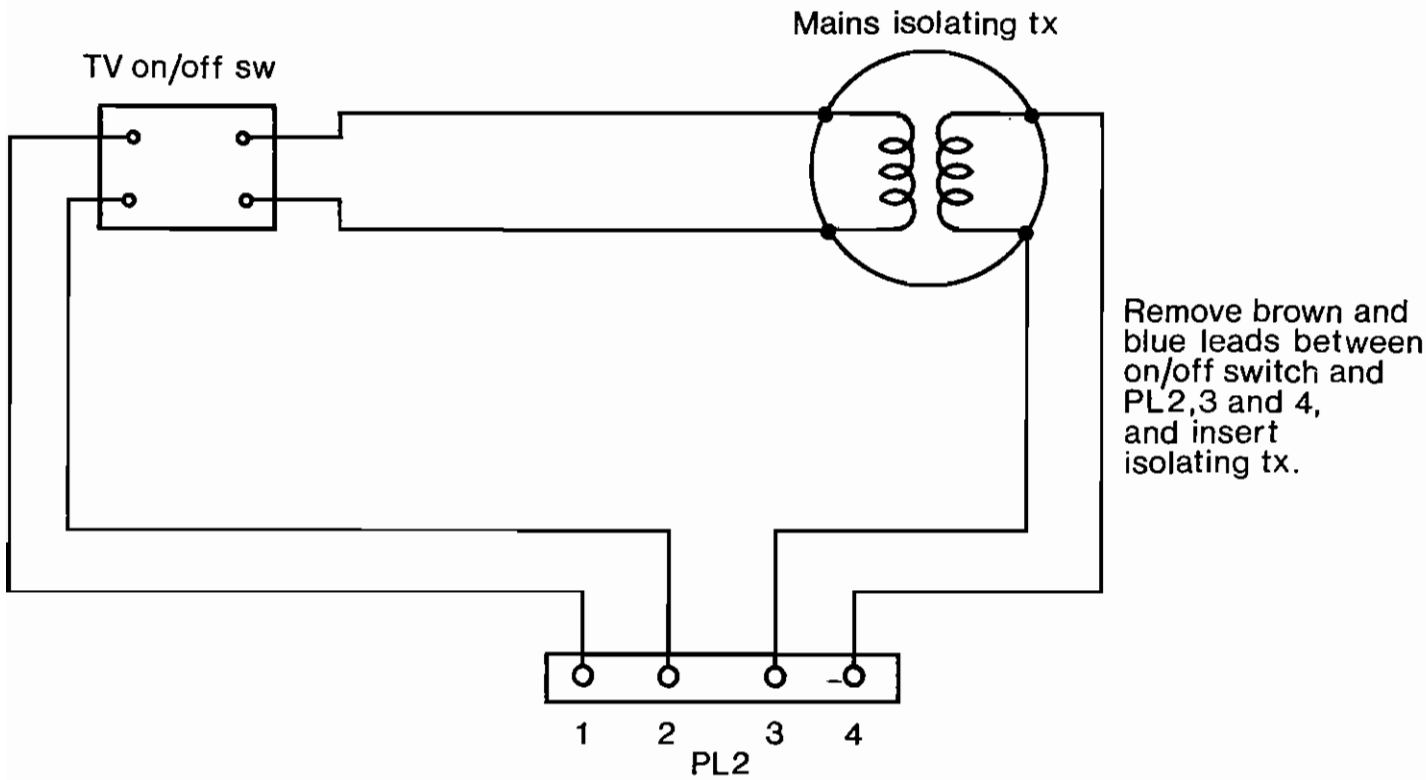
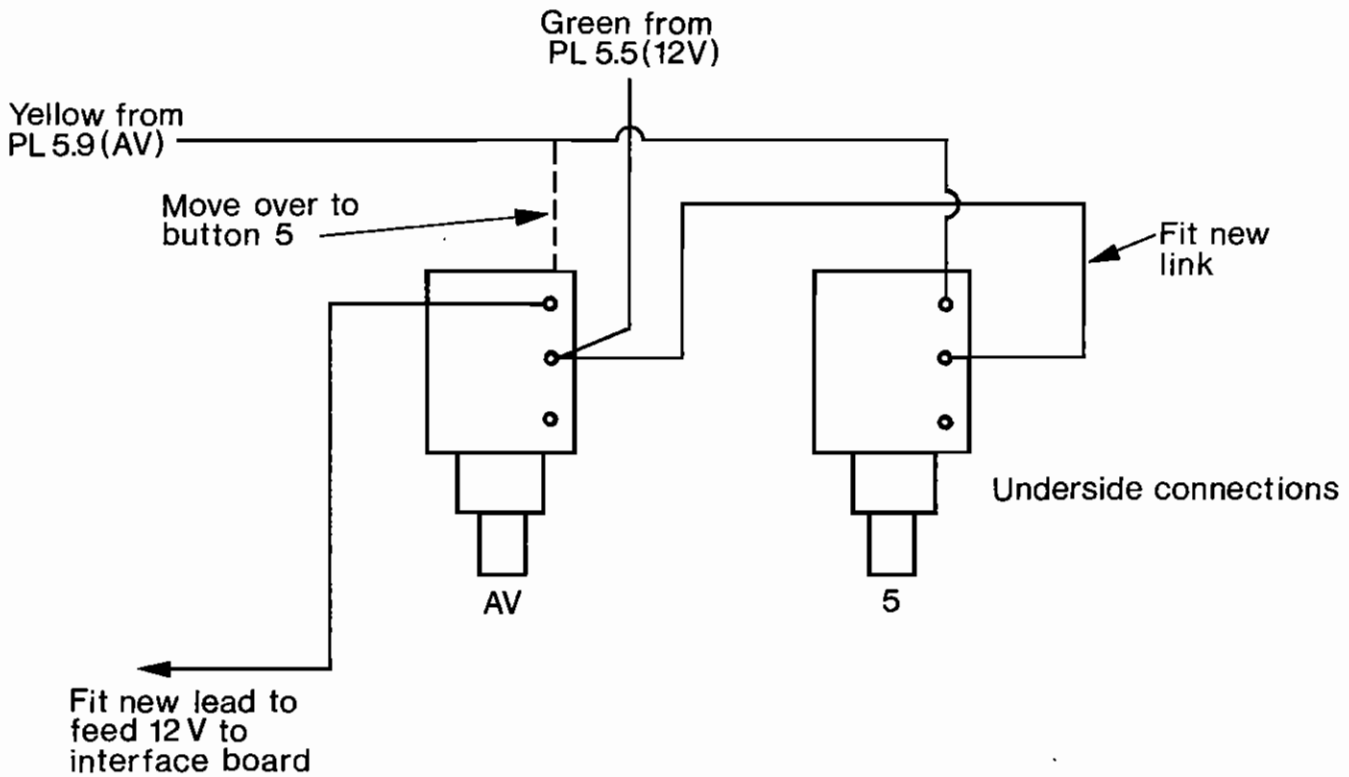


Fig.10



Inserting isolating transformer between switch and TV chassis

Fig. 11



Rewiring of channel selector if required

Fig. 12