TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

OCTOBER 1972

delay lines for colour tv

also:

WIDEBAND BAND I PREAMPLIFIER

SIMPLE RECEIVER-MONITOR CONVERSION

SERVICING THE BUSH/MURPHY TV141/V159 SERIES

TELEVISION

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SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS OCTOBER 1972

CABLE PROSPECTS

A recent late-night BBC programme on the first three months of the local TV cable set-up at Greenwich left us in some bewilderment as to what exactly such cable link-ups are trying to achieve. The basic idea seems to be to create a "people's television". Local residents commented that "the BBC and ITV are unapproachable", "now we can phone up Barry and ask him to sort out our problems", and so on. But when people were asked what they actually wanted to see they asked for general programmes such as Old Time Music Hall, Sports, Pop Music etc.—not exactly local material! In fact an analysis would probably show that what they want is what they are getting already from the big networks.

Some subscribers to the service complained that the material provided so far seemed "boring". Which brings us to the economics of the enterprise. The Greenwich experiment is run by a staff of four and is gravely restricted in what it can put out by its limited resources. Yet subscribers are obviously basing their expectations on the standards set by the major broadcasters. This clearly leaves a local company in something of a quandary.

A spokesman claimed that while the BBC and ITV cannot please everybody, cablevision can. If this is indeed the case we wonder why so many people spend so much time viewing the output of the major networks. An explanation given for the popularity of community TV in the States was the poor quality of the network programmes there, but in this respect we are much better served in the UK.

There are also disturbing aspects to local TV. For example local pressure groups could exercise undue influence, and the possible need for local funding could result in the majority subsidising a largely unwanted service.

We'd be the first to admit that the major networks are far from perfect. Local TV could provide a valuable supplementary service. But it is going to be quite a problem identifying and then providing in a professional way for genuine local requirements. It is of course early days yet and perhaps rather unfair to jump in and comment before things have got going. Yet it's only four years till the whole future of broadcasting comes up for review once again. The local operators have not a great deal of time to establish their case.

W. N. STEVENS—*Editor*

THIS MONTH

THE NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED OCTOBER 16

Hold-overs: We regret that due to limited space we have again had to hold over the next instalment in Gordon J. King's *Colour Receiver Circuits* series. This series will be resumed next month.

Cover: Our cover this month features three type DL1 delay lines, with their covers removed to show the glass block and the input and output transducers. These delay lines were kindly lent to us by **Manor Supplies** who hold stocks of these and most other colour receiver delay lines.

TELETOPICS

TIMEBASE IC

It has been quite common for some time for sync separation to be carried out in an i.c. but until very recently this was as far as i.c.s had gone in television receiver timebase circuitry. With the recent introduction of the GEC C2110 colour series however i.c.s have gone a step farther since this chassis uses a TBA920 as sync separator and line generator. A block diagram of this Mullard i.c. is shown in Fig. 1. The video signal at about 2·7V peak-peak is fed to the sync separator section at pin 8, the composite sync waveform appearing at pin 7. The noise gate switches off the sync separator when a positive-going input pulse is fed in at pin 9, an external noise limiter circuit being required (this facility is not used in the GEC chassis in which pin 9 is earthed). The line sync pulses are shaped by R1/C1/C2/R2 and fed in to the oscillator phase detector section at pin 6. The line oscillator waveform is fed internally to the oscillator phase detector circuit which produces at pin 12 a d.c. potential which is used to lock the line oscillator to the sync pulse frequency, the control potential being fed in at pin 15. The oscillator itself is a *CR* type whose waveform is produced by the charge and discharge of the external capacitor (C7) connected to pin 14. The oscillator frequency is set basically by C7 and R6 and can be varied by the control potential appearing at pin 15 from pin 12 and the external line hold control. Internally the line oscillator feeds a triangular waveform to the oscillator and flyback phase detector sections and the pulse width control section. The coincidence detector section is used to set the time-constant of the oscillator phase detector circuit. It is fed internally with sync pulses from the sync separator section, and with line flyback pulses via pin 5. When the flyback pulses are out of phase with the sync pulses the impedance looking into pin 11 is high (2kΩ). When the pulses are coincident the impedance falls to about 150Ω and the oscillator phase detector circuit is then slow acting. The effect of this is to give fast pull-in when the pulses are out of sync and good noise immunity when they are in sync. The coincidence detector is controlled by the voltage on pin 10. When the sync and flyback pulses are in sync C3 is charged: when they are out of sync C3 discharges via R3. VTR use has been taken into consideration here. With a video recorder it is necessary to be able to follow the sync pulse phase

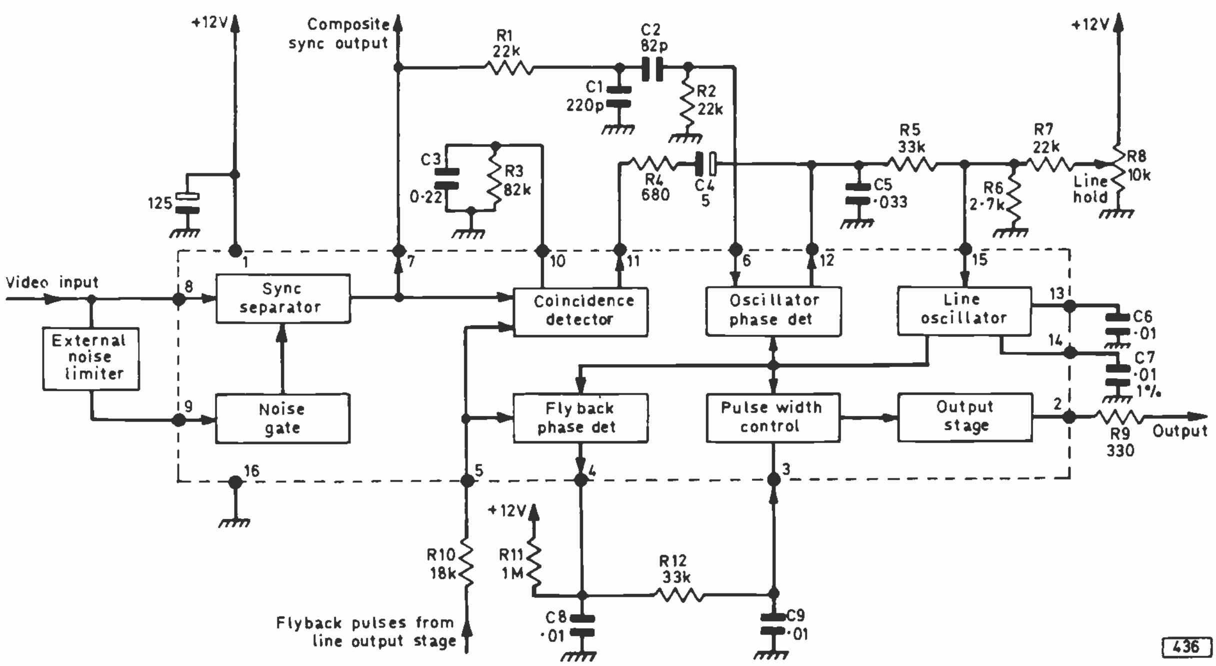


Fig. 1: Block diagram of the TBA920, the first line generator i.c. to be used in a UK produced chassis.

variations that occur as a result of wow and flutter in the tape transport system, while noise is much less of a problem. For use with a VTR therefore the network on pin 10 can simply be left out so that the oscillator phase detector circuit is always fast acting.

A second control loop is used to adjust the timing of the pulse output obtained from pin 2 to take into account the delay in the line output stage. The flyback phase detector compares the frequency of the flyback pulses fed in at pin 5 with the oscillator signal which has already been synchronised to the sync pulse frequency. Any phase difference results in an output from pin 4 which is integrated and fed into the pulse width control section at pin 3. The potential at pin 3 sets the width of the output pulse obtained at pin 2: with a high positive voltage (via R11 and R12) at pin 3 a 1 : 1 mark-space ratio output pulse (32µs on, 32µs off) will be produced while a low potential at pin 3 (negative output at pin 4) will give a 16µs output pulse at the same frequency. The action of this control loop continues until the flyback pulses are in phase with a fixed point on the oscillator waveform: the flyback pulses are then in phase with the sync pulses and delays in the line output stage are compensated. The output obtained at pin 2 is of low impedance and is suitable for driving valves, transistors or thyristors: R9 is necessary to provide current limiting.

AUDIO ICs for TV

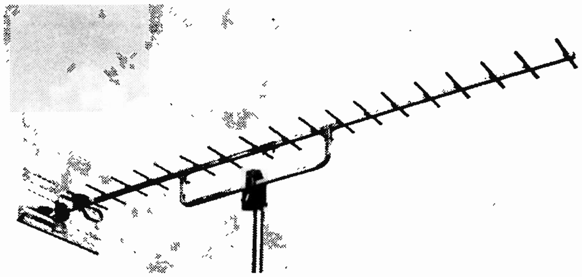
Amongst the applications suggested for another recently introduced Mullard i.c., the TCA160 audio amplifier, is use in small TV receivers. This i.c. gives an output of more than 2W into 8Ω and can be used with supply rails between 5 and 16V. It is also available fitted with a heatsink to give an output of more than 2·5W. A similar i.c., type TBA820, is announced by SGS. This will give 0·75W into 4Ω when operated from a 6V rail, 1·6W into 4Ω with a 9V rail and 2W into 8Ω with a 12V rail. It can be used with rail voltages between 3 and 16V. A further i.c. manufacturer has announced a range of i.c.s for domestic electronics applications: Sprague intend to introduce a range of some 34 devices including video processing and complete TV sound systems.

WIDEBAND UHF PREAMPLIFIER

In addition to their range of single- and two-stage group A, B and C/D mastead amplifiers S. A. Collard Ltd. (Wetherby Road, Derby) now have a two-stage wideband u.h.f. preamplifier designed to cover the u.h.f. frequencies from groups A to C/D inclusive. An average gain of 13-14dB is quoted, with a comparatively flat response of ±1dB and a noise figure in the region of 7dB. Type number is A/1057. Obviously a help for those able to receive alternative transmissions in different channel groups and of course DX enthusiasts.

MAZDA ENTER UHF AERIAL MARKET

Mazda, well known for their valves and c.r.t.s, have now entered the u.h.f. aerial market. To make stocking and handling easy the range consists of six basic aerials, a standard and a high-gain one for each of the aerial groups A, B and C/D. The aerials have



The Mazda MB20 high-gain u.h.f. aerial array. The first letter of the type number stands for Mazda, the second letter indicates the channel group while the numerals indicate the number of elements, 20 for the high-gain version and 12 for the standard version.

been newly designed and are competitively priced —in fact there are just two prices, the standard aerial for each group having a recommended retail price of £3 while the high-gain version is priced at £3.75, including universal tilting mast attachment in each case. There is a supporting range of masts and rigging kits. The aim has been for strong though lightweight construction, with optimum gain and front-to-back ratio over the group bandwidths.

SERVICE EXTENSIONS

The BBC-Wales service from the **Carmel** (Carmarthenshire) main transmitter is now in operation on channel 57 (horizontal polarisation, aerial group C). The following relay services are now in operation:
Aldeburgh BBC-1 channel 33 aerial group A.
Skipton Yorkshire TV channel 49 aerial group B.
Lark Stoke ATV channel 23 aerial group A.
All these transmissions are vertically polarised.

The first UK community cable TV service, Greenwich Cablevision, is now operating. The 14,000 subscribers pay £7.30 a year (15p a week) and the operators have permission to provide the service within an area of 25 miles from the home base.

DEVELOPMENTS

On show at the recent Internavex 72 (International Audio-Visual Aids Conference and Exhibition) at Olympia was the first videocassette player from Thorn, Model 8200. This was shown playing into a 26in. schools' colour TV receiver, Model 8733, on the Radio Rentals stand. Decca were demonstrating their latest Teldec colour videodisc player while Sony showed their ¾in. tape VCR in harness with a monitor using a large-screen Trinitron tube.

A flat video display panel of the plasma (gas discharge) type has been demonstrated by the Control Data Corporation. The panel measures 12 x 6in. and is only ¼in. deep: it gives a 64 x 20 character display of high brightness and contrast. The panel is intended for military use at present and at a price of £2,900 it is clearly unlikely to displace the c.r.t. in most applications. It could nevertheless point the way in which things might go in the future, especially as multi-colour and three-dimensional versions are said to be under development.

A device called Odyssey to enable you to play games on your television receiver is to be introduced

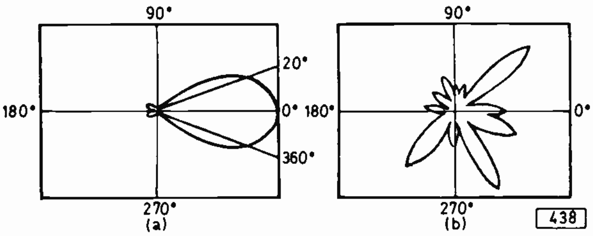


Fig. 2: These aerial polar diagrams produced by Antiference clearly indicate the importance of using the correct array. If a lower group array is used to receive channels in a higher group the forward gain falls substantially since the directors then tend to act as reflectors.

in the USA this Autumn by Magnavox. The set's screen is used as a game board or as an instructional display. The device itself operates on computer principles and has two stations which enable participants to control the position of spots of light on the screen of the set. For each game there is a separate printed-circuit card which is inserted in the control box and a coloured plastic overlay which adheres to the screen. A price of about $100 is suggested for the device with a package of 12 games. A further accessory converts the set into a rifle range with a photoelectric rifle which is plugged into the control box and puts out a light on the screen when the target is hit.

CHECK YOUR AERIAL

With the increasing number of u.h.f. relay stations in operation and the extension of the services they provide to three-channel working it is to be expected that many viewers are now using incorrect or wrongly adjusted u.h.f. aerials and this is confirmed by a field survey recently carried out by the IBA in the Hemel Hempstead area. Many viewers were found to be still using aerials intended for the reception of the main Crystal Palace transmitter instead of the Hemel Hempstead relay station: these aerials were of course of the wrong channel group and polarisation and were often pointing in the wrong direction. Other viewers were found to be using aerials which were correct but were found to be optimised for the reception of the initial BBC-2 transmissions: such installations require adjustment for good signal balance between the three services now in operation, IBA, BBC-1 and BBC-2. Measurements showed that in many parts of the relay's service area there are strong standing wave patterns that make it necessary to adjust aerials carefully to allow all three channels to be equally well received. This situation is apparently typical of many local relay stations. The effects on the picture of using an incorrect or wrongly adjusted aerial are of course ghosting, interference and noise. The IBA state that modest u.h.f. aerials should be adequate within the service area of a relay station provided they are carefully installed.

What can happen in practice through the use of an aerial of the wrong group is strikingly demonstrated by the polar response diagrams shown in Fig. 2 which were produced by the Research Department of Antiference. The response shown at (a) was obtained using an 18-element group C/D Antiference array on channel 59. The aerial was carefully adjusted and gave as shown a clean response with good gain and minimum side lobes. The equivalent group A aerial was then substituted and the exercise repeated: as the resultant polar diagram shown at (b) indicates the gain was substantially reduced and the directional characteristic completely lost.

J Beam state that they have improved the performance of their Multibeam range of aerials by retuning the director elements, using a larger reflector and readjusting the element spacing.

SLICE FIELD TRIAL

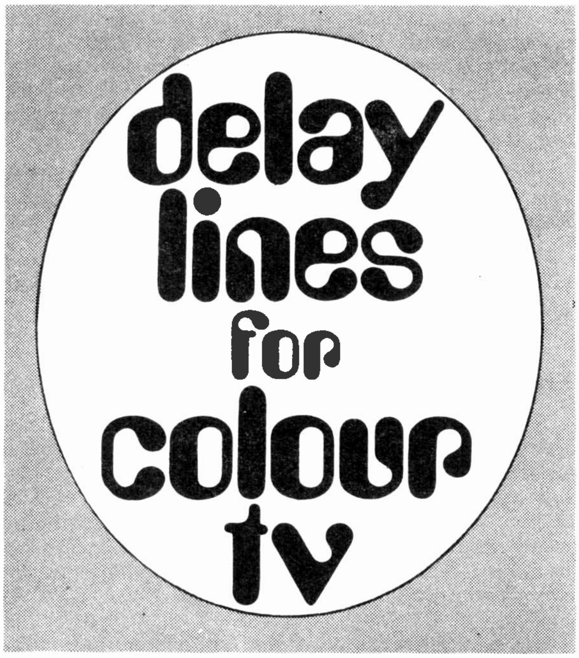
What then is "slice"? Well, you may have seen "Slice" signals just above the usual IBA test insertion signals and wondered what they are. Slice stands for "*s*ource *l*abel *i*ndicating and *c*odec (coder-decoder) *e*quipment" and has been developed by the IBA to overcome the problem of programme source identification in the complex ITV networking system. The prototype equipment is being field tested by ATV, LWT, ITN, Thames and Yorkshire Television and uses lines 16 and 329 during the field blanking interval of the TV waveform for the transmission of the coded signals. The coder-decoder unit, developed as an additional module for the IBA designed test line inserter equipment, inserts an eight-bit word data signal to provide source identification. The line 16 signal indicates the original source of the video signal while the line 329 signal indicates the studio centre so as to identify the point at which the programme is being inserted into the network. Thus at all points in the network it is possible to identify both the original source and the distribution centre. The decoder readout display unit provides a three-letter identification of the data—THS for example indicating Thames Euston centre.

NEW PRODUCTS

The first digital Avometer, Model DA114, has been announced by Avo. The completely new design features full multimeter facilities, high stability, internal calibration, automatic zero correction and a four digit non-blink display. There are separate models for mains only or battery-mains operation.

A portable, battery-operated lightweight miniature soldering iron, the Wahl "Iso-Tip", is being marketed by Van Dusen Aircraft Supplies Co., Oxford Airport, Kidlington, Oxford. The iron uses nickle-cadmium cells and gives up to 60 joints (depending on size) per charge: a recharging stand is provided and the cells recharge from dead to full charge overnight. The bit reaches soldering temperature within 5 seconds and the specially constructed tip eliminates the need for earthing. The recommended price is £8·75. Could be a boon for field service work.

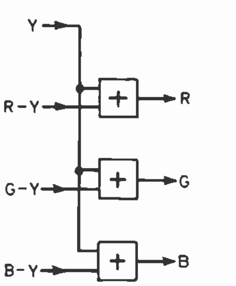
A small but powerful 12V d.c. drill has been introduced by Expo (Drills) Ltd. and is particularly suitable for drilling accurate holes in printed circuit boards (attention colour set constructors!). A large range of tools is available for use with the drill, including standard twist drills, various cutters, burrs and saws. A drill stand cum lathe bed is also available. Details can be obtained from Expo (Drills) Ltd., 62 Neal Street, Shaftesbury Avenue, London WC2H 9PA. Prices commence at £3.



Peter H. Beards B Sc(Eng) C Eng MIEE

ALL colour receivers incorporate in the luminance channel a delay line which delays the luminance signal by about 0·5μs. This is necessary because the corresponding chrominance signal is subject to greater delay than the luminance signal in the tuner, the i.f. circuits and the relatively narrowband decoder chrominance channel. The delay introduced in the luminance channel ensures therefore that the luminance and the corresponding chrominance information register correctly on the screen.

In addition a delay line providing a delay of approximately 64μs (the duration of one TV line in a 625/50 system) is incorporated in a PAL-D decoder to carry out the signal averaging process between each pair of picture lines which, in the PAL system, have an inverted V (weighted R−Y) component on alternate lines. The result of this processing is also



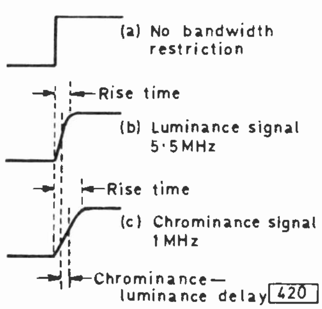
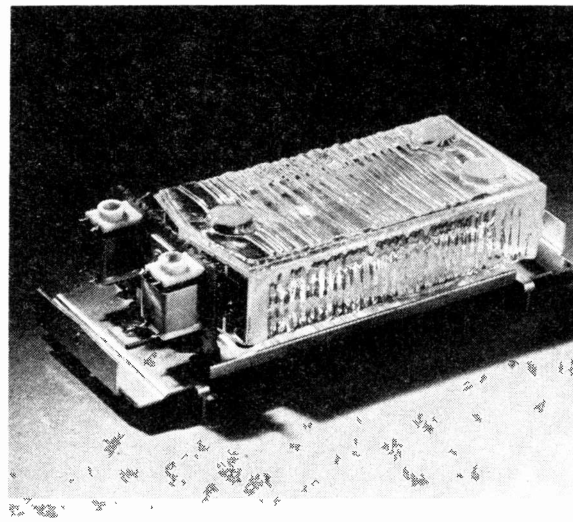


Fig. 1 left): Recombining the luminance (Y) and the colour-difference signals (R—Y, G—Y and B—Y) in order to get the original R, G and B primary-colour signals.

Fig. 2 (right): The effect of circuits of different bandwidth on a signal corresponding to an abrupt change of detail in a scene.



to separate the U (weighted B−Y) and V components of the transmitted chrominance signal.

Registration of Luminance and Chrominance

The final part of the decoding process in a colour receiver is to recombine the luminance (Y) signal with the colour-difference signals in order to get back the original R, G and B voltages produced by the colour camera. This colour-difference/luminance signal matrixing process is shown in Fig. 1 and may be done by the c.r.t. itself (colour-difference tube drive) or by adding networks prior to the c.r.t. (RGB tube drive). As already mentioned if the colour-difference signals have been delayed more than the Y signal in their passage through the receiver circuits then the two will not be in registration, i.e. the result of the matrixing will be incorrect. There are several reasons why the chrominance information gets delayed with respect to the Y information and we must now consider these.

Delay due to Bandwidth

There is first the fact that the bandwidth of the chrominance signal is approximately 1MHz as opposed to the 5·5MHz bandwidth of the luminance signal, i.e. the chrominance channel circuitry has a much narrower bandwidth than the luminance channel. The effect of this where there is an abrupt change in the scene content during a line is shown in Fig. 2. If there was no bandwidth limitation the change in signal level would be instantaneous as shown at (a). But this ideal situation cannot happen in practice since all electronic circuits take a finite time to respond to a change of input. With a wideband circuit the response is quick: as shown at (b) the luminance signal rise time compared to (a) is not great. With a narrowband circuit the response is slower so that as shown at (c) the rise time is greater. The reason for this bandwidth/delay relationship is brought out when we remember that a squarewave can be regarded as a sinewave of the same frequency plus an infinite number of harmonics: clearly the

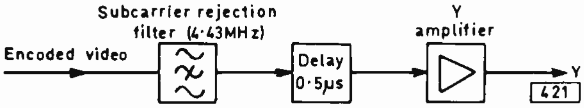


Fig. 3: Block diagram of the luminance channel.

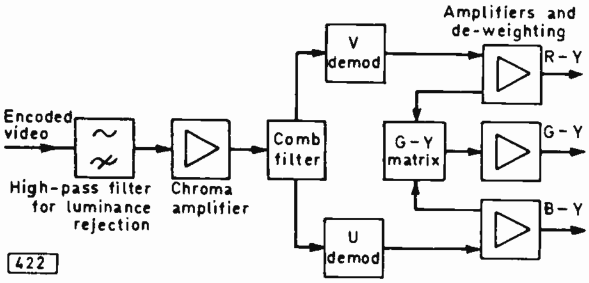


Fig. 4: Block diagram of the chrominance channel.

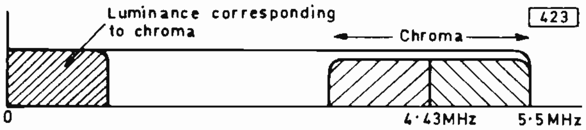


Fig. 5: The positions of the chrominance and corresponding luminance signals within the video bandwidth.

more harmonics we let through, i.e. the wider the bandwidth, the quicker is the response of the circuit to abrupt changes in signal level.

As Fig. 2 (b) and (c) show then the luminance signal rise time although finite is much faster than the chrominance signal rise time. Correct registration however is obtained if the time at which the two signals reach half their final amplitude is the same and this can be effected by delaying the luminance signal relative to the chrominance signal. (The delay of the chrominance signal relative to the luminance signal has been drawn in on Fig. 2.)

A second reason for the greater delay of the chrominance signal than the luminance signal in the receiver is the fact that the luminance channel is much simpler than the chrominance channel. Apart from the luminance delay line the luminance channel (see Fig. 3) requires only a subcarrier rejection filter and an amplifier. For comparison the basic elements required for chrominance signal processing are shown in Fig. 4: delays accumulate all the way along the chain.

Group Delay

There is also as we mentioned at the outset the delay of the chrominance relative to the luminance signal at an earlier stage in the receiver—in the tuner and the i.f. stages. Consider for example the frequency spectrum of an encoded video signal as shown in Fig. 5. Although the chrominance information is at the top end of the band, centred around the 4·43MHz subcarrier, this chrominance modulation actually represents components of the scene corresponding to the bottom 1MHz of video. Now if the signal delay in the i.f. channel is the same for all frequencies this would be of no consequence. But it is quite common for the i.f. stages to delay the frequencies corresponding to the chrominance signal (top end of the bandwidth) some 100ns more than the corresponding luminance frequencies at the lower end of the band. Hence the two get out-of-step. By the same process we find that a similar delay occurs in the tuner.

Luminance Delay Time

The exact value of luminance delay required—taking into account these various delays—depends on the receiver design but 0·5μs is typical.

Electromagnetic Delay Lines

Since a length of transmission line inevitably has some inductance while there is also the capacitance between the two conductors a lossless transmission line can be represented as an *LC* ladder network as shown in Fig. 6. If the line is correctly terminated in its characteristic impedance, which for a lossless line is a resistance *R*o, then at any point along the line the impedance looking towards the end of the line is *R*o. Drawing a phasor *V*1 as shown in Fig. 7 (a) to represent the r.m.s. voltage at any point along the line it can be seen that this phasor *V*1 is made up of *V*L and *V*2 which are the voltage across *L* and the voltage across the following section of the line. The current *I* lags *V*L by 90° but is in phase with *V*2 since the impedance across which *V*2 is dropped is *R*o. As can be seen from the resulting phasor shown at (b) *V*1 leads *V*2 by an angle θ. In the same way as we go along the line there is a progressive phase lag and therefore a time delay between the input and the output.

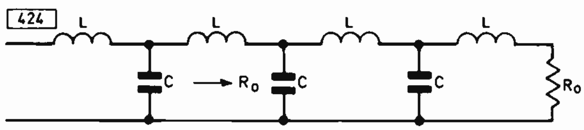


Fig. 6: Representation of a lossless delay line.

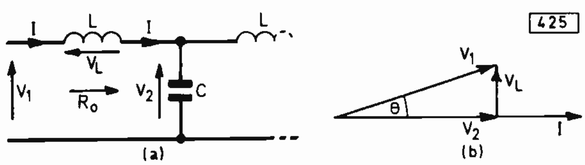


Fig. 7: Voltage relationships in one section of a line.

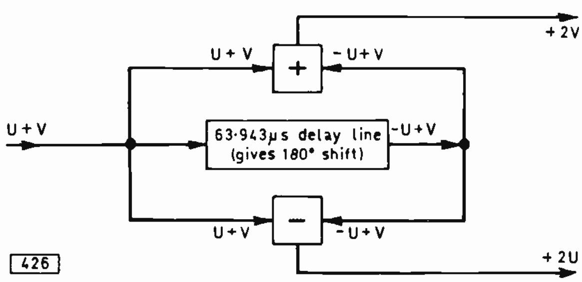


Fig. 8: Block diagram of the chrominance delay line circuit.

The velocity of propagation of a signal along a line is $1\sqrt{LC}$ meters/sec where L and C are the inductance and capacitance per metre length of the cable. Therefore the larger L and C are the slower the signal travels along the line and the less the amount of cable required for a given delay. For a luminance delay of 0·5μs a solenoid is generally used, wound on earthed strips to increase the value of C.

Chrominance Delay Line

The delay line used in the decoder for chrominance signal processing (providing a delay approximately equal to the duration of one picture line) operates in conjunction with an add and a subtract network as shown in Fig. 8. Its operation is quite simple to understand. Suppose we have a line with positive V, i.e. the input to the arrangement shown is U + V. This means that as a result of the V signal inversion on alternate lines in the PAL system the previous line would be U − V and this is what we would expect to find at the output of the delay line. In practice however for reasons that we shall give later the delay line introduces a 180° shift. Thus at the output of the delay line during the picture line in question we get − U + V. As Fig. 8 shows the result is 2V from the add network and 2U from the subtract network. The delay line and its associated networks have thus enabled us to separate quite simply the U and V components of the chrominance signal. These separated components are then fed to their respective demodulators. We also get hue error cancellation, but more on that shortly. First a more detailed look at the way in which the chrominance delay line together with the add and subtract networks act as a comb filter.

Comb Filter Action

Consider first the frequency spectrum of the encoded PAL signal. The Y signal has frequency components from 0Hz up to about 5·5MHz separated at line frequency (f_L) intervals. In the PAL system the chrominance subcarrier is three quarter offset from the line frequency (subcarrier frequency = 283·75 × f_L). Now in a PAL coder the U signal modulates the subcarrier while the subcarrier fed to the V modulator is in effect switched ± 90° on alternate lines so that V is always in quadrature with U (a basic requirement in colour TV systems) but is in advance on one line and retarded on the next to give the V signal inversion on alternate lines (i.e. ± 90° = 180°). Thus as shown in Fig. 9 the U components of the signal are separated from the Y components by $f_L/4$ (neglecting the 25Hz offset) while the inversion of the V signal line by line shifts its frequency spectrum by $f_L/2$ from the U spectrum. To separate

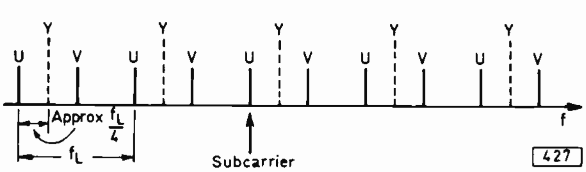
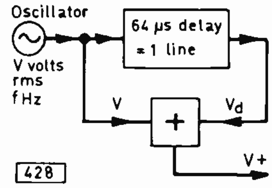
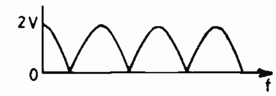


Fig. 9: PAL signal spectrum around the subcarrier frequency, showing the relationship between the Y, U and V sidebands of the composite video signal.





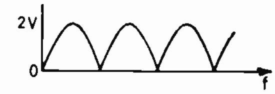


Fig. 10 (left): Addition of instantaneous and delayed signals.

Fig. 11 (above right): Comb filter response obtained with signal addition.

Fig. 12 (bottom right): Comb filter response obtained with signal subtraction.

the U and V components of the signal therefore we require a filter with two outputs, one passing the U components and attenuating the V components while the other passes V and attenuates U.

In the circuit shown in Fig. 10 V and Vd would at 0Hz be equal so that the output $V+$ would be $2V$. Now as the frequency of the oscillator is increased there will be increasing phase difference between V and Vd because of the delay line. At $f_L/2$ V and Vd will be in antiphase and $V+$ is then $0V$. At f_L the phase difference will be 360°, i.e. the delay line will contain one complete cycle: V and Vd when added will then give $2V$. In fact when f is an exact multiple of line frequency $V+$ will equal $2V$ while at half line offset $V+$ will be $0V$. The frequency response is thus as shown in Fig. 11, its shape giving rise to the name comb filter. If now the adding network is replaced by a subtracting network we will by a similar process get the response shown in Fig. 12. We can see then how in practice with the arrangement shown in Fig. 8 and a signal with a spectrum as shown in Fig. 9 we get separation of the U and V components of the chrominance signal.

Delay Time

Now if the delay time was exactly one line, i.e. 64μs, then at the subcarrier frequency the delay line would contain exactly 283·75 cycles of subcarrier. The odd quarter cycle means that V and Vd (Fig. 10) are in quadrature so that neither addition nor subtraction will give $2V$ or $0V$. The delay line must contain either an exact number of cycles, in which case addition produces 2U, or an exact number of cycles plus one half cycle in which case addition produces 2V. The latter condition is obtained when the delay line is shortened so that it contains 283·5 cycles. To find the precise delay time for 283·5 cycles of subcarrier then: using the exact subcarrier frequency a 64μs delay line would contain 283·7516 cycles (the 0·0016 is the 25Hz offset) and by simple proportion

$$Td = \frac{283{\cdot}5}{283{\cdot}7516} \times 64\mu s$$

giving us a delay time of 63·943μs for the line to contain 283·5 cycles. Subtraction then produces 2U and since Td is so close to 64μs the comb filter peaks are separated at almost line frequency intervals and correspond to the U signal spectrum. The zero points lie on the V spectrum to give cancellation. In the

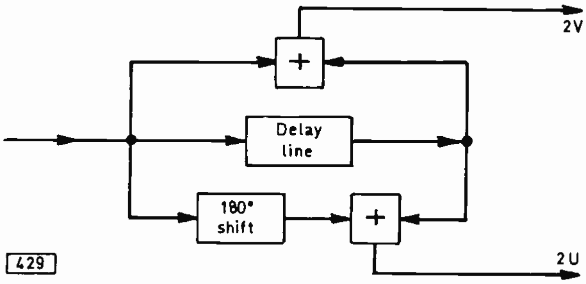


Fig. 13: In practice to subtract two signals we pass one of them through a 180° shift circuit and then combine the two in an adder network.

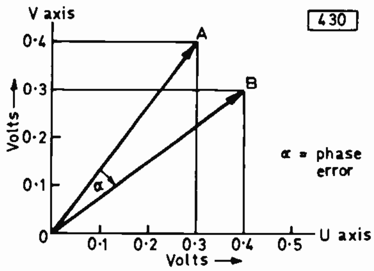


Fig. 14: The reason why a phase error in the NTSC system results in a change of hue (colour): the synchronous demodulators detect on the V and U axis, the output from each altering in proportion to signal phase shift.

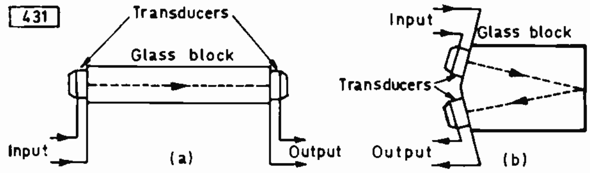
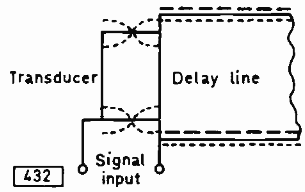


Fig. 15: Glass delay lines. (a) Straight; (b) reflection type.

Fig. 16: Ultrasonic transducer inducing a shear wave into a glass block.



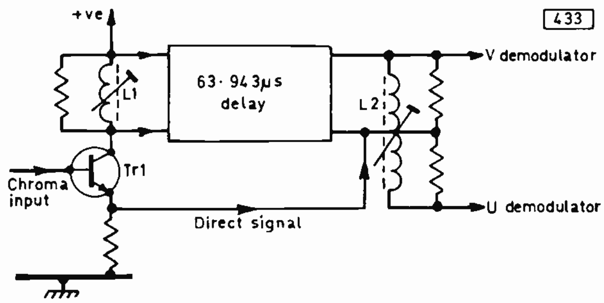


Fig. 17: Typical practical comb filter circuit.

same way the add output passes the V spectrum and rejects U.

It is the practice to shorten the line to contain 283·5 cycles rather than to increase it to contain 284 cycles of subcarrier because the latter would increase the total chrominance delay (by about 56ns) and the luminance delay would have to be lengthened correspondingly.

Because a PAL chrominance delay line contains 283·5 cycles of subcarrier it provides phase inversion and as a result of this V is as we have seen obtained from the add network and U from the subtract network. A further point is that in practice there is no such thing as a subtract network: subtraction is effected by inverting one of the signals in the subtract channel and then applying both to an adder, i.e. the arrangement needed is as shown in Fig. 13.

Hue Correction

The purpose of this PAL signal processing is not only to separate the U and V components of the chrominance signal but also to correct for the effect of phase errors. To appreciate what happens let us first remind ourselves of the problem as it arises in the original NTSC colour system. With NTSC we simply use two separate synchronous detectors to demodulate the U and V signals. Suppose that the phasor A in Fig. 14 represents the correct signal. The V demodulator would open on the V axis and give us an output of 0·4V while the U demodulator would open on the U axis and give us an output of 0·3V, 0·4V of V and 0·3V of U giving us the correct colour. But suppose now that due to a phase shift somewhere in the transmission path what we actually receive is a signal with a phase error of α, i.e. we receive a signal corresponding to the phasor shown as B. The V detector will now give us 0·3V of V and from the U detector we shall get 0·4V of U. The result of mixing these is of course a different colour to the correct one.

How does the delay line circuitry compensate for this? Well for a start it doesn't actually correct the phase error. What happens is that as a result of the addition of information from successive PAL system lines in the chrominance delay line and its associated

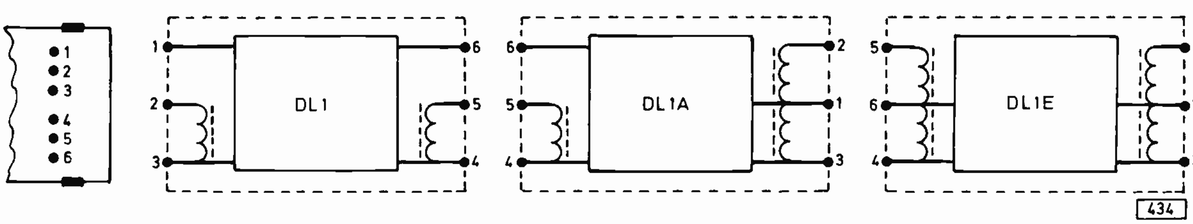


Fig. 18: Surplus delay line pin connections. These lines are available from Manor Supplies.

add and subtract networks the effect of the signal phase shift becomes an equal reduction in the amplitudes of both the U and V signals. If you plot the situation shown in Fig. 14 as it would be affected by the steps shown in Fig. 8 you will find this to be so. There is still a phase error in the signals passed on to the demodulators but it is no longer of consequence: as U and V are effectively reduced in amplitude by the same proportion the colour remains correct though its saturation, i.e. strength, is decreased. A slight reduction in saturation is negligible compared to the actual hue change that occurs with the NTSC system.

Ultrasonic Delay Lines

The disadvantage of using a conventional electromagnetic delay line in a PAL comb filter circuit is that because of the substantial delay time a very great length of cable would be required. For this reason ultrasonic delay lines are used instead. The chrominance signal is converted by a transducer into a mechanical wave which travels at about 3,000 metres/sec (about 1/100,000th the speed of a signal along an air-spaced cable) through a glass block. A similar transducer then converts the chrominance signal back into an electrical one.

Various physical arrangements are possible. An early version shown in Fig. 15 (a) uses a block with transducers at each end, the signal being fed in at one end and taken out at the other. The arrangement shown in Fig. 15 (b) is however generally used, with the transducers at the same end. The signal passes into the block at an angle and is reflected back from the far end. The most recent designs make use of multiple reflections to reduce the amount of glass used in the delay line. The glass used in these delay lines is made so that as temperature rises and the glass expands the wave velocity increases so that the delay is kept constant: such glass is said to be isopaustic.

Transducer Action

The transducer is usually designed to transmit a shear wave along the block, that is as the signal is applied the transducer distorts the glass as shown in Fig. 16, and is a half wavelength thick at 4·43MHz so that it resonates at this frequency. Electrically the transducer is capacitive and it is tuned to the subcarrier frequency by a parallel inductance. A resistor in parallel increases the tuned circuit bandwidth to about 2MHz. The delay line introduces a loss of about 12dB for which compensation is required.

Practical Details

A basic practical circuit is shown in Fig. 17. The input transformer L1 offers a high impedance to the amplifier at the subcarrier frequency: thus the gain in the collector circuit compensates for the loss in the line. The output transformer L2 is wound so that the chrominance signals from the emitter of the transistor and from the delay line are added and subtracted as required before being fed to the demodulators.

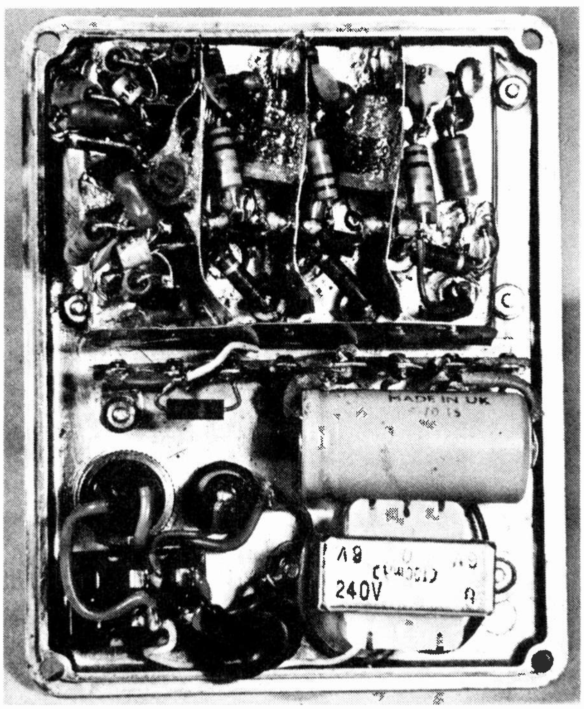
Connection data for chrominance delay lines currently available on the surplus market is given in Fig. 18. ■

Wideband BAND I PREAMPLIFIER

Roger Bunney

In the May 1972 Television we featured information on the construction of various Band I aerial arrays with coverage over the complete European transmission segment, channels E2-4 inclusive. At that time we were considering a companion wideband amplifier using field effect transistors. Unfortunately problems arose with this so we had to consider alternative approaches. We eventually decided to use the familiar silicon planar npn BF180 transistor since it is widely available at very low cost. A simple basic circuit was drawn up, the unit constructed and aligned and was found to work immediately with good gain and a low noise figure.

As the circuit (Fig. 1) shows there are five stages in all. The input signals are coupled to Tr1 emitter by C1, the emitter being biased by R1 through a v.h.f. choke. All the stages are operated in the grounded base mode. Tr1 base is biased by the potential divider network R2, R3 and decoupled to chassis by C2. The same technique is used in the other stages. The collector tuned circuit of the first three stages comprises a coil of 10 turns tapped at turn 5, the output being capacitively coupled to the emitter of the next stage. The ouput from the third stage Tr3 is split and fed to two separate stages. The two output stages Tr4 and Tr5 have low gain and serve mainly as isolation between the output of the third stage and the final amplifier outputs.



Prototype with cover removed to show construction.

The complete amplifier draws 15mA from 9V. The circuit of a simple mains power unit is also shown in Fig. 1.

Alignment is extremely simple as there are only three coils to tune. Assuming that the range ch. E2-4 inclusive is required L1 is tuned to E4, L2 to E3 and L3 to E2. The coils themselves are rather broad in tuning and no sharp peak should be found. A simple noise generator as shown in the August 1969 Practical Television page 505 is of great assistance in obtaining a level response over the bandwidth.

The complete prototype unit was constructed in an Eddystone diecast box type 6908p though any appropriate metal container will of course suffice. We prefer the Eddystone boxes however because of their very strong construction and complete screening. The layout (see photograph) follows the basic circuit arrangement. Because of the limited space available I found it best first to cut to size the tin subchassis on which the amplifier is mounted, next to drill and solder in the feedthrough decouplers, then to solder the interstage screening on to the subchassis and after this to fit the transistors into place. Maximum screening for the transistors is obtained by using holes cut out for them in the screening, with the connections to the emitter and base on one side and that to the collector on the other; the shield connection is soldered directly to the screen and actually supports the transistor. Some thought must be given to the sequence of fitting the rest of the components in order to ease construction: basically one starts in the middle and builds outwards.

The prototype has two outputs but a single output stage could be used instead. In this case resistors R16 and R17 are omitted and the coupling to the final stage is via C13 only as with the previous stages.

The unit is extremely stable over the bandwidth. The gain depends of course on the bandwidth required. To cover ch.E2-E4 vision (48-67MHz) a gain of 25dB can be expected. The prototype was aligned to cover ch.E2-B5 and had a gain of around 22dB. This is demonstrated in practical terms by measurements using a signal strength meter/attenuator. A ch.B3 signal without amplifier measured 160μV into the 75Ω input: with the amplifier in circuit the signal increased to 2.2mV. Unfortunately no facilities were available for the measurement of the noise figure but results observed off screen on weak signals indicate an extremely good noise figure.

All components are available from Home Radio (Components) Ltd. It may be found necessary to

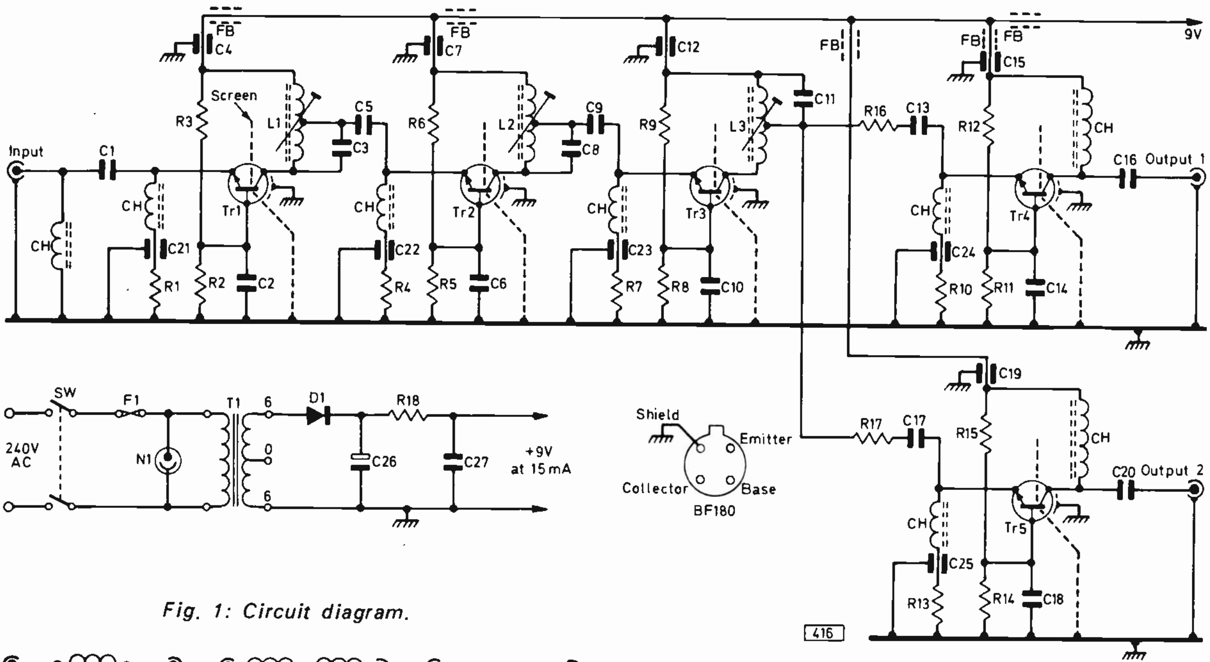


Fig. 1: Circuit diagram.

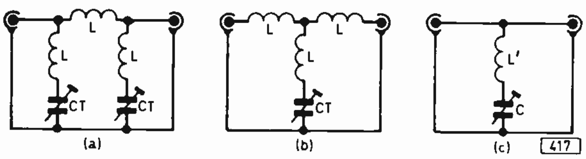


Fig. 2: Filters: (a) u.h.f. pi type; (b) u.h.f. T type; (c) acceptor for f.m. radio rejection. L 2½ turns 3/16in. diameter, use inner conductor of low-loss coaxial cable; CT 2-10pF ceramic concentric trimmer; L' 5 turns, other details as L, C' 3-30pF Philips concentric trimmer.

use a non-hexagonal dust core for L3 (i.e. one with a screwdriver slot) to maintain coverage below ch.E2.

As constructed the amplifier will cover ch.E2-B5 with no problems. Thus it may be of use for small relay systems, especially if the various higher frequency channels are translated to Band I frequencies for distribution.

Overloading

If this amplifier—and indeed many other amplifiers using bipolar transistors—is used close to a very high-powered TV transmitter overloading may occur. The effect has been observed with both home constructed and currently available commercial designs. In the case of a group of u.h.f.

—*continued on page 549*

★ components list

Resistors:
R1 1kΩ
R2 3·3kΩ
R3 10kΩ
R4 1kΩ
R5 3·3kΩ
R6 10kΩ
R7 1kΩ
R8 3·3kΩ
R9 10kΩ
R10 1kΩ
R11 3·3kΩ
R12 10kΩ
R13 1kΩ
R14 3·3kΩ
R15 10kΩ
R16 22Ω
R17 22Ω
All ¼ or ½W 10%
R18 680Ω ½W 10%

Semiconductors:
Tr1-5 All BF180
D1 Silicon power diode 100V p.i.v.

Capacitors:
C1 40pF
C2 0·01μF
C3 2·2pF
C4 1000pF
C5 10pF
C6 0·01μF
C7 1000pF
C8 2·2pF
C9 10pF
C10 0·01μF
C11 2·2pF
C12 1000pF
C13 10pF
C14 0·01μF
C15 1000pF
C16 25pF
C17 10pF
C18 0·01μF
C19 1000pF
C20 25pF
C21 1000pF
C22 1000pF
C23 1000pF
C24 1000pF
C25 1000pF
C26 500μF
C27 0·01μF

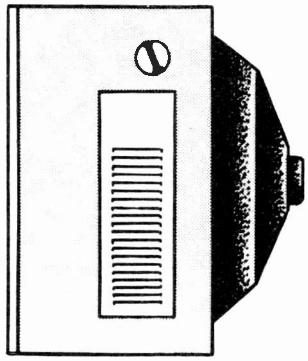
2·2pF	silver mica 5%
40pF	tubular ceramic 20%
0·01μF	miniature ceramic 20% 20V wkg.
1000pF	feedthrough
10pF	tubular ceramic 10%
25pF	tubular ceramic 20%
500μF	25V electrolytic

Miscellaneous:
CH Radiospares v.h.f. choke, 1A (total 8)
FB Radiospares ferrite bead (total 5)
L1-3 10 turns close-spaced 26 s.w.g. enamelled wire tapped at 5th turn, wound on ¼in. coil former with dust core
Coaxial sockets (3)
SW DPST toggle switch
F1 Miniature 100mA fuse with panel mounting ⅜in. holder
N1 Mains neon indicator
T1 Miniature mains transformer, 0-240V primary, 6-0-6V secondary (Eagle)

Renovating the RENTALS

CALEB BRADLEY B Sc

7 VARICAP TUNER CONVERSIONS



WHEN television transmissions on the u.h.f. Bands IV and V began (at first BBC-2 only, in monochrome—remember?) suitable transistors for use at u.h.f. were not readily available and in consequence valve u.h.f. tuners were used exclusively. Even as high-performance transistor tuners became available, typically using low-noise transistors such as the BF180 and BF181, many set makers preferred until comparatively recently to stick with valve tuners on the grounds of cheapness and compatibility with the h.t. and heater supplies of valved sets. As a result there are now tens of thousands of dual-standard sets in use in which one can find the common PC88/PC86 valved u.h.f. tuner. The following faults are often found on these tuners.

UHF Tuner Troubles

(a) Low gain. This causes a weak, grainy picture on 625 and is usually due to wear of one or both valves or, much less commonly, to an open-circuit decoupler or resistor value change. In fringe areas the PC88 r.f. amplifier valve may need replacing every two years or less.
(b) Tuning mechanism troubles. Scores of different slow-motion rotary and pushbutton tuning arrangements have been used, some fiendishly complicated. Almost all can suffer from seizure, cords snapping, gears stripping, backlash, stiffness or poor repeatability of station selection.
(c) Tuning drift with warmup.
(d) Burnup of internal resistors due to valve interelectrode shorts.

The i.f. output level obtained from this type of tuner is rather less than that from the corresponding two-valve v.h.f. tuner and extra i.f. gain is provided in the receiver to compensate for this. The amplification may be provided by extra (or different) i.f. stages switched into use for 625 or, more economically, by the injection arrangement where the u.h.f. tuner feeds into the v.h.f. tuner which acts as an i.f. preamplifier on 625.

Straightforward transistor tuners overcome many of these troubles and give better fringe area performance. But they still need tuning mechanisms. Sometimes the v.h.f. and u.h.f. tuners are combined into a single transistorised "integrated" tuner: these are good until they go wrong when they may be found virtually impossible to service and have therefore to be exchanged with the manufacturer. Some makes suffer more than others from patterning troubles due to internal instability.

Something better than these types of u.h.f. tuner is needed for this single-standard age. Colour receivers especially need much better tuning stability than monochrome receivers. This is because slight mistuning on monochrome merely causes reduced picture definition whereas on colour the position of the chrominance subcarrier on one sloping side of the i.f. response curve is critical. The best pushbutton transistor tuners are barely stable enough for colour.

The solution is now with us in the form of the varicap tuner which has no moving parts.

The Varicap Diode

All semiconductor junction diodes have the property of capacitance when reverse biased, the capacitance varying with the reverse voltage applied. The "plates" of the capacitor (see Fig. 1) consist of the conductive p- and n-type materials which form the anode and cathode respectively. The "dielectric" between the plates consists of the insulating depletion layer which is present at all pn junctions when not biased and increases with increase in reverse bias. As Figs. 1(b) and (c) show, the depletion layer widens as the reverse bias increases, effectively increasing the distance between the "plates" of the capacitor. Since capacitance is inversely proportional to the distance between the plates of a capacitor the capacitance at a reverse biased semiconductor pn

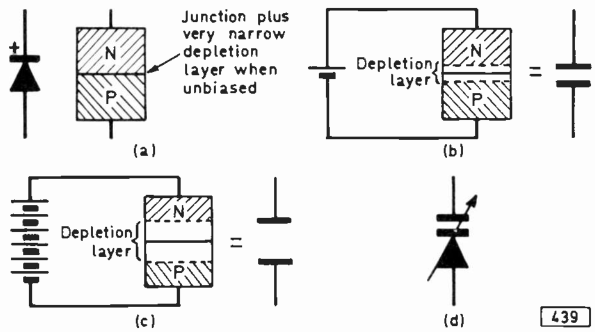


Fig. 1: (a) Symbol and basic construction of a semiconductor junction diode. (b) The depletion layer which is present at the junction is increased when reverse bias is applied. As shown the combination of the depletion layer plus the n- and p-type regions forms a capacitor. (c) As the reverse bias is increased the depletion layer widens and the capacitance decreases. (d) Circuit symbol for the varicap diode which exploits this property.

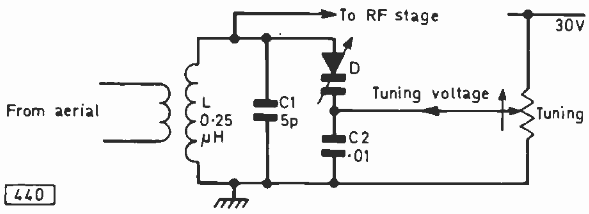


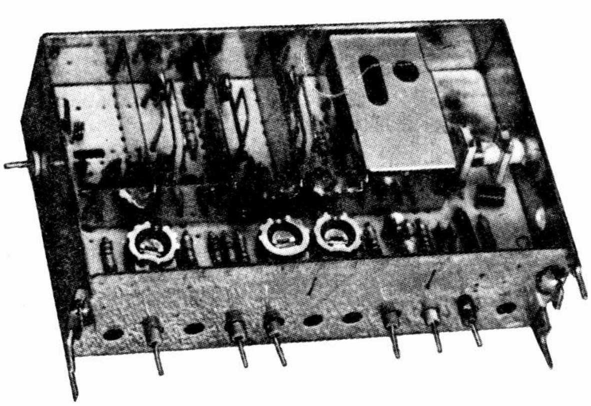
Fig. 2: Simple example of the use of a varicap diode for tuning. The arrow on the tuning potentiometer shows the direction of increasing frequency (i.e. decreasing capacitance).

junction decreases as the reverse bias is increased.

Normally this capacitance property of diodes (and transistor junctions) is ignored, or deliberately minimised in components for high-frequency use to reduce feedback effects. Varicap (or varactor) diodes however have large junction areas to give a wide and closely specified capacitance range so that they can be used as solid-state substitutes for mechanical tuning capacitors. A possible varicap tuning arrangement such as could be used for the r.f. stage of a v.h.f. radio receiver is shown in Fig. 2. Coil L is tuned by the parallel capacitances of C1 and the varicap diode D. C2 is of large capacitance value and so does not affect the tuning but serves to isolate the varicap control voltage obtained from the potentiometer connected across the 30V supply. The supply must be well stabilised for adequate tuning stability: fortunately no great current need be drawn from it.

Electronic tuning of this kind is easily adaptable to give switched selection of preset stations and for remote control arrangements since the tuning potentiometer can be mounted any distance from the tuned circuit. In this case C2 in Fig. 2 should be large enough to bypass any hum and noise picked up on the tuning wire.

Mechanical tuning capacitors will be around for some time however since varicap diodes have definite limitations. The range of capacitance given is usually small, with the better diodes being very expensive. The capacitance values available are of the order of a few picofarads which generally speaking restricts the use of varicaps to tuned circuits for v.h.f. and higher. They are suitable for only small-signal circuits since large signals tend to modulate the



Mullard ELC1043 u.h.f. varicap tuner unit with top cover removed.

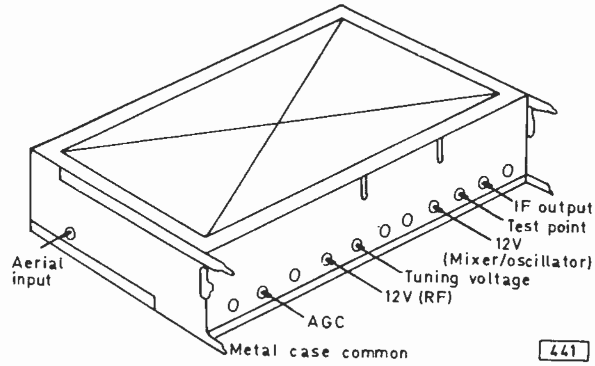


Fig. 3: External connections to the Mullard ELC1043 u.h.f. varicap tuner.

tuning bias, generating harmonics. The varicap has a significant leakage resistance so that the *Q* (selectivity) of the tuned circuit is less than could be obtained with conventional capacitors. Also it is expensive to select varicaps with near-identical characteristics, needed where several tuned stages have to be ganged to a single tuning potentiometer.

Virtually all varicap diodes are silicon rather than germanium since the latter semiconductor material cannot give the low leakage and high reverse breakdown voltage characteristics required.

ELC1043 UHF Varicap Tuner

This Mullard type ELC1043 u.h.f. varicap tuner shown in the photograph is now generally available (see end of article for a supplier) and this month we shall describe how it can be used as a superior replacement for other types of u.h.f. tuner. It has a light metal case with two snap-on covers, the overall size being 96 x 58 x 26mm for which room can easily be found in any set. Each tuned circuit in the tuner is in a separate screened compartment with additional screening of the mixer/oscillator stage to minimise radiation. The external connections are brought out via feed-through capacitors and are shown in Fig. 3.

Circuit Description

Two r.f. amplifier stages (using BF262 transistors) rather than one are used to compensate for the lower *Q* of the varicap tuned circuits, giving the tuner a good overall gain of 20dB. The aerial input circuit is untuned for optimum front-end noise performance, a typical figure of better than 8dB being achieved. Coupling between the first and second r.f. amplifier is by a half-wave tuned line and between the second r.f. amplifier stage and the mixer/oscillator transistor (BF263) by a pair of bandpass half-wave tuned lines. The secondary of the bandpass circuit is coupled to the emitter of the BF263 via a coupling loop which also serves to couple in the oscillator feedback from the oscillator tuned line. This coupling loop is terminated by a capacitor which is large enough to ensure that the emitter circuit presents a low impedance at i.f.

The four half-wave tuning lines, only about an inch long, are each terminated at one end by a fixed capacitor and tuned at the other end by a varicap

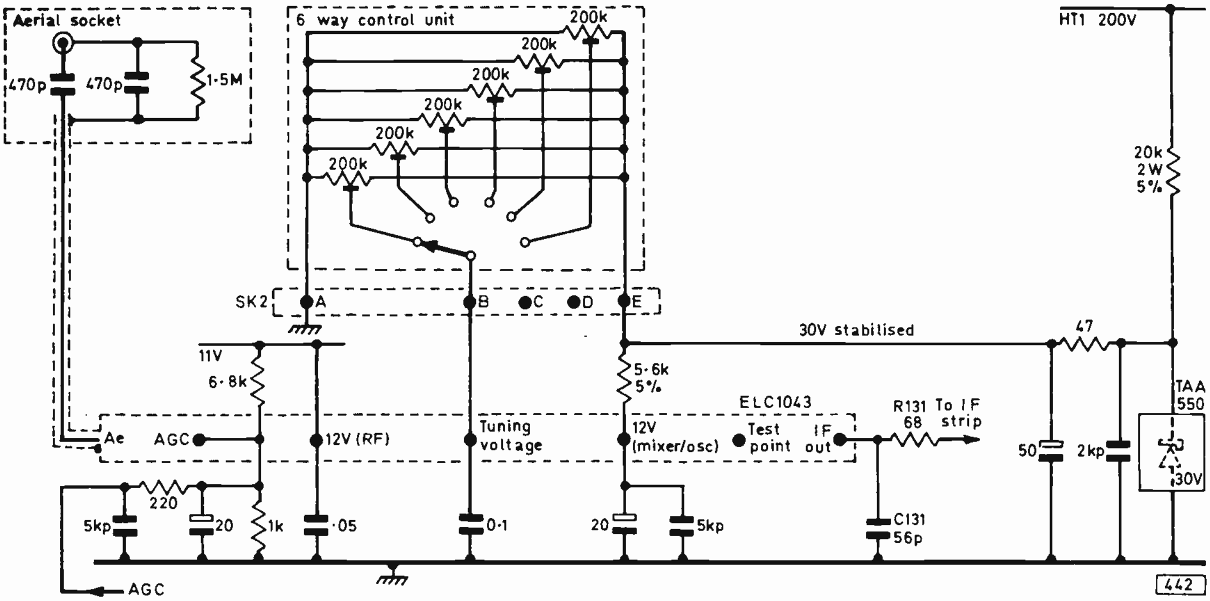


Fig. 4: The circuitry used with the ELC1043 varicap tuner in the Pye 769 chassis.

diode: with this arrangement stray capacitance at the point of connection does not restrict the tuning range. Four varicap diodes (type BB105B) are used and three factory-aligned skeleton presets control the tracking of the first three: they should on no account be adjusted.

Connections to Receiver

Figure 4 shows how the tuner is connected in circuit in a modern single-standard chassis, the Pye 769. The connections are as follows.

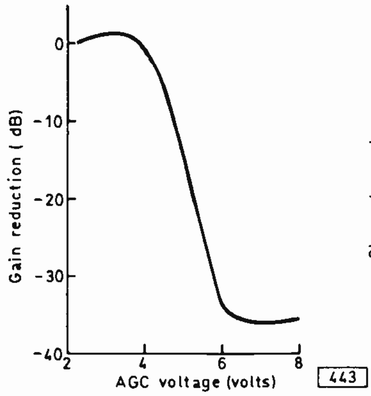
Aerial. This is connected via the usual isolating components to the terminal at one end of the tuner. When the tuner is used to replace an existing u.h.f. tuner the old aerial socket, the components on it and the aerial lead to the tuner can all be kept. The screen of the coaxial lead can be soldered directly to the tuner case or clamped under a small bolt screwed into the tapped hole provided near the aerial terminal. For tuners to be used abroad with 300Ω balanced aerial feeder Mullard can supply a 300/75Ω printed circuit balun transformer type number 4313/130/41080. Tuners already fitted with this carry the suffix /01.

I.F. Output. This can be fed by coaxial cable to the normal point in the receiver, i.e. the i.f. strip input or the 625 injection point on the v.h.f. tuner. Since this point is at h.t. potential in some valve circuits a 1,000pF series isolating capacitor should always be used if in doubt. It is prudent to keep the i.f. output lead short relative to a quarter wavelength at 37MHz, i.e. less than 2ft. This length adds about 40pF to the i.f. output loading. The i.f. output tuning coil is accessible at one end of the tuner (opposite end to the aerial input) and may require careful trimming with a non-metallic screwdriver for optimum resolution of the test card gratings. If the core has to go all the way in extra capacitance such as C131 in Fig. 4 is needed. For proper i.f. alignment a test point for connecting a signal generator is provided on the tuner as usual.

A.G.C. Voltage. A swing of 2.5V to 6V increases the r.f. amplifier current from 6.5mA to 12mA causing a gain reduction of at least 35dB—see Fig. 5. Less than 500μA a.g.c. current is drawn. When adding the tuner to a receiver it is easiest not to bother with tuner a.g.c. and to fit instead a preset potentiometer to provide this voltage range. The potentiometer can be regarded as a sensitivity control which need only be backed off from its maximum gain extreme (2.5V) when used in strong-signal areas where cross-modulation occurs, i.e. simultaneous sound-on-vision and vision-on-sound, and patterning. In fact the tuner can give acceptable performance with an aerial signal as high as 8mV. For fringe area reception this sensitivity control is useful for locating the peak point on the a.g.c. curve (Fig. 5); this point varies slightly with frequency and different tuners. The a.g.c. voltage should be decoupled by say 20μF.

12V Supply to Mixer/Oscillator. This draws less than 4.7mA and can be supplied from the stabilised 30V tuning supply (see below) via a 5.6kΩ 5% resistor. A less stable voltage supply will cause tuning drift. The supply can be adequately decoupled by 20μF and 5,000pF capacitors in parallel, the smaller capacitor making up for the possible r.f. impedance of the 20μF electrolytic.

12V Supply to R.F. Stage. Since the current drawn here varies greatly with a.g.c. it should not be taken from the tuning supply otherwise the tuning will be affected by a.g.c. variations. If the receiver has a 12V rail as in Fig. 4 this can be used: a decoupling capacitor must be connected at the tuner. Alternatively a 12V supply can be derived from the valve h.t. line (200V approximately) by means of a 12V 400mW zener diode, 8.2kΩ 5W resistor and 20μF and 0.1μF parallel decouplers (see Fig. 8 later). Further possibilities include extracting 12V from across the cathode decoupling capacitors of the audio or field output valves.



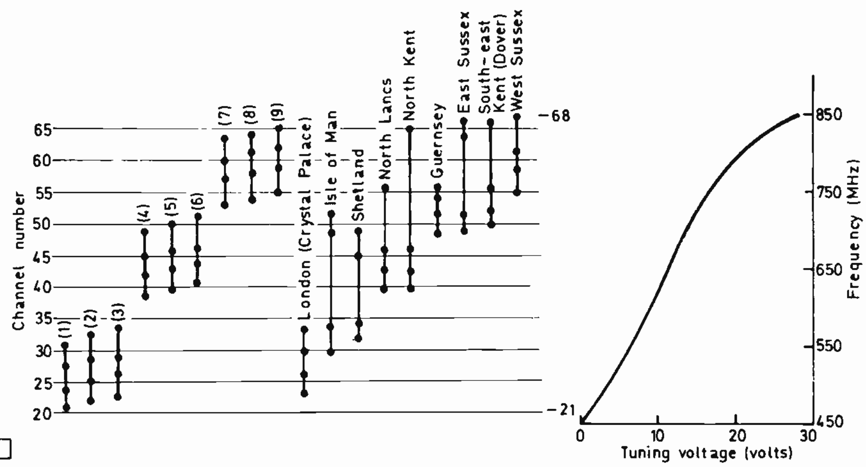


Fig. 5 (left): Plot of a.g.c. voltage against gain reduction. Peak gain occurs at about 3V but this varies slightly with different tuners.

Fig. 6 (right): Varicap tuner tuning range and UK u.h.f. channel allocations. Four channels are allocated to each transmitter. Channel groups 1-9 above are used by the following stations: (1)—Channels 21, 24, 27 and 31—Divis, Caithness, Cardiganshire, East Lothian, Sandy Heath, Rowridge, Halifax; (2)—channels 22, 25, 28 and 32—Argyllshire, Caradon Hill, Belmont, Fermanagh, Hereford, Durris, Cumberland; (3)—channels 23, 26, 29, 33—Darvel, Banff, Stockland Hill, Lewis, Bilsdale; (4)—channels 39, 42, 45 and 49—Flintshire, Rosemarkie, Northumberland; (5)—channels 40, 43, 46 and 50—Sutton Coldfield, Dorset, Black Hill, Orkney, Pembrokeshire, Guildford; (6)—channels 41, 44, 47 and 51—Tunbridge Wells, Buchan, Caenarvonshire, Jersey, Kirkcudbrightshire, Londonderry, Emley Moor, Wenvoe, Suffolk, Redruth; (7)—channels 53, 57, 60 and 63—Llanddona, Carmarthenshire, East Yorkshire, Northamptonshire, Perthshire, Beacon Hill, Wigtown, Reigate; (8)—channels 54, 58, 61 and 64—Hereford, Armath, Mendip, Dumbarton, Pontop Pike, Nottinghamshire; (9)—channels 55, 59, 62 and 65—Tacolneston, North Antrim, Huntshaw Cross, Selkirkshire, Winter Hill.

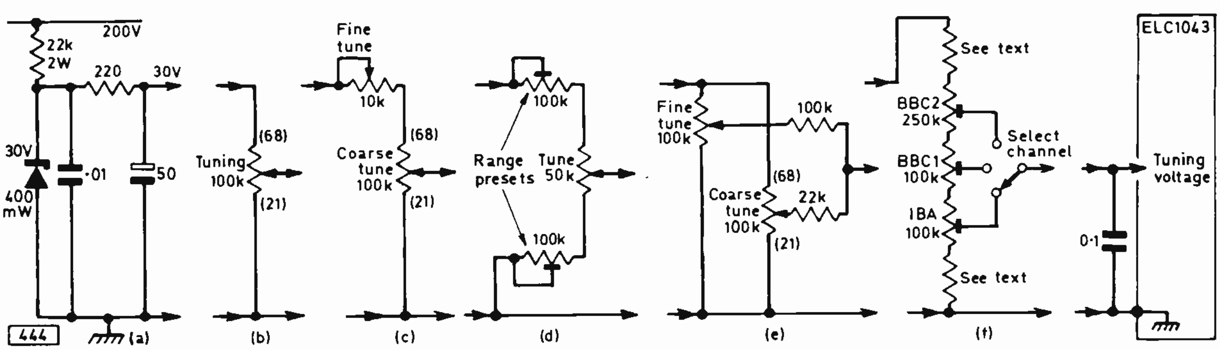


Fig. 7: (a) Tuning voltage supply. For greater stability use a TAA550 i.c. in place of the 30V zener diode. (b-f) Alternative tuning arrangements—all potentiometers are small carbon linear types. Services noted on (f) correspond to the London channel allocations.

Tuning Voltage. A swing of 0 to 28V is needed to tune over the full range of channels 21 to 68 in Bands IV and V, there being a margin of 2MHz available below channel 21 and above channel 68. The tuning range is shown in Fig. 6 which plots tuning voltage against frequency and summarizes the channel numbers used in different parts of the country. The tuning current drawn is very small, less than 75μA.

The recommended tuning voltage source is 28–30V from a Mullard TAA550 stabilizer as shown in Fig. 4. This is a special purpose i.c. which acts as a high-performance zener diode. For monochrome television where ultimate tuning stability is not essential an ordinary 30V 400mW zener is adequate and cheaper. This can be fed with a constant 8mA by a 22kΩ resistor from the valve h.t. line (190 to 210V) as shown in Fig. 7(a).

A variety of tuning arrangements is possible some of which are shown in Fig. 7(b)–(f). The simplest circuit—Fig. 7(b)—consists of a potentiometer across the 30V supply, its slider feeding the tuning voltage input of the tuner. The control knob can be calibrated directly in channel numbers 21 to 68: as the shape of the curve in Fig. 6 shows, the scale is almost linear with slight expansion towards the high-frequency extreme. The disadvantage of this scheme is that the control is too coarse to tune in a single channel easily. A multi-turn potentiometer if available would be more suitable. A less expensive solution is to fit two controls, coarse and fine, as in Fig. 7(c). This arrangement is workable but suffers

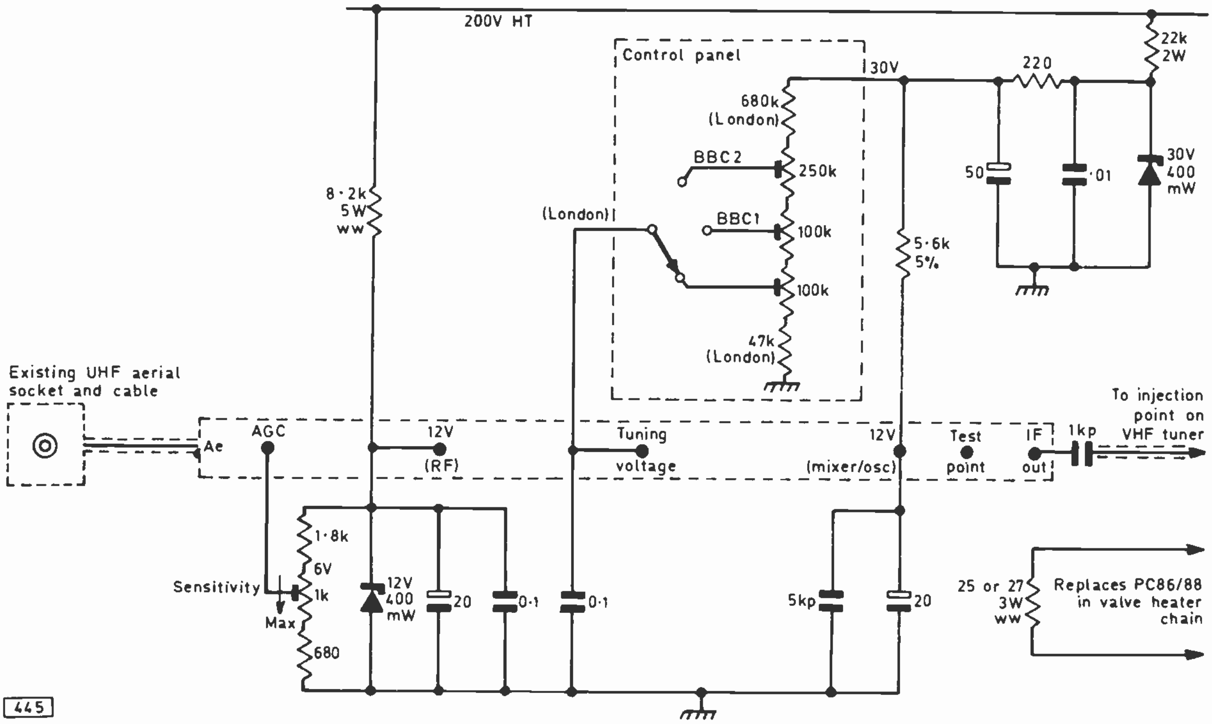
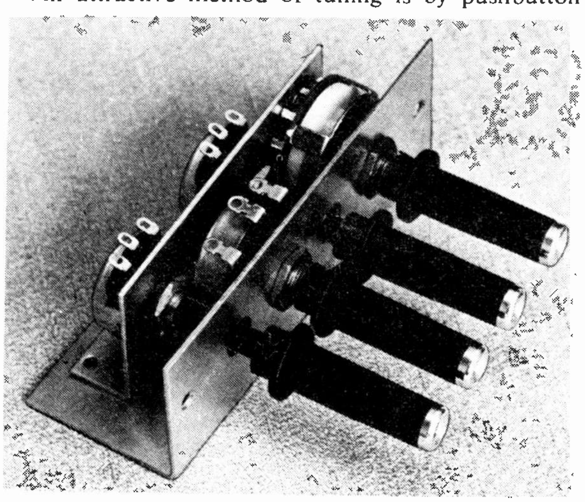


Fig. 8: Varicap tuner conversion to replace a valve u.h.f. tuner.

from the fine tuning range varying over the band. The more sophisticated arrangement shown in Fig. 7(e) solves this and in practice is easy to use. For fancy appearance the coarse control can be a slider type, fitted with a scale of channel numbers.

The arrangement shown in Fig. 7(d) is only intended to cover the local group of channels but has the advantage of easy one-knob tuning of all three stations. The two preset controls are set up so that the channel range swept by the 50kΩ potentiometer just covers the channels required. If it is fitted with a reasonably large knob tuning is quite easy.

An attractive method of tuning is by pushbutton



The varicap conversion control unit available from Manor Supplies.

or switch. Special pushbutton/potentiometer control assemblies are used on some sets but are not readily available at present (see supplier at end of article though). A circuit for switch tuning is shown in Fig. 7(f). Here the three local stations are preset on the potentiometers and selected by an ordinary three-way wavechange switch. The two fixed resistors are chosen to suit the local channel allocations (see Fig. 6). As the voltages to tune channels 21 to 68 are fairly linearly distributed across the total series resistance in Fig. 7(f) it is easy to choose appropriate values. For example for the London channels—or transmitters under (1), (2) or (3) in Fig. 6—the upper fixed resistor should be 680kΩ and the lower one 47kΩ.

The tuning voltage should be decoupled at the tuner by an 0.1μF capacitor to avoid freak effects due to noisy tuning potentiometers or interference pickup. Do not fit a large electrolytic decoupler here or there will be an unpleasant lag in the tuning.

The installation of the tuning controls can be contrived to suit particular receivers. An interesting bracket has however been developed by Manor Supplies. This allows the channel selection switch and tuning potentiometers shown in Fig. 7(f) to be mounted sufficiently closely to fit control panel holes intended for conventional pushbutton tuners. The controls (see photograph) are stagger-mounted on a two-piece bracket which can be adjusted slightly to fit different panel hole spacings. By using this bracket sets such as those in the Bush TV125 series can be very easily converted to varicap 625 tuning. A kit is available consisting of the bracket, most of the components in Fig. 4 (a 30V zener diode is supplied in place of the TAA550) and 7(f) and four slim-style knobs

Any of the control circuits shown in Figs. 7(b) to 7(f) can be built into a small plastic box and used remotely from the set. *Ensure that all parts of the circuit are adequately insulated from the user however since the receiver chassis can be at live mains potential.* For this reason turned metal knobs must not be used unless the controls have plastic spindles.

Typical Conversion

To investigate the performance of the varicap tuner as a replacement unit, one was fitted in place of the valve u.h.f. tuner originally used in a Pye set in the 11U series which we covered recently (see May 1972 issue). The circuit adopted is shown in full in Fig. 8. To maintain heater continuity a 25Ω wirewound resistor was connected in place of the old PC86/PC88 valves in the heater chain.

To avoid tuning drift the tuner should be mounted in a cool position in the set; likewise the 30V zener diode. The three high-wattage resistors should be mounted away from the tuner as they run warm. In some sets it may be necessary to mount a metal sheet to shield the tuner from heat if drift proves troublesome.

The tuner case should be securely bonded to the receiver chassis at or near the v.h.f. tuner by a heavy wire since poor connection here can be a source of patterning—especially if the wire is more than a few inches long.

The improvement in 625 reception was remarkable. On my aerial the old valve tuner had brought in programmes from two transmitters with some grain (noise) always visible and with little or no "spare" contrast gain. Fitting the varicap tuner resulted in completely noise-free pictures on all the channels with enough gain in hand to drive the picture to "soot and whitewash" on advancing the preset contrast control. On this set, which is without flywheel line sync, the former raggedness of picture verticals was greatly improved. This is partly thanks to the high-level type viewer contrast control used on this chassis as this technique always allows fully

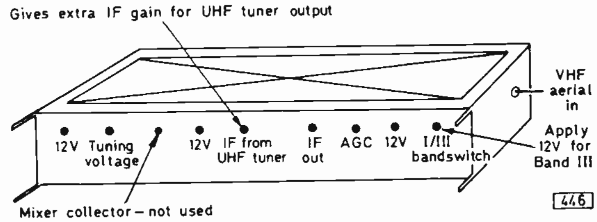


Fig. 9: Connections to the ELC1042 v.h.f. varicap tuner unit. This has exactly the same a.g.c. and tuning voltage requirements as the ELC1043 u.h.f. varicap tuner and can be used as a replacement for obsolete v.h.f. push-button or turret tuners.

amplified video to pass to the sync separator. The higher video level showed up some slight misalignment of the f.m. sound detector, but this was tweaked correctly without difficulty for minimum buzz on sound. The tuning stability has proved so good that the three station presets will shortly be relegated to a position at the back of the set, out of reach of unskilled hands, leaving just a three-way channel switch at the front of the set.

Supplier

Manor Supplies (172 West End Lane, London NW6) can supply the ELC1043 varicap tuner at £4.50 plus 25p post and packing and the kit of bracket, components and knobs described for £1.90 plus 15p post and packing.

Service Hint

We have heard reports of tuner unit drift in Philips colour receivers (520 series) fitted with the G8 chassis with varicap tuner being due to the 33kΩ resistor (R2143) which feeds the 30V tuning line going high-resistance. This resistor is mounted on the i.f. panel.

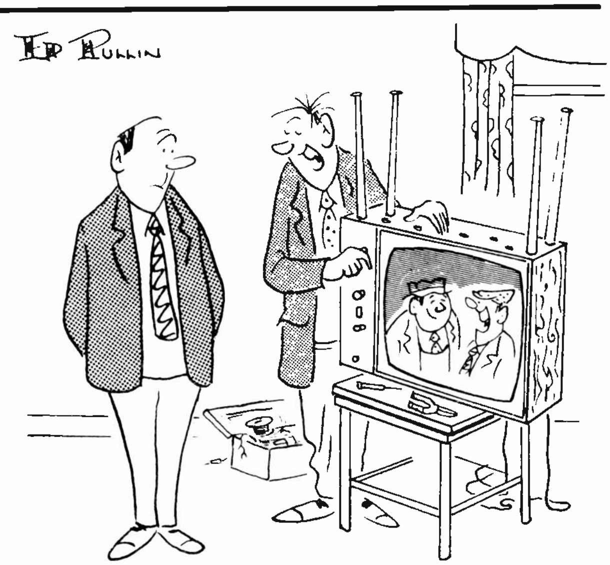
WIDEBAND BAND I PREAMPLIFIER

—continued from page 543

transmitters the problem usually shows up in the appearance of the u.h.f. transmissions on various frequencies in Band I. This can also occur in Band III although in this Band various f.m. radio services can appear. In most cases the problem can be overcome by using simple filters.

For the prevention of u.h.f. breakthrough a simple pi or T filter can be used. To align the pi filter shown in Fig. 2(a) the two variable capacitors are adjusted to provide maximum attenuation on the highest and lowest channel in the group. The T filter (Fig. 2(b)) is adjusted for maximum attenuation at the centre channel frequency. The adjustments are best carried out with the filter connected in series with a u.h.f. aerial feeding into a receiver tuned to the u.h.f. channel concerned.

The simple acceptor trap shown in Fig. 2(c) can be used to remove f.m. radio services breaking through in Band III. The variable capacitor is tuned until the interference disappears. ◆



"That'll stop the tube shorting out!"

CIRCUIT NOTES

H. K. HILLS

Four-stage DC Coupled Monochrome Video Amplifier

The Beovision 500, 800 and 1400 range of monochrome receivers uses a four-stage video amplifier circuit (Fig. 1) with three BC147 emitter-followers and d.c. coupling from the vision detector right through to the cathode of the c.r.t. thus maintaining the correct black level throughout the video channel. A separate detector is used for the intercarrier sound signal.

The second emitter-follower in the video chain also drives the a.g.c. amplifier whilst the drive to the sync separator is taken from its collector. The video output stage Tr4 has a comparatively high value (15kΩ) load resistor and no peaking coils. A 220Ω bias stabilising resistor is connected from the l.t. rail to its emitter. The 100kΩ resistor from its collector to the base of the driver Tr3 provides a.c. and d.c. feedback, the latter to stabilise the d.c. conditions in the output circuit. Negative feedback is developed at l.f. across the 56Ω resistor in the emitter lead of Tr4, the decoupling capacitor being effective at h.f. Low-frequency attenuation to minimise aircraft flutter is provided by the 2·5μF electrolytic which shunts the 100kΩ resistor in the feed to the c.r.t.'s cathode: from medium to high frequencies the reactance of this electrolytic is so low that it virtually short-circuits the resistor but at lower frequencies its reactance becomes comparable with that of the resistor so that a portion of the l.f. video drive is developed across this combination instead of being developed at the cathode of the c.r.t.

A great deal of care seems to have been put into the design of this circuit.

BRC 8000 PAL V Switch/Colour-Killer Circuit

With the 3000 chassis BRC adopted the technique of squaring the ident signal and using this instead of the output from a separate bistable circuit to

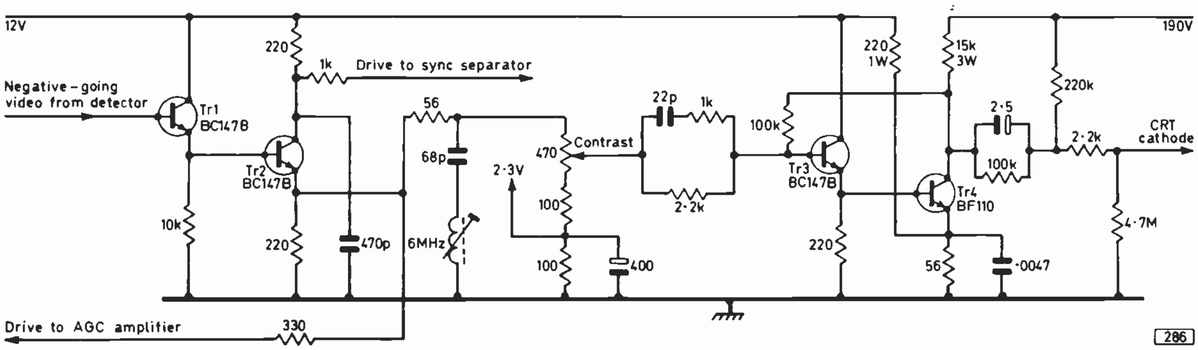


Fig. 1: The four-stage d.c. coupled video circuit used in Beovision monochrome receivers.

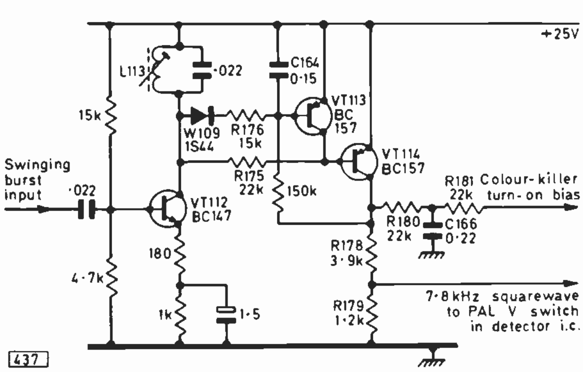


Fig. 2: The PAL V switch squarer/driver stage and colour-killer system used in the BRC 8000/8500 chassis.

drive the PAL V switch. They also obtained the chrominance channel colour-killer turn-on bias from the PAL V switch circuit. Similar techniques but with even simpler circuitry are used in the BRC 8000 chassis in which the PAL switch itself is within the i.c. (Motorola type MC1327P) used for demodulation of the colour-difference signals. The 8000 chassis PAL V switch driver and colour-killer circuit is shown in Fig. 2. The swinging bursts are fed in the normal manner to the base of the ident stage VT112 which produces the ident sinewave across the tuned circuit in its collector lead. The ident signal is then applied via R175 to the base of the squarer transistor VT114 which generates the required squarewave signal across its load resistors R178 and R179, being driven alternately on and off by the ident signal. The 7·8kHz squarewave signal for the

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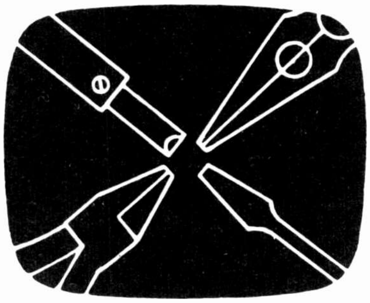


SERVICING television receivers

L. LAWRY-JOHNS

BUSH TV141, TV148 SERIES

THESE models and the Murphy equivalents—Models V153 and V159—were released just before the partly transistorised TV145U, TV148CU and TV161U series which we dealt with in April and May 1970. Whilst the model numbers are so similar there is a good deal of difference between the two ranges. The earlier models which we are now covering used valves throughout except for the u.h.f. tuner. The timebases used in the two series were however very similar.

The Power Supply

The power supply circuitry is worth close attention as trouble will be experienced here. The arrangement of the two rectifiers in the circuit is one which the writer distrusts and alters when the occasion arises. It will be seen that the two rectifiers are in series, with the heater supply taken from the junction. This means that the h.t. current flows through both 3SR1 and 3SR2 with 3SR2 also carrying the heater current. It is therefore more prone to break down. When it shorts the h.t. is unaffected as 3SR1 still rectifies but the valve heaters are grossly over-run (including the tube) and this can lead to many later failures after the basic fault condition has been detected and cleared. Fuse 3F1 should therefore feed two rectifiers, one for h.t. and the other for the heater supply—as is done in the TV161 series.

No Results

The most common fault which will be encountered is lack of h.t. at any of the h.t. points with the valve heaters operating normally. This is due to the 16Ω section of 3R57 failing. This section is between the third and fourth tags from the right (the first two sections are 3R58 which is the heater circuit dropper).

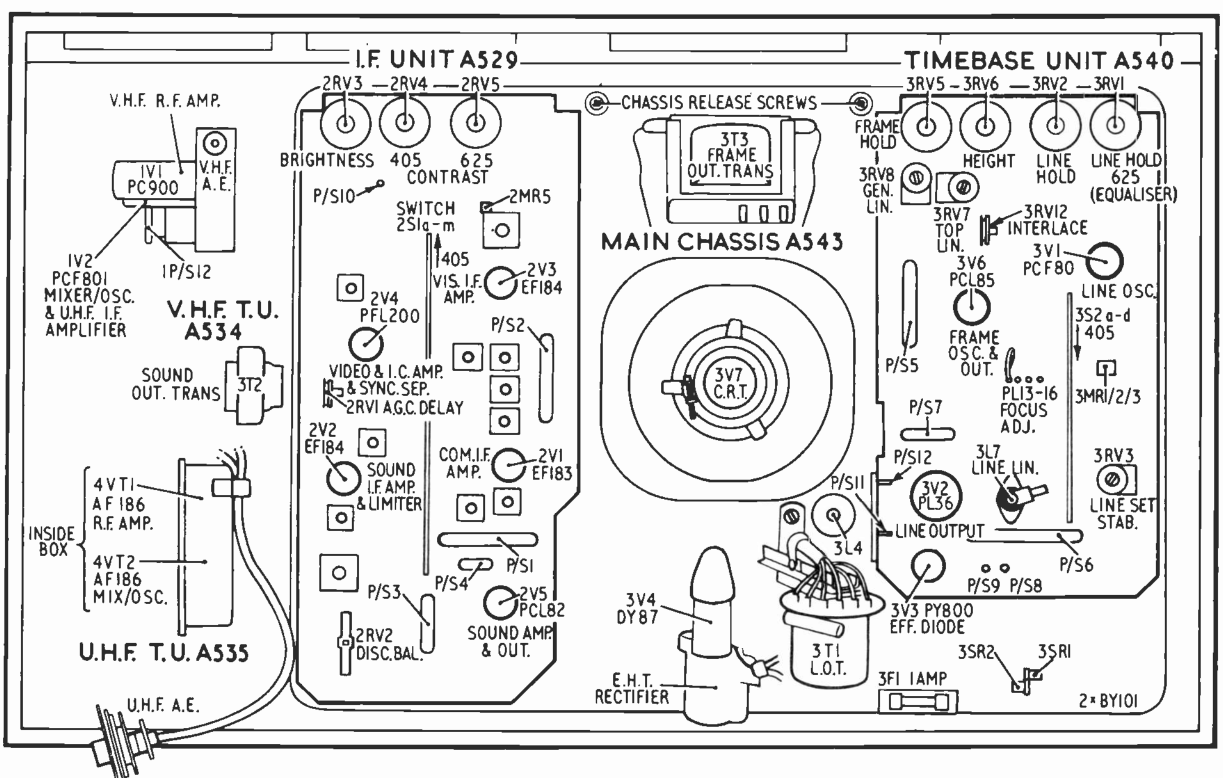


Fig. 1: Rear chassis view of the complete receiver.

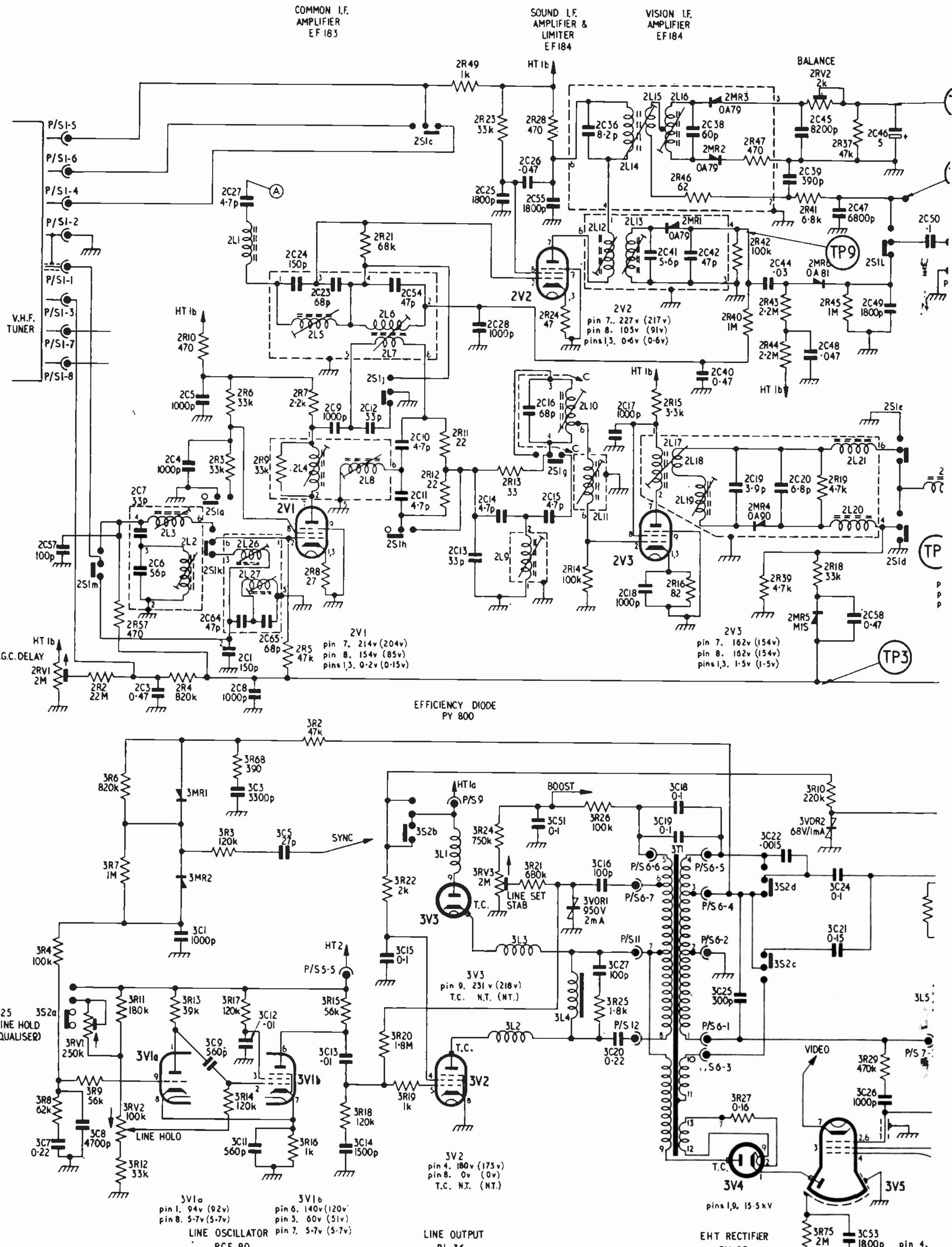
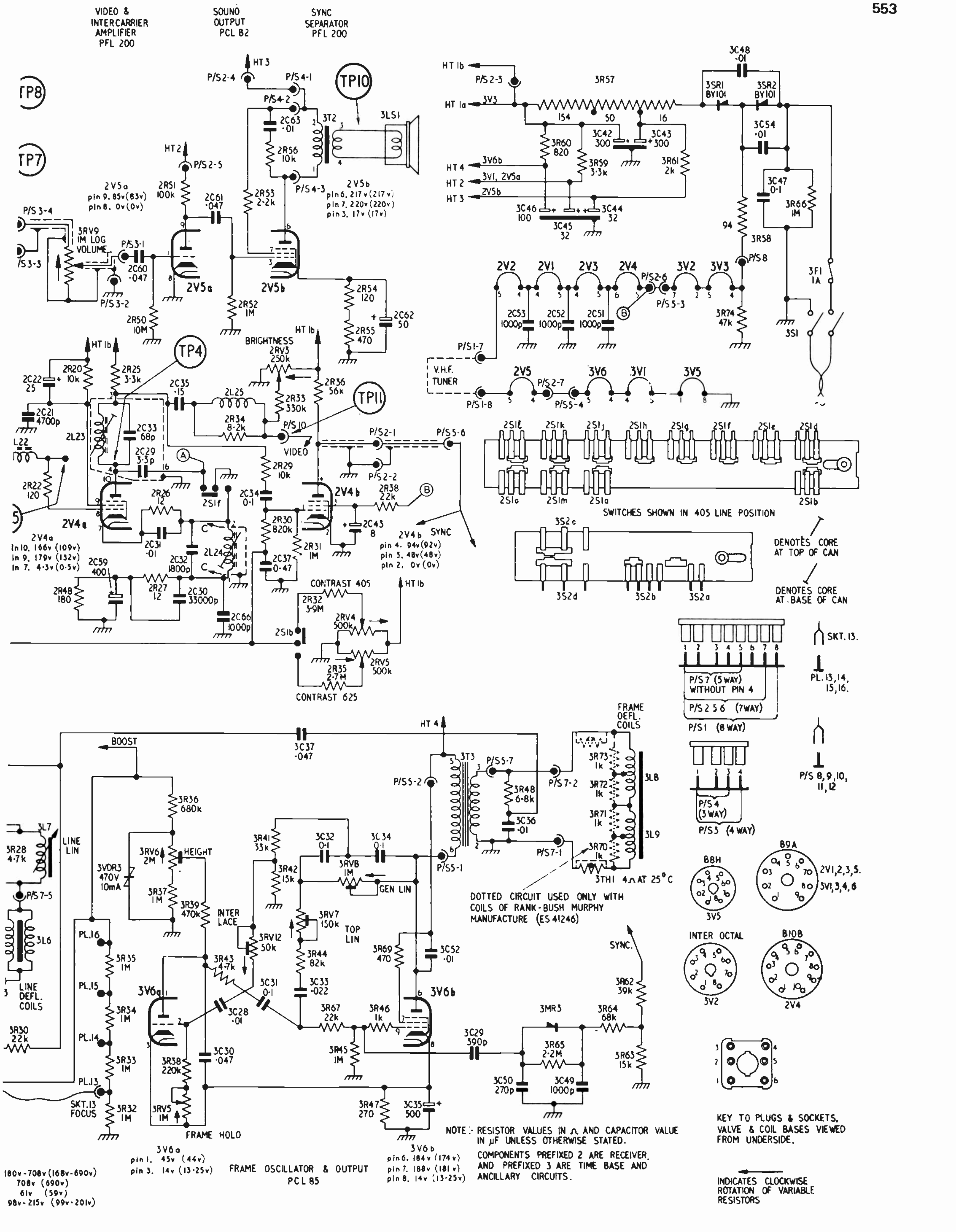


Fig. 2: Circuit diagram, Bush TV141/TV148 series. 2V1 EF183; 2V2 EF184; 2V3 EF184; 2V5 PCL82. 2V4 PFL200;


VIDEO & INTERCARRIER AMPLIFIER PFL 200
SOUND OUTPUT PCL 82
SYNC SEPARATOR PFL 200
TP8
TP7
TP10
TP4
TP11
2V5a pin 9. 85v (83v) pin 8. 0v (0v)
2V5b pin 6. 217v (217v) pin 7. 220v (220v) pin 3. 17v (17v)
3RV9 1M LOG VOLUME
BRIGHTNESS 2RV3 250k
VIDEO
2V4a In 10. 166v (109v) In 9. 179v (132v) In 7. 4·3v (0·5v)
2V4b pin 4. 94v (92v) pin 3. 48v (48v) pin 2. 0v (0v)
SYNC
CONTRAST 405
CONTRAST 625
V.H.F. TUNER
SWITCHES SHOWN IN 405 LINE POSITION
DENOTES CORE AT TOP OF CAN
DENOTES CORE AT BASE OF CAN
SKT. 13.
PL. 13, 14, 15, 16.
P/S 7 (5 WAY) WITHOUT PIN 4
P/S 2 5 6 (7 WAY)
P/S 1 (8 WAY)
P/S 8, 9, 10, 11, 12
P/S 4 (3 WAY)
P/S 3 (4 WAY)
FRAME DEFL. COILS
3TH1 4Ω AT 25°C
DOTTED CIRCUIT USED ONLY WITH COILS OF RANK-BUSH MURPHY MANUFACTURE (ES 41246)
B8H
B9A
2V1, 2, 3, 5.
3V1, 3, 4, 6
3V5
INTER OCTAL
B10B
3V2
2V4
BOOST
LINE LIN
3VDR3 470V 10mA
HEIGHT
INTER LACE
TOP LIN
GEN LIN
LINE DEFL. COILS
SKT. 13 FOCUS
FRAME HOLD
3V6a pin 1. 45v (44v) pin 3. 14v (13·25v)
FRAME OSCILLATOR & OUTPUT PCL 85
3V6b pin 6. 184v (174v) pin 7. 188v (181v) pin 8. 14v (13·25v)
180v-708v (168v-690v) 708v (690v) 61v (59v) 98v-215v (99v-201v)
NOTE:- RESISTOR VALUES IN Ω AND CAPACITOR VALUE IN μF UNLESS OTHERWISE STATED.
COMPONENTS PREFIXED 2 ARE RECEIVER, AND PREFIXED 3 ARE TIME BASE AND ANCILLARY CIRCUITS.
KEY TO PLUGS & SOCKETS, VALVE & COIL BASES VIEWED FROM UNDERSIDE.
INDICATES CLOCKWISE ROTATION OF VARIABLE RESISTORS

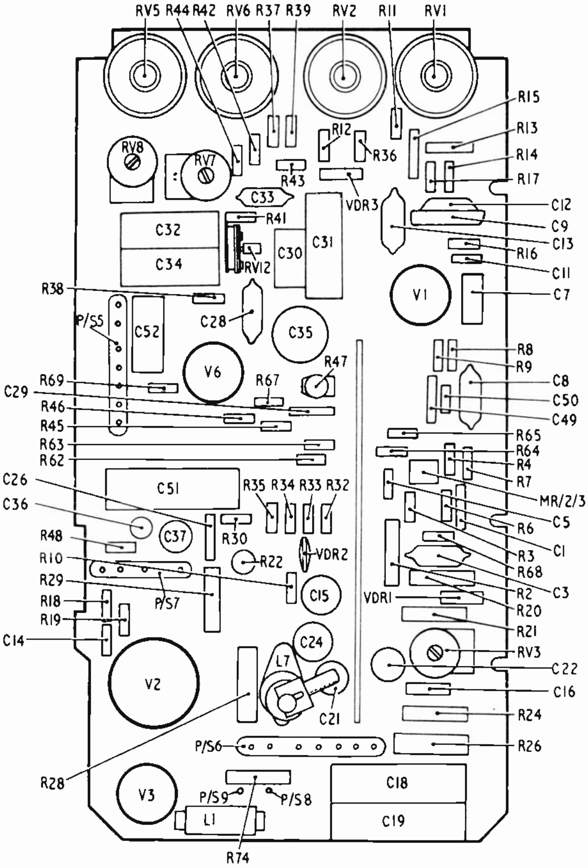


Fig. 3: Timebase board component layout.

The temptation to wire a replacement resistor across these tags should be resisted at it dissipates quite a lot of heat and would then be directly below the boost capacitors 3C18 and 3C19. The replacement resistor should be placed behind the panel where the dropper is situated and the wires passed through for connection round the tags.

Whilst the 16Ω section is the one which most commonly fails there are times when one of the others will be found open-circuit. This will leave only HT3 functioning. To maintain smoothing efficiency the correct value replacement must be fitted (within reasonable tolerance).

Rivet Your Attention!

A common fault on these and similar receivers is often of an intermittent nature and can be misleading. A typical complaint from the set owner might be "the picture goes small and wavy, there's hum on the sound and a smell of burning". The latter part of the complaint is the red herring. One tends to go immediately hot foot in pursuit of a short-circuit only to find that there isn't one and quite often that the set functions quite normally when switched on. When the fault does show however the conditions are just as described. The overheating takes place in the resistor between the two smoothing blocks, suggesting that the main $300+300\mu F$ capacitor block is not functioning. Sparking may be seen at the earthing tag on the capacitor at the lead out. A sharp edge and a heavy clout effectively joints the ali rivet to the tag and all is well again.

Why did the resistor overheat? Oh yes, well if the proper reservoir is out of action the nearest capacitor obliges and the resistor between takes a heck of a current which should be taken by the 16Ω section. That's reasonable enough, isn't it?

On the odd occasion the 94Ω resistor 3R58 goes open-circuit and this of course puts the valves out but leaves plenty of h.t. to tickle the unwary. It is mainly the h.t. side which gives the trouble however and this should be taken to include the electrolytics which normally show their lack of efficiency by producing a slightly wavy picture which rises and falls in a regular manner.

The Line Timebase

It is difficult to say whether the line or the field timebase gives the most trouble but as there is more to the line timebase we will deal with this first.

The most common fault is for one of the boost capacitors to short. This causes more trouble than usual since they (3C18-3C19) are returned to chassis through 3T1. Thus the effect of one of the capacitors shorting is that a heavy current will flow through the PY800 boost diode and this will normally blow the fuse 3F1. It is prudent therefore not only to check the h.t. line for shorts before replacing the fuse but also to check from 3V3 top cap to chassis. Quite often the fuse does not blow and the poor PY800 is left glowing red hot until some sympathetic soul turns the set off. Whilst only one of the $0.1\mu F$ capacitors may be at fault it is a good plan to replace both or to fit a single $0{\cdot}22\mu F$ (1kV) one in place of both. The PY800 may not feel very well after this ordeal and may tend to arc internally: it is prudent therefore to replace this also.

The PL36 line output valve can be responsible for a number of fault symptoms but the usual ones are lack of width (due to low emission) or no picture at all when it may be found that the heater is not glowing due to the glass being cracked. This latter condition could be the result of the valve having been overheated by lack of line drive. Suspects here should be first the PCF80 line oscillator and then the flywheel sync discriminator diodes (3MR1 and 3MR2) one of which may be shorted or open-circuit.

Slight overheating of the PL36 may be due not to lack of line drive but to shorted turns in the line output transformer, a low PY800 or a shorted DY87 e.h.t. rectifier. The DY87 can be checked merely by lifting off its top cap and the PY800 by replacement. If line drive is present at the PL36 control grid (junction 3C13 and 3R19) it is highly likely that the transformer is at fault.

The line output transformer can give rise to a misleading fault condition in these receivers. The symptoms are that the picture tends to appear quite normal at low brilliance but expands rapidly and fades as the brightness increases. This would normally direct attention to the DY87 and indeed a new valve may seem to clear the condition up to a point. The basic fault may still be present however and will not be finally overcome until the transformer is replaced.

CONTINUED NEXT MONTH

RECEIVER MONITOR CONVERSION

P. M. Delaney B Sc

THE circuit shown in Fig. 1 was evolved whilst in the process of converting a domestic television receiver to act as a monitor as well. The set converted was one using the Philips Style 70 chassis (see TELEVISION May 1971 for the complete circuit of this).

The video preamplifier (Tr1) circuit follows the design by Keith Cummins published in the August 1971 issue of TELEVISION and raises the video input signal to the level required to drive the video output pentode in the TV set. Tr1 is connected in the common-base mode and raises the 1V across 75Ω input signal to 3V or so. D1 acts as a d.c. restorer following C5 and the output passes via a small low-capacitance slide switch to the grid circuit (see Fig. 2) of the video output valve.

The rest of the circuit shown in Fig. 1 is used to take a 1V video signal from the detector circuit in the receiver and convert it to a 75Ω impedance output. It is thus basically a source-follower. It was found however that a conventional source-follower field effect transistor (f.e.t.) circuit did not respond sufficiently to the sync pulses to enable the signal from the receiver to lock the picture. Also a high impedance has to be presented to the receiver circuitry to avoid loading the detector stage and distorting the signal. The circuit adopted, using two field effect transistors Tr2 and Tr3, is known as a White source-follower. The upper field effect transistor Tr2 acts as a conventional source-follower with the lower field effect transistor Tr3 acting as its source resistor. The field effect transistors used are n-channel depletion-mode types, requiring negative gate bias. When a negative-going sync pulse arrives at the gate of the upper f.e.t. it is turned off. The resultant positive-going pulse across its drain load resistor R15 is coupled via C8 to the gate of the lower f.e.t., driving it on. The required signal thus appears at the output, the double 180° phase shift (through the two f.e.t.s) resulting in the sync pulse being in the correct relationship to the video signal at the output. The circuit also has a much lower output impedance than is normally associated with source-followers.

The complete circuit was assembled on a couple of small pieces of Veroboard which can be squeezed into convenient spaces in the set. A mains isolating

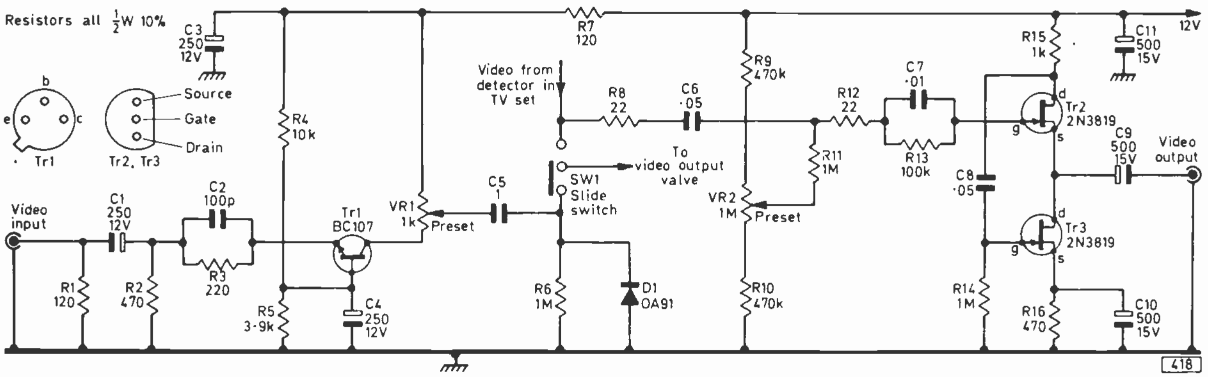


Fig. 1: The additional circuitry used in the receiver-monitor conversion.

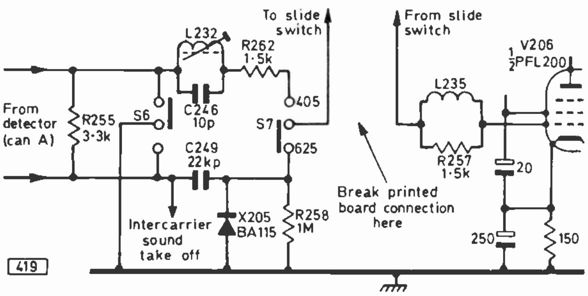


Fig. 2: Connections to the main chassis.

transformer, e.g. the Douglas No. 30 or 151 (obtainable from Barrie Electronics, 11 Moscow Road, Queensway, London W2 4AH), is also required of course: this should be connected between the mains on-off switch and the rest of the circuit. The physical positioning of this transformer needs care in order that its magnetic field does not affect the line and field circuits. The TV set case will need extending in order to hold the transformer—few sets have sufficient space for this bulky item.

The connection of the extra circuitry into the set is fairly easy. A convenient point in the set must be found and the printed circuit foil carefully cut

—continued on page 567

LONG-DISTANCE TELEVISION

ROGER BUNNEY

As I write towards the end of July conditions are still fairly active. Sporadic E though not so good as at the end of May has produced some very good openings while with a high-pressure system stationary over the United Kingdom and Europe for much of the month Tropospherics have given some variety to the loggings of Sporadic E! I have also received some detailed news of "exotic DX"—more of this later. Firstly the log:

1/7/72 BRT (Belgium) E2; NOS (Holland) E4—both trops.
2/7/72 USSR R1; TVE (Spain) E2, 3, 4; BRT E2 (trops); plus unidentified signals.
4/7/72 TVE E2, 3, 4.
5/7/72 RAI (Italy) IA, IB; TVE E2; BRT (trops) E2.
7/7/72 BRT E2.
8/7/72 USSR R1; NRK E2; BRT E2, 10; NOS E4—latter three stations trops.
10/7/72 RAI IA, IB.
11/7/72 Unidentified R1 SpE.
12/7/72 TVP (Poland) R1; WG (West Germany) E2.
13/7/72 WG E2; RAI IA; MT (Hungary) R1, 2.
14/7/72 NRK (Norway) E2, 3.
15/7/72 BRT E2; NOS E4—trops.
16/7/72 TVE E2.
18/7/72 USSR R1, 2; TVP R1; MT R1; DFF (East Germany) E3; NRK E2; RUV (Iceland) E4; TVE E2, 3; ORTF (France) F2; NOS E4 (trops).
19/7/72 MT R1, 2, 4; JRT (Yugoslavia) E3, 4; TVE E2, E3 twice, 4; also many unidentified signals.
20/7/72 BRT E2—trops.
21/7/72 NRK E2.
22/7/72 JRT E4; RAI IA; WG E2; ORF (Austria) E2a; TVR (Rumania) R2; CST (Czechoslovakia) R1; ORTF F2; plus many unidentified signals.
23/7/72 TVE E2, 3, 4; JRT E4.
25/7/72 RUV E4; NRK E2; NOS E4 (trops); plus unidentified signals.
26/7/72 NOS E4—trops.
27/7/72 USSR R1; TVE E2, 4; SR (Sweden) E2.
28/7/72 JRT E4.
29/7/72 RAI IB; TVE E2, 4; RTP (Portugal) E2, 3; also unidentified signals.
30/7/72 TVE E2; NRK E2.

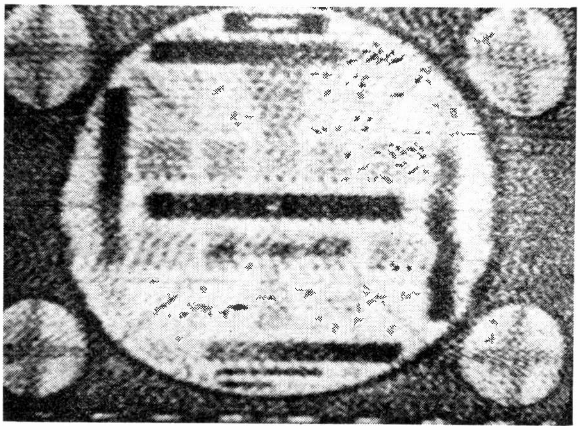
On July 6th and again from the 10th to the 22nd an improvement in Tropospheric propagation was noted. Here in Southampton various ORTF (French) v.h.f. and u.h.f. transmitters were noted up to ch.E59. From more favourable locations I understand that various Low Country transmitters were received and at times West Germany at u.h.f. East German transmitters were received in Holland and the DFF ch.E5 transmitter was noted carrying a new identification slide. On a personal note I am again on the move, to another location some miles from Southampton in the Test Valley(!). Consequently from July 22nd I have been using the wideband Band I dipole described in last month's column. From the results since obtained it seems to work quite well.

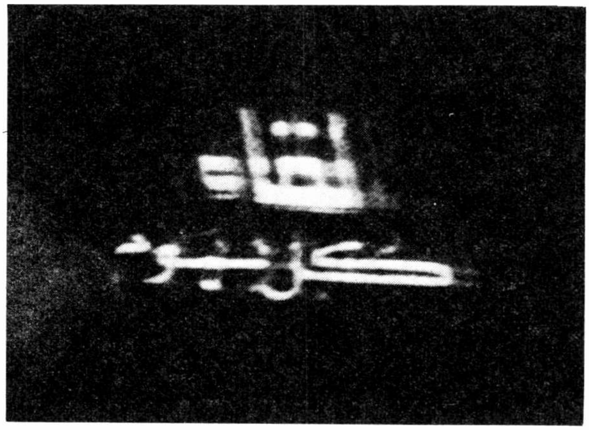
In addition to the new slide in use by the DFF we have heard from Hugh Cocks at Mayfield that the DFF has been noted using the SWF/YLE type electronic card with identification "DFF Berlin—1". I have seen no evidence of this card in Band I so far but am keeping my eyes skinned! Hugh also mentions that in a recent opening the USSR changed from the conventional "0249" test card to a pattern of vertical stripes. Most of us will have seen the new Swiss card by now but apparently the French network in Switzerland is still using the old type card with only the identification letter "G" in the upper right-hand square.

I reported recently (August issue) reception of a new Icelandic transmitter on ch.E2. It seems that there is indeed a high-powered transmitter in operation on this channel as several enthusiasts in Holland have reported reception of it. As yet there is no EBU listing however!

Exotic Receptions

We now have detailed information on some exciting DX TV receptions during July. Seppo J. Pirhonen of Lahti, Finland has sent photographs of Amman, Jordan ch.E3 received at Lahti on July 4th between 1650-1735 CET (BST). These photographs clearly show the strength of reception and Seppo comments that the signals were mostly strong but with ghosting at times. Amongst the photographs are the test card (compare with photograph in the DX-TV column, TELEVISION November 1970), the Mosque, extract from the Koran and a caption in Arabic. Shortly after the above letter came another, from Rym Muntjewerff of Beemster, Holland. He too has received Amman ch.E3!! This reception occurred on

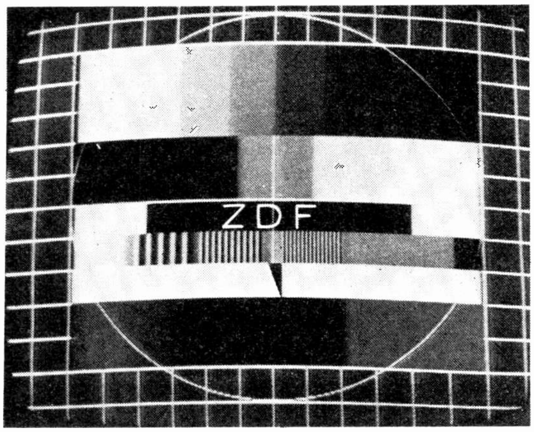




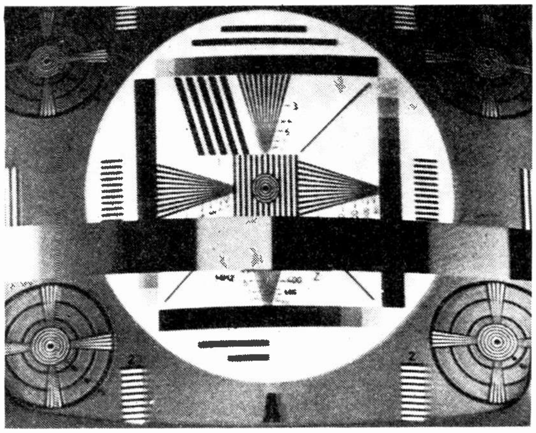
Amman Jordan ch.E3 test card (left) and arabic caption (right) received in Lahti, Finland (see text).

DATA PANEL 15—2nd series

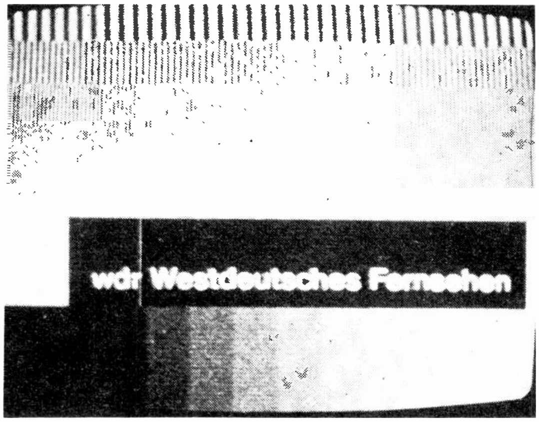
WEST GERMANY—1



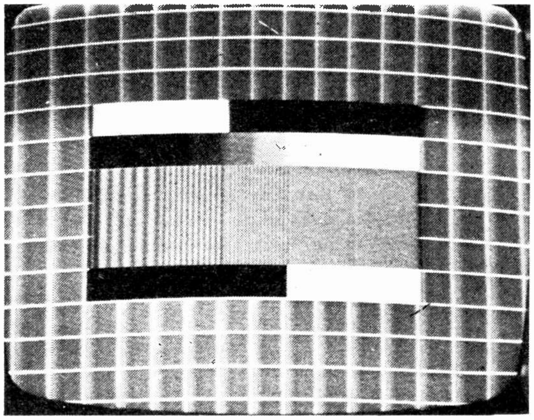
ZDF (Zweites Deutsches Fernsehen) test card.



TO5 (Telefunken) test card with colour bar used by WDR-1. Note transmitter initial letter at bottom centre of frame.



Electronic pattern used by WDR-3.



EBU bar pattern used by WDR (Westdeutscher Rundfunk).

Photographs this month courtesy Europese Testbeeldjagers.

July 9th from 1640-1658 CET when again the test card was noted. In view of the limited extent of the test transmissions from Jordan these two receptions were fortunate indeed. Rym goes on to say that on July 8th he received a clock which gave the time 0957 whilst it was 0657 here. This must locate the transmitter some distance into the USSR (the reception was on ch.R1). From research here I would suggest that the signal originated from between +55° - +65° East (+4 hours GMT). This basically "runs down the Ural Mountains" and could mean reception from Kazan, Ufa, Aktyubinsk or Tyumen. The photograph sent shows three ghost images as well as the main one. Congratulations to our two friends on these achievements.

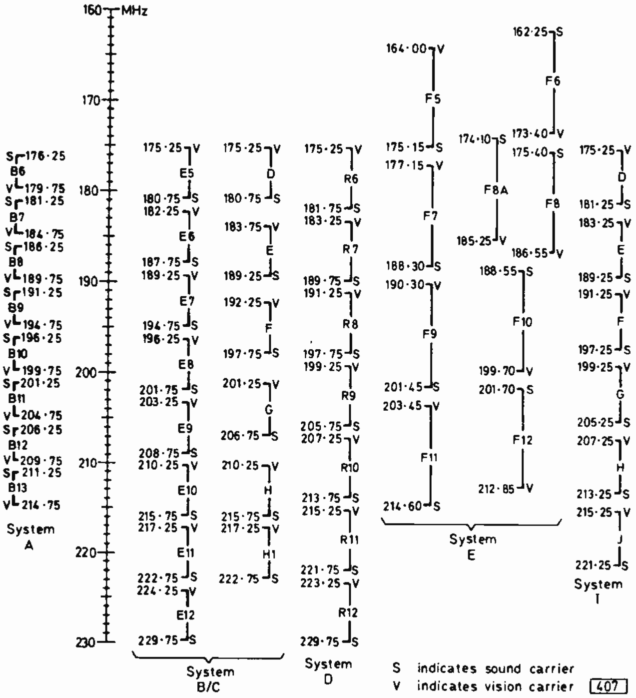
Albania

We have further information from our Italian contact Michele Dolci about Albanian TV. It seems there is now only one high-powered transmitter, on ch.C, using transmission system B (Western European). The programmes are picked up over a large part of South-East Italy. Garry Smith of Derby tells us that the new TV centre opened on November 1st 1971 with four hours of programmes daily. The main transmitter is atop Dajti Mountain and is linked to a network of translator stations now being constructed to give complete coverage of the country. Television receivers are constructed in Albania —there is a large assembly plant at Durres. They are of up-to-date appearance and have "three holes for the push buttons"! Michele Dolci also mentions that Italy may be going into colour with *SECAM* in 1973 for "economical reasons of market competition with France."

EBU Transmitter List

The EBU has just published the *List of Television Stations No. 17*. The subscription of 300 Belgian Francs includes a map and six bi-monthly supplements. This is highly recommended as an accurate guide to European stations. The address is: EBU, Technical Centre, 32 Avenue Albert Lancaster, Bruxelles 18. A close check between the latest list and last year's one plus the supple-

EUROPEAN AREA BAND III CHANNEL ALLOCATION CHART



System A: UK, Eire 405-line system. Positive vision modulation, a.m. sound.

System B: Most of Western Europe (excluding France). Negative vision modulation, f.m. sound, 625 lines.

Italy as System B but with alternative frequency allocations (channels ID-IH1).

System C: Belgium. Positive vision modulation, f.m. sound, 625 lines.

System D: Eastern Europe (excluding East Germany). Negative vision modulation, f.m. sound, 625 lines.

System E: France, Monaco. 819 lines, positive vision modulation, a.m. sound.

System I: Eire. 625 lines, negative vision modulation, f.m. sound.

ments has brought to light some changes not previously noted here.

Bulgaria: Previously two ch.R1 and one ch.R2 transmitter was listed but it appears that these have moved to Band III. Certainly there are no Band I transmitters now listed in this country. This is something of a blow since Bulgaria has been received in the UK only a few times and if this information is accurate reception of Bulgaria here in future is going to be difficult if not impossible.

Spain: The e.r.p. of the transmitter at Vejer (ch.E2) situated near Gibraltar has been increased to 14kW.

Hungary: Pecs ch.R2 has been increased to 60kW. This would account for the increased number of loggings of this transmitter. Tokaj ch.R4 has also been increased, to 8kW.

Israel: The first u.h.f. transmitter in this area is operating from Mount Shalom, Tel Aviv, on ch.E27 with 7kW.

Poland: Warsaw ch.R2 is now listed as 100kW e.r.p.

Egypt: After some years Port Said is again listed on ch.E3 with 10kW. Our Cyprus contact has not as yet reported reception from it.

Luxembourg

Tele-Luxembourg are expected to be operating their new ch.E21 1000kW transmitter during September. We hope those in good locations will keep a close watch on this channel and let us know of any activity.

Data Panel

This month we commence a series of West German test cards. There are problems with this country however as the cards tend to be changed rather frequently. Consequently some of the cards shown may have been discontinued, modified or used on other networks.

There are three programme networks in West Germany. The programmes on the 1st and 3rd networks are produced by the members of the ARD (a body similar to the IBA): the 1st network is a national one with some regional variations while the 3rd network is a regional one in which each ARD member provides his own service. The 2nd network is a national service produced by the ZDF (Zweites Deutsches Fernsehen): there are no regional variations and the service can be compared to BBC-2.

Programme times: The 1st network provides a schools programme 0700-0800, then morning programme 0900-1200, afternoon programme 1515-1655, regional programme 1700-1900, national programme 1900 till closedown. There are apparently *no* identifications during the evening national programme. The 2nd network operates from approximately 1630 till closedown and the 3rd network from approximately 1700 till closedown. Test transmissions occur as follows: 1st network, after schools and in main programme gaps; 2nd network, approximately 0600 till programme start; 3rd network, approximately 0630 till programme start. All times GMT. We will continue with more information on West German television next month. Our thanks to the Europese Testbeeldjagers for sending us the information!

Tropospheric Propagation

The Autumn months often produce excellent tropospheric reception in the UK as a result of settled high-pressure systems—by the time you read this conditions may already have produced enhanced "trops". For this reason a chart of the various Band III channel allocations at present in use is included this month. A cross reference against the UK 405-line channels gives accurate markers for finding the various channels. Although the extension of u.h.f. services has greatly increased tropospheric activity Band III can still provide excellent DX: remember that most of the East European countries use Band III extensively. Poland and Czechoslovakia have been received in Band III via this mode—who knows whether USSR in Band III may be possible this season! The mechanism of Tropospheric propagation was discussed in *Long-Distance Television*, January 1972.

From Our Correspondents

A very full bag this time. Garry Smith of Derby has returned from Switzerland with useful information (see above). His return coincided with improved trops which enabled him to receive Dublin ch.B7 (a new country for him), Sweden E8 and Denmark E5, 8, and 10. Geoffrey Chapman of Blandford, Dorset has sent a photograph of the "CS U 01" Czechoslovakian pattern but with an alternative identification. This carried (on ch.R2) the inscription "02 K8". This is the third identification noted with this pattern.

From the USA we hear that veteran TV DX enthusiast Bob Cooper of Oklahoma is constructing a new aerial system, having recently moved. Preparations are well advanced for three towers which will be 160, 140 and 100ft. high. These will be arranged in triangular formation some 20ft. apart, with solid platforms at 50 and 100ft. An equipment building will be constructed at 50ft. We hope when this structure is complete and a photograph is available to publish it since this must be the World's most elaborate TV DX aerial structure!

THE 'TELEVISION' COLOUR RECEIVER PART 7
CABINET CONSTRUCTION

ONE frequent request has been that details of the cabinet construction be brought forward. There seem to be two basic reasons: first that because of delays in the delivery of Component-Packs some readers have not been able to keep up with the electronics; secondly that a large number of garages, garden sheds and workshops appear to be unheated and their owners do not fancy cabinet construction around Christmas time! These are sound enough reasons so this month we are dealing with the cabinet.

The arrangement to be described is that used in the prototype and we emphasise at the outset that construction is quite straightforward. The author is not a cabinet-maker and indeed finds even a simple shelf rather an ordeal! The principle adopted in the design therefore was "if I can do it then anybody can"! Those of our readers who are more proficient at woodworking may prefer to modify the design or use different joints etc. That's up to them but the basic dimensions are laid down by the electrical components to be incorporated; also no course should be adopted that leads to a weaker cabinet (colour tubes are heavy—and expensive!).

Tube and Shield

Before you start you must decide on the tube size. The prototype is fitted with a 22in. Mazda tube and we feel that this size is likely to be the most popular. Any of the current 90° shadowmask tubes can however be employed—that is basically 19, 22, 25 and 26in.

We have been assured that there will be little or no difficulty in meeting the demands of readers of the magazine for tubes but we feel we should urge constructors to obtain their tube before starting cabinet construction just in case they are forced to use for example a 25in. tube rather than a 26in. one.

You must also decide whether your budget allows a new tube and whether in fact the additional outlay is worth while. There is no reason why a rebuilt tube should not be as good as a new one and also no reason why a rebuild tube should not be guaranteed for the same period of time—usually four years. We would emphasise that a *rebuilt tube* is not the same as a *regunned tube*—the latter involves a lesser amount of work and will generally be at a lower cost. We have no experience of regunned colour tubes.

Whatever your decision you will find a number of suppliers advertising in the magazine. It's a large purchase and therefore worth taking your time over. If a particular advertised tube seems attractive but you feel that insufficient information is given don't be afraid to ask the advertiser for further information. Be careful that the price quoted for a rebuild does not take into account a deduction for old glass being supplied. The difference in price may often be £7.50. There may also be quite large differences in the carriage charges involved in the supply of tubes and this should be taken into account.

If you have a very limited budget you might consider the possibility of using a faulty tube—often the fault is no more than a few missing phosphor dots or face scratches and these may have only a very small visual effect. But before you buy make sure you understand from the supplier what the fault is. There is no reason why the tube should not be guaranteed apart from the named fault condition.

Once you have decided on the tube size the problem of obtaining a screening shield arises. Because of the number of tube sizes the suppliers listed cannot guarantee immediate delivery on receipt of an order. An ordering system which enables you to book a shield in advance has therefore been arranged. The shield will be supplied complete with earthing springs and lugs on to which the degaussing coil can be fitted. The suppliers are Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk, and they suggest a deposit of £1·00 for each shield ordered. Make clear which size tube you are using and enclose *two* stamped and addressed envelopes. The first will be used to acknowledge your order and the second will be used later to advise you that the shield is ready for delivery on receipt of the balance of your payment. Although this process may seem tedious it will give maximum efficiency and help to keep the supplier's costs—and therefore the price to you—down.

The maximum price of the shield (including springs) and postage will be £2·60.

Basic Cabinet Requirements

The cabinet design is based on using a timber frame rather than proprietary boards. This decision will be obvious to those who have tried using this type of board for cabinet work: unless the lengths and angles are cut extremely accurately the whole assembly can be very weak. A timber frame makes the cabinet a little heavier but the important thing is that the tube is held solidly in place.

Other points to consider are that the receiver should stand at a comfortable height for viewing and that the size must be adequate to accommodate all the electrical sections. The limitations on the

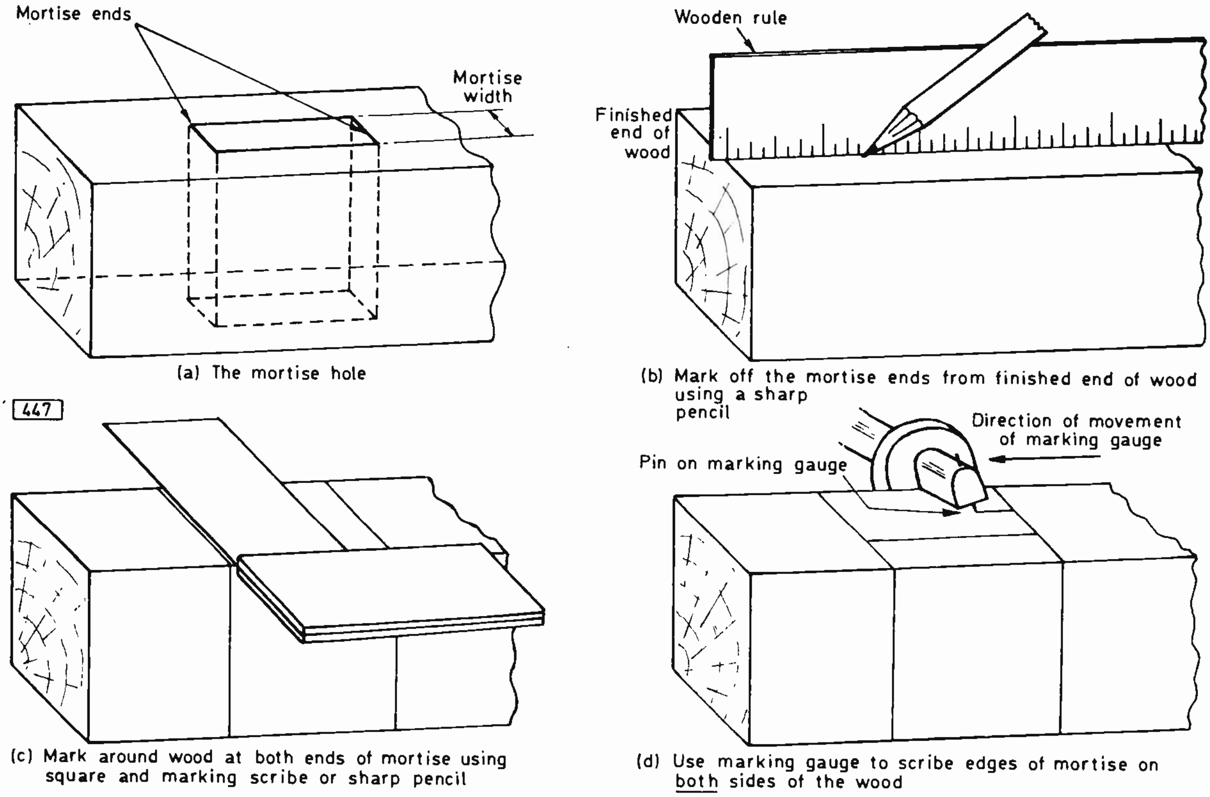


Fig. 1: Marking off the mortise.

arrangement of the front of the receiver are the tube and its mounting brackets, the loudspeaker and the user controls.

There is also a slightly unusual feature in our design, a convergence drawer which pulls out at the front. This forms a bar across the whole width of the receiver beneath the tube—see photograph.

One of the nicest features of the newer 19, 22 and 26in. shadowmask tubes is the more pleasing aspect ratio created by the squared-off corners; also the push-through presentation so that a plastic mask is not required. Such masks are an additional expense, a great nuisance to fit and all too easily broken. They are also difficult to obtain.

The depth of the cabinet could be either sufficient to house the overall length of the tube or shorter with the end of the tube in a convex bulb on the rear cover. Bulbs of this sort present problems for the home constructor. However it is provided it must in order to offer the tube neck reasonable protection be strong enough to withstand a fairly hefty clout. This is only really possible using a single mould but the cost of providing a relatively small number by injection moulding for example is quite daunting. We decided therefore to make the cabinet depth greater than the length of the tube. This results in a cabinet depth of only 20in. for a 22in. tube so we doubt whether there will be too many objections.

Types of Joint Used

In order not to confuse the cabinet construction details we will first run over the three types of joint used in the prototype cabinet: experienced cabinet makers can skip the next few paragraphs. The three joints used are the mortise and tenon, a form of lap joint and a dowelled joint.

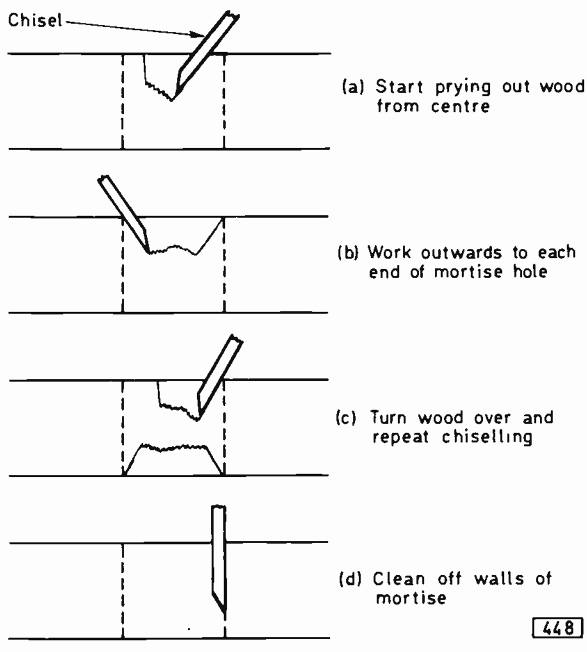


Fig. 2: Chiselling out the mortise.

The mortise and tenon is used to make a strong joint when one piece of wood meets another at right angles somewhere along its length. There is a number of slightly different versions of this joint, the one suggested being reasonably simple with no shoulders on the tenon. The mortise—see Fig. 1(a)—is a rectangular hole cut through the wood, the longer side of the hole being parallel with the length of the wood. The mortise width is about one-third the width of the wood.

To make the mortise first measure off the positions of the ends of the mortise from a finished end of the wood—see Fig. 1(b)—using a carpenter's **wood** rule (note: this is not the place to use a plastic ruler) and a sharp, hard pencil. Rule all round the wood from there using a square—Fig. 1 (c)—so that there are two complete lines around the wood. The reason for completing the lines right back to the starting point is that this gives a good idea of the accuracy of the marking and a check on the squareness of the wood.

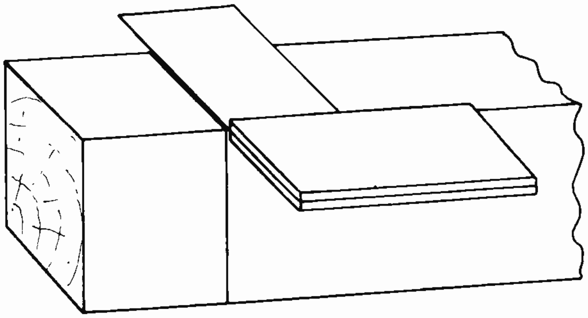
Now set a marking gauge—Fig. 1(d)—to a dimension equal to one-third of the width of the wood and mark off the edges of the mortise on both sides of the wood. Use the same setting of the gauge from opposite edges of the wood in order to mark the mortise and don't upset the setting just at the moment because the same setting will be used for the tenon. Always make sure that the shoulder of the marking gauge is pressed hard against the wood edge when marking off, and drag the pin across the surface of the wood rather than pushing it in the same direction of motion—otherwise the wood grain will beat you and you will end up with a wavy line.

The mortise must now be beaten out and it is conventional to do this using a chisel and mallet or hammer. Use a chisel of about the same width as the hole but no wider. Mark off the edge of the hole on both sides of the wood with the chisel, using hand pressure. Always have the back edge of the chisel (i.e. the completely flat side) facing the wood that is to remain. Now start to remove wood from the centre of the mortise, not being too greedy or fast and not using too shallow an angle of cut (Fig. 2). Hammer in the chisel and pry out a piece of wood and repeat in that way. Work out towards the ends of the mortise taking care not to damage the ends with the back of the chisel. Turn over the wood and pry out wood from that side as well in the same way. Finally clean up the walls of the mortise with the chisel vertical.

Now the tenon part of the joint: mark off from the end of the wood the width of the piece that the tenon is going into (Fig. 3). Use a square and scribe to mark round the wood the length of the tenon. Then, using the marking gauge already set for the mortise, mark off the thickness of the tenon. Mark from one side around to the other. Saw down the "cheeks" of the tenon and then the shoulders. Remember that when you saw there is wastage caused by the cut itself: this waste *must* be on the wood being removed otherwise the tenon will not be wide enough and the joint will be slack.

A full mortise and tenon joint would add extra shoulders on the tenon but the additional complication of the slightly improved joint is not necessary on this project.

The dowelled joint is necessary at the top cross-members where three pieces of wood meet orthogonally. It is the kind of joint favoured at the top of chair legs. The basic idea is shown in Fig. 4(a). The dowel-pins securely hold the pieces of wood together, the pins being inserted in holes of the same diameter in the two wood pieces to be connected.



(a) Mark off length of tenon and square around wood

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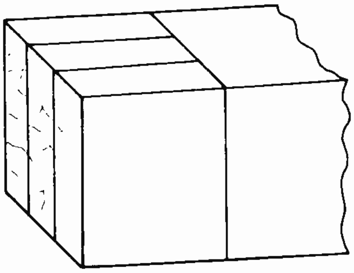
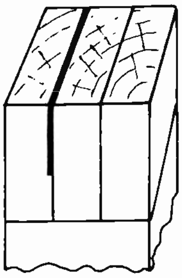


(b) Mark off width of tenon using marking gauge and saw down width of tenon (cheeks) and shoulders



(c) Remember to saw so that the wastage caused by the saw is on the piece being removed

Fig. 3: Making the tenon.

Table 1: Stock Required for Cabinet Frame

1½ x 1½in. timber:	4 lengths of 29in.*
	2 lengths of 25½in.*
	2 lengths of 17in.*
	2 lengths of 28⅜in.*
	2 lengths of 19⅝in.*
1½ x 1in. timber:	2 lengths of 18 11/16in.*
	1 length of 19⅝in.*
3 x 1in. timber:	
	1 length of 28 5/16in.*
Dowelling:	16in. of ¼in. diameter

Evostik Resin W

4 carriage bolts of at least 2in. length which *must* be threaded the full length. Threaded part of bolt to be ⅜in. diameter.

8 oversize flat metal washers for above

4 correct flat metal washers for above

8 full nuts for above.

4 machine bolts with ⅜in. diameter shaft, hexagonal heads and at least 1½in. length.

4 flat metal washers for above

4 full nuts for above.

9¾in. of 10 or 12 s.w.g. flat metal strip 1in. wide.

Note: Timber merchants generally supply and charge for lengths of timber to the nearest foot.

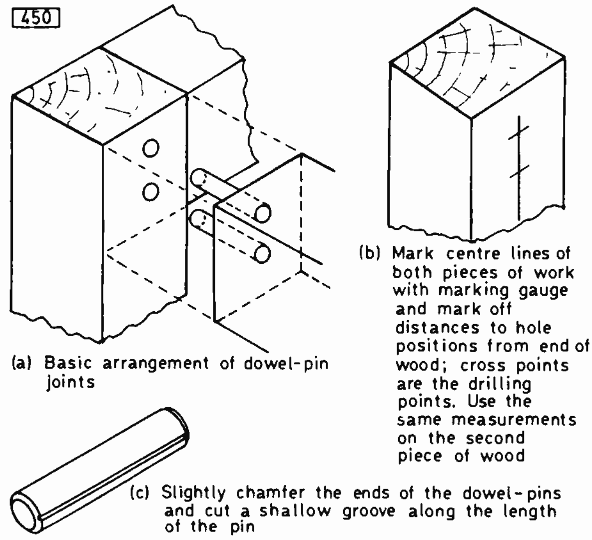


Fig. 4: Dowel-pin jointing.

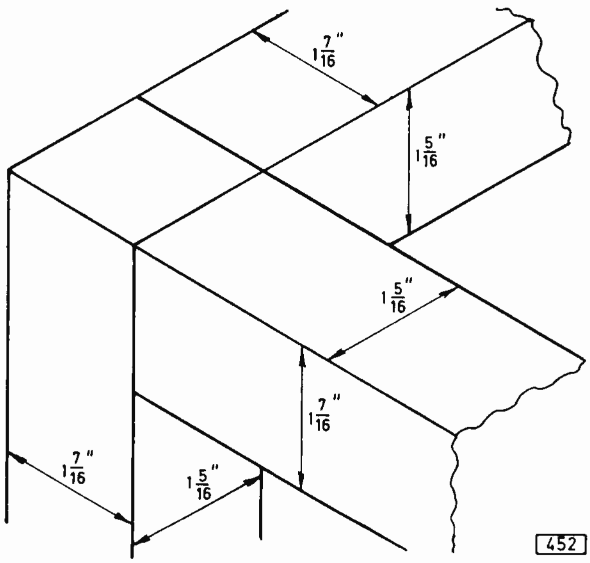


Fig. 6: Top left-hand corner of the cabinet, showing choice of lay of the timber dimensions for correct matching.

The important things to remember when making a dowel-pin joint are that the dowel-pin should be a little shorter than the total depth of the holes in the two pieces of wood, that the holes must be accurately located on both pieces and that the holes are drilled vertically into the wood.

First mark the centre lines—see Fig. 4(b)—on both pieces of wood and measure off the positions of the hole centres—usually $\frac{1}{3}$ and $\frac{2}{3}$ of the height of the wood mating into the vertical. Drill your dowel-pin holes at the cross-points on your marking lines, being very careful to make them vertical—dowelling jigs are made to ensure this but would seem an unnecessary expense unless you are going into this very seriously in the future.

Drill the holes to the correct depth for the work: in the case of the prototype 1in. long dowel-pins were used with $\frac{9}{16}$in. holes drilled in both pieces of wood. This gives $\frac{1}{8}$in. tolerance of clearance at the ends of the holes for glue clearance later. To judge the depth of the hole being drilled you can use either a depth gauge clamped to the bit or a piece of Sellotape fastened around the bit at the right point.

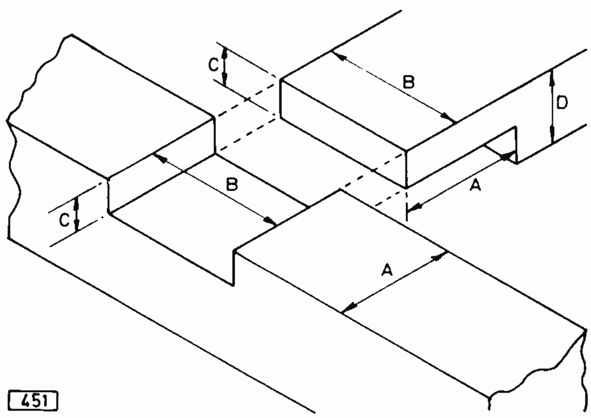


Fig. 5: Middle lap joint used in the receiver—note which dimensions are equal.

The dowel-pins—$\frac{1}{4}$in. dowelling was used in the prototype—are cut off to the length wanted—say 1in. as noted above—and to allow the free escape of excess glue when the joint is finally completed it is wise to chamfer the ends of the pin very slightly and mark off with a knife a shallow groove along the length—see Fig. 4(c).

The half-lap joints used in the receiver appear only where there is little or no stress on the jointed section. The construction is shown in Fig. 5 and the procedure should by now be obvious. The material taken from the larger piece of wood is removed by chisel and it is both important and quite difficult to do this accurately. If you undercut too far the lap will not lie evenly, if you don't cut far enough the lap will not be smooth along the top surface. It is difficult because you will be chiselling against the grain of the wood which will tend to tear rather than cut. Using a decent tool you should find that you need only the ball of your hand against the chisel in order to do the job efficiently.

Constructing the Cabinet

All dimensions given in the text and in the diagrams marked with an asterisk (*) are for a 22in. tube receiver. For other sizes see Table 2.

Ready-planed hardwood was used throughout the prototype. No special care was taken in the choice of wood except to make sure that it was not badly warped and that there were no splits in it. Lengths were obtained in all cases slightly longer than needed so that they could be cut so that knots did not appear right at the end of a length or at a joint position. We make no excuse for using Imperial measurements throughout since the vast majority of people aren't equipped with carpenter's rules in metric or metric drill sizes.

Note that although the wood dimensions are given to the nearest half inch a piece of wood nominally $1\frac{1}{2}$in. x $1\frac{1}{2}$in. for example will in fact measure some-

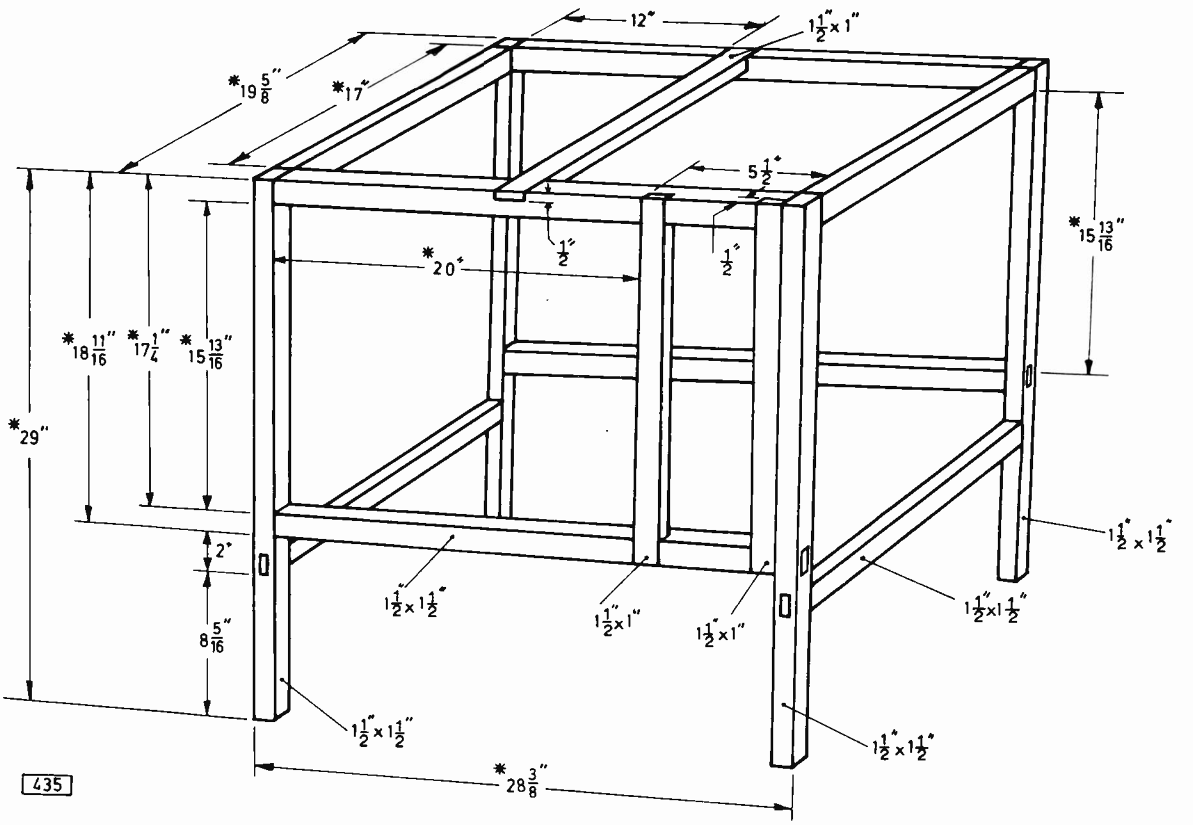


Fig. 7: The main frame of the cabinet. The dimensions given are those for use with a 22in. tube: for modification data for other tube sizes (dimensions marked) see Table 2. Note that the timber dimensions are nominal: larger widths are forward facing (as shown in Fig. 6) and the actual dimensions (widths) are assumed to be $1\frac{7}{16}$ x $1\frac{5}{16}$ for $1\frac{1}{2}$ x $1\frac{1}{2}$in. stock.*

thing like $1\frac{7}{16}$in. x $1\frac{5}{16}$in. because of the surface removal by planing. A rule must be chosen *and kept to* so that pieces match up correctly: for the prototype the wider dimension—for example $1\frac{7}{16}$—faces forward and on a front-to-back run of timber this means that the same dimension must be horizontal (see Fig. 6).

The basic frame arrangement of timber in the receiver is shown in Fig. 7. All eight joints at the four top corners are dowel-pin. The lower mating joints are mortise and tenon, the two vertical struts on the front are half-lapped and so is the front-to-back strut across the top of the receiver. These struts perform important functions: the two vertical ones support the forward facing loudspeaker and the control-knob panel—to be described later—and the horizontal strut across the top of the cabinet gives the cladding to be added at the top a very rigid surface so that it neither warps up nor is it easily bent down—even when sitting on the top!

First cut four accurate 29in.* lengths of $1\frac{1}{2}$ x $1\frac{1}{2}$in. timber for the four verticals. Note the wider dimensions of the wood and mark two of these as "fronts" —one "left front", one "right front"—and the other two as "rears"—again one "left", the other "right". Pencil the markings on the forward-facing sides of each of the pieces and make the markings clear.

On the front left vertical mark off dowelling holes at the top—as already described—on the back and to the right. Move down from the top of the vertical by $17\frac{1}{4}$in.* which will be the top of the mortise of the horizontal, lower bar at the front. Measure off a $1\frac{7}{16}$in. mortise hole left to right through the wood and from the bottom of this mortise move down a further 2in. to locate the *bottom* of the second mortise—in this case for the front-to-back horizontal bar.

Repeat the process for the "rear left" and the other verticals, noting of course the different sides at which the dowel-pin joints are made in each case.

On the four verticals marked out you can now drill 16 dowel holes (4 on each vertical) and hammer out the eight mortises with a chisel. After this check the dimensions of the cut pieces that you have. If any error does exist don't be afraid to put the piece of timber on one side and start that vertical again—it might well be cheaper in the end.

Accurately cut two pieces of $1\frac{1}{2}$ x $1\frac{1}{2}$in. stock each of $28\frac{3}{8}$in.*, identify the standard horizontal and vertical dimensions of each (Fig. 6) and clearly mark the pieces on the forward faces as "front lower horizontal" and "rear lower horizontal". On the rear piece mark off a tenon $1\frac{7}{16}$in. from the end at each end (note that the tenons are all vertical) and saw the two tenons.

On the front piece do exactly the same thing and then in addition mark off a half-lap 20in.* from the *end of the left-hand tenon* and on the forward edge of the wood. Make the half-lap $\frac{1}{2}$in. deep and $1\frac{7}{16}$in. wide (so as to suit the nominally 1 x $1\frac{1}{2}$in. vertical

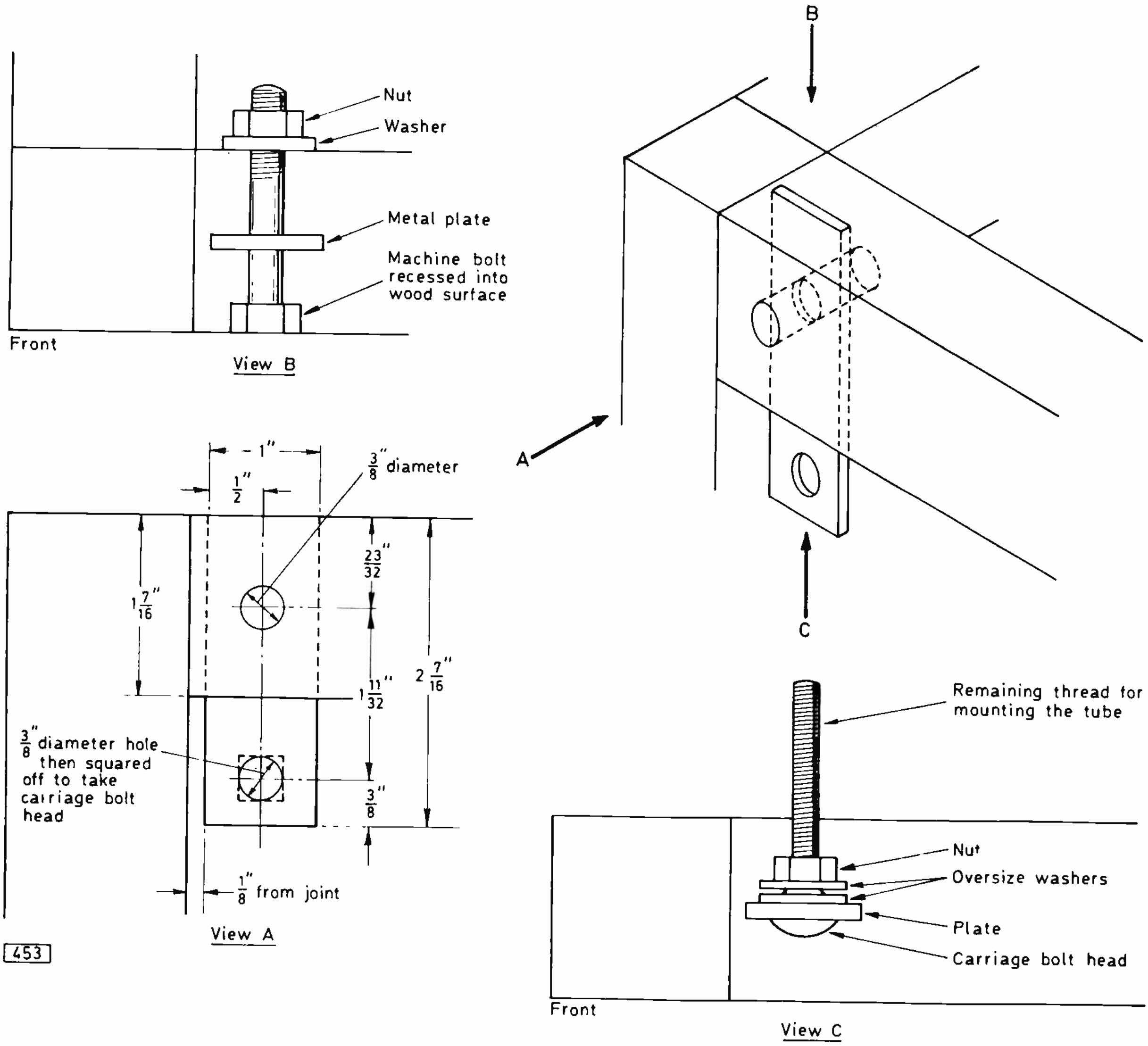


Fig. 8: Tube mounting arrangement: top left-hand corner shown.

struts). Put another half-lap also on the front edge right up to the start of the right-hand tenon—using the same dimensions as before.

Now cut two $1\frac{1}{2}$ x $1\frac{1}{2}$in. lengths of timber of exactly $19\frac{5}{8}$in.* for the lower side pieces of the frame. Mark these on the *top* surface as "left side lower" and "right side lower": the $1\frac{7}{16}$in. dimension will of course be the horizontal side of the timber. Mark off and saw tenons on each end of both pieces of $1\frac{5}{16}$in. for all.

Move up to the top pieces now. Cut the side pieces first, two lengths of $1\frac{1}{2}$ x $1\frac{1}{2}$in. again each cut to exactly 17in.*. Mark off and drill dowel holes on the ends of each; again making sure that the horizontal side of the wood is the $1\frac{7}{16}$in. dimension. Don't forget to clearly mark the pieces as "left side upper" and "right side upper" and as for the other side pieces put your markings on the upper surfaces.

For the upper horizontals cut off two accurate lengths of $25\frac{1}{2}$in.* $1\frac{1}{2}$ x $1\frac{1}{2}$in. stock. Here the forward-facing surfaces will be the $1\frac{7}{16}$in. dimensions. Mark the pieces—on the front surfaces—as "rear upper horizontal" and "front upper horizontal". The rear piece should have dowel holes marked and drilled in each end and 12in. from the left-hand end put a $\frac{1}{2}$in. deep, $1\frac{7}{16}$in. wide half-lap.

For the front piece do exactly the same thing except additionally put half-laps of the same dimensions on the forward-face of the wood at 20in.* from the left-hand end and fully up to the right-hand end of the piece.

We are now left with only the horizontal and two vertical struts. For the horizontal one cut an accurate $19\frac{5}{8}$in.* length of $1\frac{1}{2}$ x 1in. timber and saw out half-laps at each end both of $1\frac{5}{16}$in. length and $\frac{1}{2}$in. remaining wood. Note that this is slightly more than half the depth of the stock.

The vertical struts are made in an almost identical manner except that the overall length of the pieces should be $18\frac{11}{16}$in.* and the half-laps will be $1\frac{7}{16}$in. long.

Cut off 16 1in. lengths of dowel and chamfer and score each as indicated earlier.

You are now ready to dry assemble the whole frame of the receiver. All the joints should be tight but not impossible to assemble. If there is any excessive tautness on any joint ease it slightly by removing wood from the correct place. Take this process easy—should it be necessary at all—because an almost perfect joint can be easily ruined by pairing off just a little too much wood or removing it from the wrong place. If you are happy with all the joints check with a spirit level that the horizontal surfaces *are* horizontal—quite obviously the frame must be standing on a flat surface for this check!

Glueing Up

A rather frightening mystique exists among cabinet makers about glue. Each professional seems to have his own recipe continuously bubbling away on a gas-ring in the corner of his workshop. Fortunately for the home constructor these mysterious processes are no longer essential: a wood glue such as Evostik Resin W can be used with ease and complete confidence.

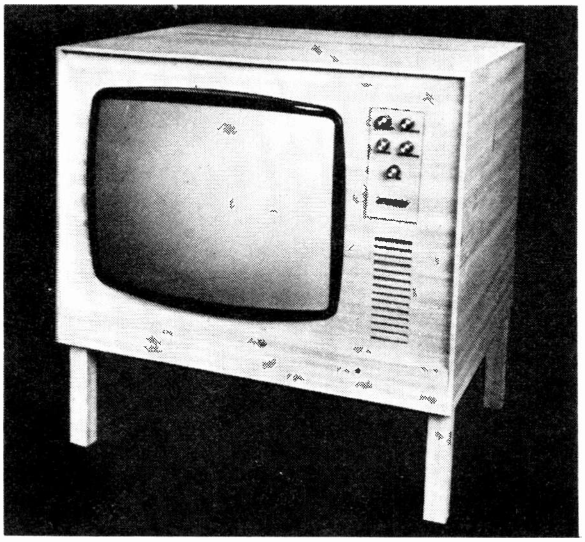
The expert will also insist that the chassis is glued up in sections—a complete left-hand side and then a complete right-hand side, then a period of waiting and a final glueing session with the side pieces and the horizontals between them. The problem as seen by the author is that it is much more difficult to judge the squareness of one section than it is of the whole frame: we therefore suggest one massive glueing operation.

Have ready all the pieces of timber laid out in a reasonable order so that they can be picked out and put in the correct position immediately they are wanted. Also have ready a dozen ten-feet lengths of stout string or cord. We would also suggest that you don't do the glueing on the lounge carpet!

Start on one side frame using an over indulgent amount of glue on each piece of wood. Put glue into the dowel holes until it is almost coming out of the holes and give both the mortise and tenon part of each joint a coating of glue. Very quickly repeat the process on the second side not bothering too much with squaring the first side before moving on.

Then move on to the front and rear horizontals—forgetting the struts for the time being—until the whole frame is standing fairly rigidly by itself. Now square off the sides and the front, easing joints into place so that no gaps are left anywhere. Check horizontals and verticals with your spirit level.

If the assembly has been well made you need do little else: the frame will harden in place by itself in about 24 hours provided it is untouched. If any of the joints are dodgey or try to force themselves apart—particularly the dowel-pin joints if you haven't scored the length of the dowels properly—then the string may be needed to tie up the verticals to one another to keep the whole thing square. Before leaving the work to harden clean off with a rag all the excess glue that can be seen dripping around. Don't be too fussy at this stage because any glue that does harden can always be removed with a knife or even sanded off. Make a final check on the squareness of the frame and leave for 24 hours.



The finished cabinet of the prototype receiver.

When the frame has hardened glue the struts on in their correct positions. For a satisfactory result here you will almost certainly have to use a clamp at each end (such as a C clamp if available) or tie the ends up very tightly with string. After the struts have hardened check the surfaces around the joints for smoothness and sandpaper or slightly plane down if necessary so that the top, the sides and the front offer a flat mounting surface for the cladding.

Tube Mounting Points

Considerable thought was given to the question of mounting the tube in the cabinet in a safe and reasonably simple way. The idea is to use the strength of the frame in a way that is most economic.

Figure 8 shows one of the mounting points—the one for the top left-hand corner of the tube. A flat metal plate drilled correctly is inserted *through* the top timber and bolted up. The bottom hole carries the mounting bolt for the tube. The same system is used at the other three mounting corners of the tube. In *each* case the plate is mounted so that its centre line is $\frac{5}{8}$in. away from the nearest vertical (the first strut forms the right-hand vertical). Using 1in. wide plate this means that the edge of the plate is $\frac{1}{8}$in. away from the vertical in each case.

Each of the plates in the prototype was of 10 s.w.g. and was in fact copper bar that was redundant from a heavy lightning conductor earthing path. A total length of $9\frac{3}{4}$in. is needed (4 off $2\frac{7}{16}$in.). This kind of material can probably be picked up in a local scrap yard for 20 or 30p. With the length cut accurately to $2\frac{7}{16}$in. (using a hacksaw) two holes are drilled on the centre line, both of $\frac{3}{8}$in. diameter, one 23/32in. from one end and the other $\frac{3}{8}$in. from the other end. The second hole is then squared off with a needle file to take the shank of a carriage bolt whose shank should also be $\frac{3}{8}$in. diameter.

Four such carriage bolts will be needed and all should be at least 2in. in length and *must be threaded right up to the carriage head.* With the bolt in the square hole some of the carriage end will still be visible at the back of the plate. Two oversize flat

Table 2: Dimension Modifications for Tube Sizes other than 22in.

Where the 22in. tube dimension appears as:	replace for 19in. by:	for 25in.	for 26in.
$15\frac{13}{16}$	$14\frac{9}{32}$	$17\frac{7}{16}$	$17\frac{29}{32}$
17	16	19	19
$17\frac{1}{4}$	$15\frac{23}{32}$	$18\frac{7}{8}$	$19\frac{11}{32}$
$18\frac{11}{16}$	$17\frac{5}{32}$	$20\frac{5}{16}$	$20\frac{25}{32}$
$19\frac{5}{8}$	$18\frac{5}{8}$	$21\frac{5}{8}$	$21\frac{5}{8}$
20	$17\frac{1}{2}$	$21\frac{19}{32}$	$22\frac{7}{8}$
$28\frac{3}{8}$	$25\frac{7}{8}$	$29\frac{31}{32}$	$31\frac{1}{4}$
29	$27\frac{15}{32}$	$30\frac{5}{8}$	$31\frac{3}{32}$

All dimensions in inches.

metal washers—see Fig. 8 view C—should cover this up: tighten a nut down on the washers from the back. This provides a fixed mounting point for the tube which can itself be tightened down later with a further nut on to what is then a fixed "stud". This kind of system must be provided to allow some flexibility in the position of the tube and because the front side of the mount will be inaccessible once the front cladding has been attached.

To accommodate the flat strips a rectangular hole must be cut through the horizontal timber in each of the four spots where it is required. If as in the prototype 10 s.w.g. metal is used—we would not advise the use of anything thinner than 14 s.w.g.—these holes can be formed by drilling a line of $\frac{1}{8}$in. holes along the centre line on the top surface. The hole can then be cleaned up using a flat needle file.

With a $\frac{3}{8}$in. diameter hole drilled along the centre line position of the strip and half-way down the front-face a machine bolt can be passed through both the wood and the metal strip and a washer and nut used to tighten up and hold the strip in place—see Fig. 8 view B. The heads of the four machine bolts must *not* protrude from the surface. You will therefore have to shape the front ends of the holes to the hexagonal shape of the bolt heads so that the bolts recess themselves into the wood.

Both the machine bolts and the carriage bolts used for the mounting process have $\frac{3}{8}$in. diameter shafts. We have not quoted a nominal head dimension for the carriage bolt because there appears to be no standard method of doing this while the title of the machine bolt will depend on the thread used and this is unimportant for the project. So take along a rule when you buy the bolts to make sure you are buying what you need.

The mounting lugs with the tube mounting bolts in position *must* be in place before the outer surface of the receiver is clad. Check that the distances between all the bolts are correct (Table 3).

Convergence Drawer

We will discuss the contents and the make-up of the convergence drawer subsequently but because the drawer forms part of the cabinet we must consider here the front surface of the drawer. In the prototype this was formed with nominal 3 x 1in. stock and the length was cut to just $\frac{1}{16}$in. shorter than the overall width of the receiver frame (i.e. $28\frac{3}{8}$*—$\frac{1}{16}$ in.). This piece of wood should be finished off in the same way that you choose for the rest of the cabinet.

Cabinet Cladding

The prototype receiver was clad using 6mm. hardboard. Four pieces are required: for the top, the two sides and the front of the cabinet—we will discuss the back and the bottom in a future issue.

To make the cabinet appearance more interesting and to match the depth of the convergence drawer front an overhang of 1in. was put on the top and the sides of the cabinet cladding. The side covering was taken down to the lower limit of the convergence drawer front which is also the bottom of the side rails (all dimensions are shown in Table 4).

The prototype was veneered so the cladding was both pinned and glued in place. If you want to avoid veneering—as you will if you have any sense!—the cladding should be either only glued in place or most carefully pinned in just a few selected places as well, the pins being punched below the surface and the small holes filled before staining and polishing.

Because of the overhang the cladding for the front panel is fitted first. This has to be accurately cut for the push-through presentation of the tube face and for the control spindles, loudspeaker, etc. Note that the hardboard for the front panel goes down as far as the bottom of the lower front horizontal timber.

Two masters will be available from the magazine offices to cover the two areas of necessarily accurate cutting because we feel that a full-scale drawing is absolutely essential. The first master is for the tube face cut-out and covers the four tube sizes 19, 22, 25 and 26in., using the top left-hand corner as reference. This is available for 10p. The second master is for the control panel and loudspeaker

Table 3: Tube Mounting Bolt Positions

	19in.	22in.	25in.	26in.
Horizontal distance between bolts	$16\frac{1}{4}$	$18\frac{3}{4}$	$20\frac{11}{32}$	$21\frac{5}{8}$
Vertical distance between bolts	$13\frac{1}{32}$	$14\frac{9}{16}$	$16\frac{3}{16}$	$16\frac{21}{32}$

All dimensions in inches.

Table 4: Hardboard Cladding Dimensions
(allowing for 1in. overhang at front edge of top and sides)

Tube size:	19in.	22in.	25in.	26in.
top:	$25\frac{7}{8}$ x $19\frac{5}{8}$	$28\frac{3}{8}$ x $20\frac{5}{8}$	$29\frac{31}{32}$ x $22\frac{5}{8}$	$31\frac{1}{4}$ x $22\frac{5}{8}$
sides (two required):	$19\frac{5}{8}$ x $19\frac{5}{32}$	$20\frac{5}{8}$ x $20\frac{11}{16}$	$22\frac{5}{8}$ x $22\frac{5}{16}$	$22\frac{5}{8}$ x $22\frac{25}{32}$
front:	$25\frac{7}{8}$ x $17\frac{5}{32}$	$28\frac{3}{8}$ x $18\frac{11}{16}$	$29\frac{31}{32}$ x $20\frac{5}{16}$	$31\frac{1}{4}$ x $20\frac{25}{32}$

All dimensions in inches.

cut-out frets and is again marked for the four tube sizes. This is available from the magazine for 5p.

The masters should be fixed flat on the front panel hardboard—already cut to the right size (Table 4) and the cut-out shapes and control spindle drilling holes etc. marked through.

To cut out the tube face plate shape, a small hole should be drilled in the part of the board that is going to be removed and a pad-saw or key-hole saw used to cut around the marked edge. The accuracy of the cut should be better than $\frac{1}{16}$in. if it is not to be visible from the front. In order not to tear the hardboard the blade used in the saw should have a large number of teeth per inch. If this isn't available—and they don't seem to be generally—use a hacksaw blade mounted temporarily in the pad-saw handle.

The loudspeaker frets are cut out in the same way: this is an extremely tedious job. The markings given for the tuner control panel apply to one particular unit (Component-Pack No. 15).

Layout Error

The print connection between point 3F (B output) and the junction of L201/D201/Tr207 collector is missing in our illustration of the RGB board layout —Fig. 6, page 449, August issue. We have checked and found that the boards supplied by E. J. Papworth & Son Ltd., also Manor Supplies, are correct; also most of the print patterns sent out to readers for home board construction were corrected. Those making their own boards or obtaining them from any other source should however check this point.

Component-Packs

The following component-packs are now available and readers may care to order them in advance for later complete receiver assembly.

Component-Pack 14

Line output transformer (Mullard AT2055 or equivalent), e.h.t. trippler unit (ITT type TS25—version to have 18in. e.h.t. lead with other leads 12in.) and focus assembly (Erie focus potentiometer with suitable Pressac connectors supplied).

Supplier: Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk. Price: £9.60 including post and packing.

Line output transformers as wound for the prototype are available from E. J. Papworth & Son Ltd., 80 Merton High Street, London SW19 at £5.25 including post and packing.

Manor Supplies can supply Mullard line output transformers and e.h.t. tripplers (mainly Mullard type LP1174-10 which are suitable except that the mounting leads are rather shorter). Present prices: transformer £3.25, trippler £4.75, 25p post and packing. Check monthly adverts for latest prices.

Component-Pack 15

Varactor tuner control unit. The front panel master layout now available (see earlier in article) is based on the use of this particular tuner control panel which incorporates switches and potentiometers for controlling the varactor tuner to be recommended for use with this receiver. It is essential therefore to obtain this control panel before cutting the receiver front panel if the recommended tuner is going to be used.

Supplier: Manor Supplies, 64 Golders Manor Drive, London NW11 (mail order address). Price: £2.05 including post and packing.

When ordering Component-Pack No. 15 readers should state on the order that the unit is the one intended for use with the TELEVISION Colour Receiver: although the price is the same this is not the same unit as the one (see *Renovating the Rentals* this month) sold by Manor Supplies to replace conventional u.h.f. push-button assemblies when converting a receiver to use a varactor (varicap) tuner unit.

RECEIVER-MONITOR CONVERSION

—continued from page 555

through. A single-edged razor is suitable for this purpose. The circuitry of the set used (Philips Style 70 chassis) is shown in Fig. 2. S6 and S7 are part of the 405-625 system switch. Note that on this chassis the video input to the pentode is the same on both systems, i.e. the bias on the output valve is not varied from one standard to the other. The signal is direct coupled on 405 and a.c. coupled via C249 on 625 with d.c. restoration by means of X205. The connections carrying video signals should be of screened cable, earthed at one end only to save earth loop problems.

Setting up is quite easy. Using a scope, adjust VR2 to give the required output level across 75Ω. Then couple this to the input, observe the picture and adjust VR1 to give a correctly contrasted picture. An alternative method would be to apply a 1V signal to the input, adjust VR1, then adjust the output to suit.

The output obtained from the set and circuit used is suitable for driving other monitors or mixing in a small CCTV studio or feeding to a videotape recorder. The input will accept a videotape recorder output or the output from a CCTV camera.

Power for the circuit can be taken from the transistor u.h.f. tuner (on 625 only) or from the h.t. line via a suitable potential divider.

CIRCUIT NOTES

—continued from page 550

PAL V switch is tapped from the junction of resistors R178/R179 and fed to the demodulator i.c.

VT113 provides the colour-killer action. On monochrome there is no ident signal (since there are no bursts). As its emitter is connected direct to the 25V rail VT113 conducts, shorting the base of VT114 to the positive rail. This action ensures that VT114 remains cut off so that its collector is at chassis potential and there is no turn-on bias for the chrominance channel. On colour the ident signal appears at VT112 collector, is rectified by W109 and smoothed by R176 and C164, producing a positive bias that cuts VT113 off (its base is then at approximately 26V). VT114 operates as already indicated and the squarewave output is smoothed by R180 and C166 and fed via R181 as the turn-on bias to the chrominance channel.

YOUR PROBLEMS SOLVED

★ **Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 571 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.**

BUSH TV148U

The picture and sound break up to give what can only be described as a pulsating movement—this trouble is experienced on u.h.f. only. If the push-button of the channel that has been selected is pressed hard the trouble clears. A camera change or loud passage will start the trouble off again.—A. J. Sprout (Enfield).

The symptoms described could be the result of a defect in the a.g.c. line—possibly a faulty anti-lockout diode 2MR5 (type M1S). If mechanical pressure cures the fault, however, it is likely to have a mechanical origin. Check by disturbance the plugs and sockets taking the i.f. signal from the u.h.f. tuner to the v.h.f. tuner and remake as necessary. Also check the clearance between the vanes of the u.h.f. tuner gang.

EKCO T433

The trouble is distorted sound on 625 lines. The EH90 sound detector has been replaced with a new one but this has only slightly improved matters.—T. Anson (Bognor).

Try adjusting the EH90 oscillator coil L28 which is below and slightly to the left of the EH90. If this does not put matters right check the screen and cathode voltages on 625 and check resistor values as necessary.

DEFIANT 9A61U

The fault with this set is no e.h.t. There is a faint line whistle which can be varied by adjusting the line hold control. I have tried all the usual cures—the valves, boost capacitor, width circuit and line output pentode screen components. The oscillator stage appears to be in order. A new line output transformer has been tried but the symptoms remain the same. Have you any further suggestions? — T. Byford (Southend).

On several occasions we have found the contacts between the line output transformer and the panel above it to be at fault and we suggest you check this possibility first. Then if necessary obtain a replacement L620 line output stage h.t. feed coil: shorted turns in this can result in non-operation when under load.

ULTRA V1781

The field linearity is poor on this set, the picture being stretched at the top with the bottom half closed up leaving four inches of blank screen. The 30PL13 field timebase valve and its cathode components have been replaced but the fault is still present.—F. Goodwin (Hampstead).

It is our custom on these old Ultra sets to replace a number of small capacitors in the field timebase as a matter of routine. We suggest you replace C104 ($0{\cdot}02\mu$F) and C103 ($0{\cdot}03\mu$F) associated with the linearity network and C99 ($0{\cdot}1\mu$F—coupling) and C103 ($0{\cdot}05\mu$F—field charging) on pin 9 (triode anode) of the 30PL13. Then if necessary check the values of the resistors in the linearity circuit—R121 180kΩ, R123 180kΩ and R129 82kΩ.

BUSH TV77

The sound and picture are good except for triggering over picture verticals after a few minutes. This distortion of the picture moves up and down, sometimes becoming almost stationary.—T. Cadmuth (Bradford).

Line triggering displacement can occur if the aerial is receiving reflected signal(s) which would appear on the screen as ghosting: check this first. If this is not the cause of the trouble observe the sides and bottom closely to see if there is any sign of ripples and rhythmic rise and fall to denote poor smoothing. This would call for a check of the h.t. electrolytics. Then if necessary check the flywheel line sync discriminator diodes.

ULTRA 6618

The fault on this set (BRC 850 dual-standard chassis) is that the sound keeps going off. It can be brought back by operating the light switch in the room—or in almost any other part of the house. All likely valves have been changed and the channel selector switch checked.—T. Cradock (Morpeth).

There are two $0{\cdot}02\mu$F coupling capacitors (C65 and C66) in the vicinity of the audio valve (PCL86—the capacitors are connected to pins 1 and 9). Either of these capacitors could be faulty.

STELLA ST1017U

On switching on everything lights up and seems to be in order with perfect sound but the screen in daylight is blank. On switching off a bright spot appears, so the e.h.t. is present. In the dark, shadows can be discerned on the screen with the brightness control advanced.—T. Murray (Gloucester).

You will have to check the tube base voltages. First the heater voltage, across pins 1 and 8: this should be about 6·3V (a.c.). If it is a lot less suspect a partially shorted heater in which case sharply tapping the tube neck may clear the trouble for a short time. Next check the first anode voltage at pin 3: this should be well over 300V. If low check the value of the focus control R713 (2MΩ) and the boost line decoupler C609. The grid voltage (pins 2 and 6) should vary from very little at minimum brilliance to about 150V at maximum brilliance. If this voltage is low and remains so check the feed resistor R212 (68kΩ) from the h.t. line to the brilliance control and the decoupler C704 connected to the slider of the brilliance control. The cathode voltage (pin 7) should be around 140V. If high check the video amplifier valve V608 (EF80) which is d.c. coupled to the tube in this chassis.

INVICTA 7120

The width is excessive and the width control has no effect. This preset control has been checked and found to be in order. Voltages read normally but the line output valve appears to be overheating slightly with excessive screen current.—G. Dawkins (Liverpool).

The voltage dependent resistor (VDR1, type E298/ED/A265) in series with the width control should be checked: a 100kΩ resistor bridged across it should restore width control action if it has gone open-circuit.

PYE 81

On switching on after the set has been off for several hours all one gets is a blank raster. An unstable picture appears after about half an hour and normal results come after a further 15 minutes. If the set is switched on when it has been off for only a short time the picture and sound come on much sooner.—R. Hale (Bristol).

Your instability is probably in the cascode i.f. stage VT2 and VT3. Suspect especially the l.t. supply decoupler C15, VT2 base decoupler C16 and VT3 emitter decoupler C19.

PHILIPS G20T230A

The problem is a white bar about 3in. wide across the screen (it is not as bright as the picture). The bar moves upwards when the set is warming up and tends to move downwards when the set has reached its normal operating temperature. There also seems to be louder than normal hum.—R. Foster (Hendon).

The symptoms suggest that the main smoothing electrolytics on the right-hand side are faulty. We often find however that it is not the electrolytics themselves that are causing the trouble but the bonding between the cans and chassis: improve the contact if possible or provide alternative leads to chassis.

ALBA T1095

The contrast control has no effect and if the brightness control is advanced the picture enlarges and then disappears. The picture is also of increased size.—R. Tapforth (Gloucester).

The increased picture size and blooming are due to the inability of the e.h.t. rectifier to supply sufficient beam current for the c.r.t. The DY87 should therefore be checked, then if necessary the other valves in the line output stage, the PY800 and PL36. For the inoperative contrast control we suggest you check the clamp diode in the a.g.c. circuit (X401 type OA81 or OA91) and then if necessary the value of the 2·7MΩ resistor R462 connected to the slider of the contrast control.

FERGUSON 3703

The fault with this set (Thorn 3000 chassis) appears to be in the convergence system. Figures on monochrome are outlined by a red or green ghosting effect which is worst at the top and bottom of the picture, tapering in towards the centre of the screen where for about an inch conditions are correct. The effect on colour is the same. Straight vertical lines take on an X shape, the top showing red and green at each side but converging correctly at the centre. The set operates perfectly when switched on from cold, the above fault developing after about twenty minutes.—J. Atkinson (Hornchurch).

Check the 50Ω R-G amplitude control R719 which with the convergence board down is the second control up in the second row from the left. Then if necessary check the associated components W705 (type OA91—omitted on later boards) and the non-polarised electrolytic C706 (150μF).

EKCO TCG316

I obtained one of these old "de-luxe" models recently and after resetting most of the preset controls and making one or two valve replacements get quite reasonable results. There are, however, a couple of points on which I would welcome your comments. First there is a switch-off spot I would like to eliminate. Secondly the flyback lines can be seen on a blank raster.—F. Barker (Finchley).

Switch-off spot suppression is not really necessary on this chassis as the e.h.t. is moderate and the Metrosil fitted discharges the c.r.t. The presence of flyback lines denotes faulty flyback suppression. In these old Ekco chassis a suppression pulse is taken from the field blocking oscillator circuit via an 0·001μF capacitor to the first anode of the tube. It is usually this coupling capacitor which is at fault.

BUSH TV118

The picture quality, contrast and brightness vary with changes in the scene: also it is several minutes before the picture comes on.—C. Graham (Lincoln).

The trouble is probably due to a changed value resistor in the PCF80 video amplifier circuit and we suggest you check the anode load resistor R34 (10kΩ) and cathode bias stabilising resistor R31 (33kΩ). If these are in order check the EF184 vision i.f. amplifier and the EF85 common i.f. amplifier valves.

FERGUSON 3617

This set is fitted with the Thorn 850 dual-standard chassis. The line hold control has to be carefully adjusted to get any sort of picture and even then a band slips across the screen distorting the picture. When I manage to lock the picture for a few seconds there is a smudgy effect and adjustment of the contrast control seems to make matters worse. The valves on the i.f. board, also the line oscillator and field timebase valves, have been replaced but the condition is the same. Both 625 and 405 are affected in this way.—A. Kemp (Manchester).

We suggest you check the resistors in the PCL84 video amplifier stage where you will almost certainly find that at least R24 (47kΩ) the bias stabilising resistor has changed value. Some of the other resistors could also be outside their tolerance range. Change all discoloured resistors and make sure that all voltages are correct. Also check R38 (43kΩ) the upper resistor of the potential divider feeding the screen grid of the sync separator. The tuner feed resistors R168/R169/R170 near the mains fuse may also be defective.

COSSOR CT1922A

There was total field collapse on this model. The PCL85 field timebase valve and its cathode components, also the height circuit resistors, have all been checked or replaced but the problem remains. On switching on there is a flashover between pins 6 (pentode anode) and 5 of the PCL85. While testing with a bulb and battery for short-circuits there was a weak flashover between pins 6 and 5 of the PCL85 when I checked from the scan coils to chassis.—R. Hinchcliff (West Drayton).

The symptoms indicate that there is an open-circuit in the field scan coils. This causes high voltages at pin 6 of the PCL85 and consequently the flashovers.

EKCO T536

On 625 lines part of the picture moves from right to left when the picture is bright, e.g. a white sky. Also I get four pictures: the fault only lasts about three seconds and appears to be affected by the white sky. On 405 lines there is a slight move from left to right.—G. Hemmings (Spalding).

The preset contrast controls appear to be set too high. Reduce the settings so as to read 2·9V on 625 and 1·6V on 405, measured across the vision detector load resistor R20.

GEC 2015

The height and vertical linearity controls have been set to their extreme limits and the PCL85 field timebase valve and its pentode cathode components replaced but there is still lack of height at both top and bottom, showing at the bottom as a ¾in. black margin.—T. Brown (Dunstable).

We suspect that the 2·7MΩ resistor from the boost rail to the height control has increased in value. This resistor is near one corner of the timebase panel. The voltage at the h.t. end of the height control should be 110V and on 405 lines the triode anode voltage of the PCL85 (pin 1) should be 50V.

PYE 13

If the brightness control is turned farther than about half way the picture expands and the screen darkens. The c.r.t. seems to be all right, with plenty of contrast. —G. Moore (Catford).

The e.h.t. regulation is poor so the DY87 e.h.t. rectifier should be checked. If the picture is small when visible however suspect the PL36 line output valve instead.

BUSH TV141U

On 625 lines there is a continuous buzz on sound which can be reduced by turning the contrast down—this, however, spoils an otherwise good picture.—J. T. Durban (Leeds).

The most likely cause of the trouble is inadequate a.g.c. at the common i.f. stage 2V1 and this could well be due to a weak EF184 in the final i.f. stage position (2V3). Check this valve and also the EF183 (2V1). Then check the setting of the f.m. detector balance control 2RV2 and the detector diodes 2MR2 and 2MR3.

DECCA DR1

There is lack of both height and width although the picture is a lot larger on 625 lines. The line output stage valves and transformer have been replaced without effecting a cure.—S. Halloran (Swansea).

There is clearly something in the boost circuit reducing the supply to the height and "set boost" (width) controls. The latter control—R171 1MΩ should be checked for correct value, also the 470kΩ resistor R170 in series with it. If these are OK check the other components in the line output valve grid circuit—R169 (1MΩ), R146 (2·2MΩ) and the v.d.r.

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TELEVISION OCTOBER 1972

TEST CASE

118

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

? *The fault on a Philips Model 23TG173A was lack of raster accompanied by a line whistle of abnormal loudness from the line output transformer. The line whistle appeared to be of the correct frequency and by removing the aerial (to remove the sync pulses) and adjusting the line hold control the whistle was found to change normally in pitch, proving at least that the line oscillator was delivering drive and that its frequency could be regulated in the correct manner.*

Further tests indicated lack of e.h.t. voltage and only very mild pulse voltage at the anode of the DY87 e.h.t. rectifier. Also that the heater of the rectifier was unlit. As an internal short in the rectifier can sometimes cause this symptom the anode was disconnected but the pulse suppression remained.

By removing the top cap connector of the PY800 efficiency diode a slight increase in e.h.t. rectifier anode pulse potential was noticed. The technician then performed two tests, the first of which was negative, and then replaced one component to cure the fault.

What tests were these and which components if in trouble would be likely to cause the symptoms described? See next month's TELEVISION *for the answer and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 117

Page 523 (last month)

The nature of the interference dot display on the screen can indicate to the experienced technician the source of the discharge responsible for it.

When the discharge is anywhere in the pulse producing components—such as the line output transformer—it invariably occurs during the flyback period when the pulse voltage peaks. This gives rise to a uniform column of dots or dashes—often towards the left-hand side of the screen—because the discharges, which are radiated and then picked up by the aerial, occur at approximately the same instant during each line cycle.

When the interference is in the form of random white dots all over the screen however one can be pretty sure that the discharge is on the d.c. side of the e.h.t. system. It will be recalled that the effect occurred only when the tube beam current was increased by advancing either the brightness or contrast control. There are two main causes of this type of trouble, a short somewhere in the tube or poor connection between the external conductive tube coating and the earthing spring or clip pressing against it. The latter proved to be the case with the set concerned and was put right by simply increasing the tension of the spring so that it pressed harder against the conductive coating.

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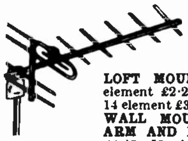

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