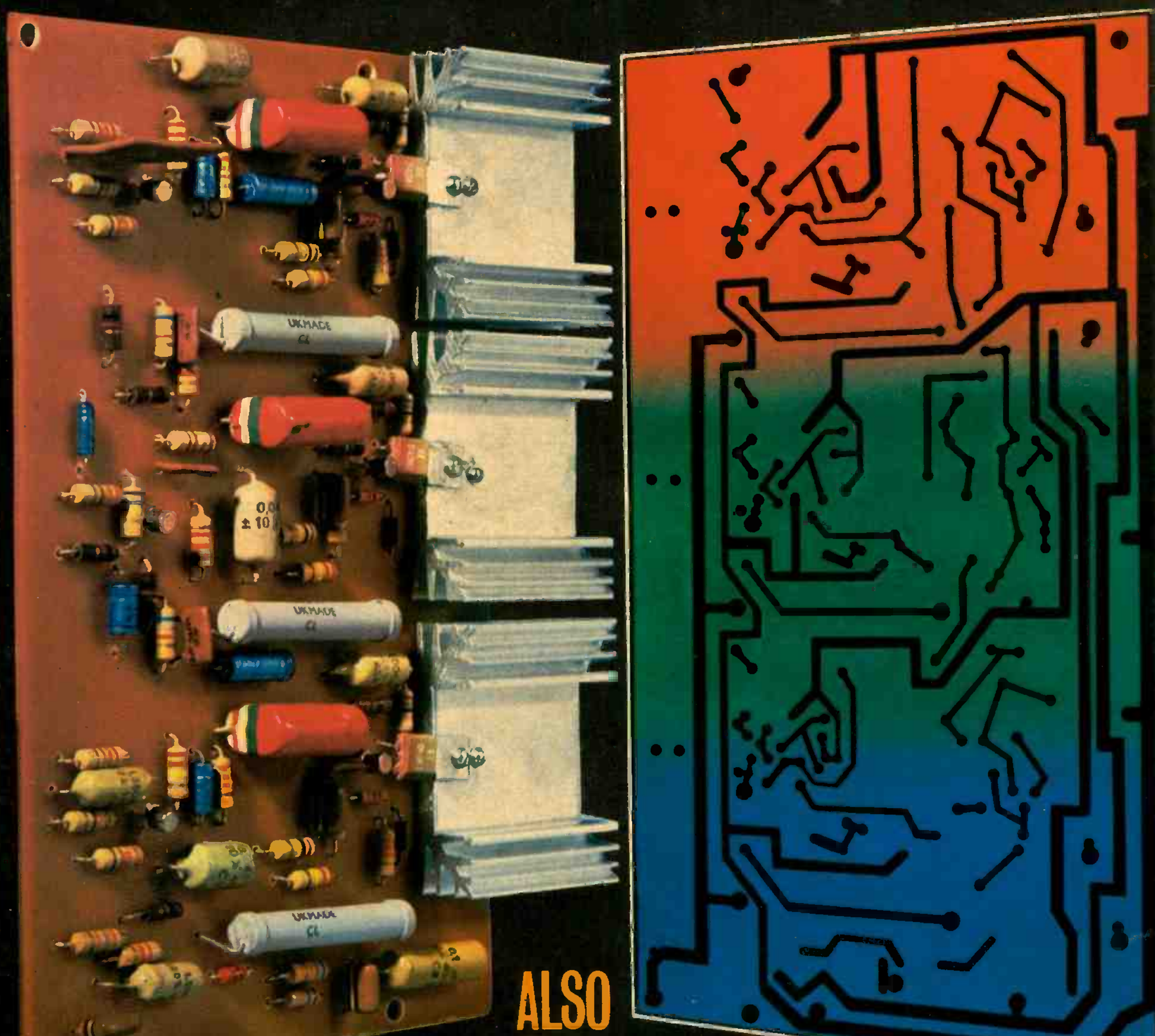
TELEVISION

20p

AUGUST 1972

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

RGB OUTPUT MODULE



ALSO

SERVICING THE BRC 1500 CHASSIS

THE SINEWAVE LINE OSCILLATOR

TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

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KICKING THE HABIT!

Modern life is beset with pressures, frustrations, annoyances and stresses. Traffic jams, strikes, occupational competition, national politics, the world situation, noise and pollution—all play their part. The effect in many cases is cumulative and self-perpetuating.

To combat all this many people resort to stimulants, restoratives, narcotics or escapism, much of which invites further trouble. A classic vicious circle. The least innocuous of escape routes it would seem is television viewing. But even here we get lectured that if not taken in moderation harm can result. It seems we just can't win!

Even the most anti-TV pundit will agree that selective viewing is beneficial. But just how deeply is TV *as a habit* a part of Mr. Average? In the last ITA annual report it was claimed that the *average* viewer spends 4·6 hours a day staring at his box. This amounts to ten weeks' viewing day and night each year! And this remember is an average: think of the immobilised cabbages at the higher end of the scale!

But *you*, of course, are not like that. You view selectively. You can take it or leave it. Or can you? A revealing experiment by the Munich Society of National Psychology showed that not only is TV today an essential part of normal home life but that it has become a habit as difficult to kick as any other. The Society paid couples and single people so much a day to abstain from viewing for a year. No one lasted the course: in fact no one lasted more than six months and 90% were back at the box within four months!

It was found that during the "blackout" period families became more quarrelsome and normally quiet men "beat wives and children and chased other women." Resisting the temptation to be frivolous (it was also reported that viewing appears to act as an aphrodisiac—even the news bulletins!) this experiment clearly shows that when TV becomes a habit it can change the character of its devotees.

The choice seems obvious. TV is a great comfort and means of relaxation for millions of viewers. But like most things moderation is essential. So if *you* are a compulsive TV addict, try to kick the habit. But be warned: if you do the withdrawal symptoms may be painful!

W. N. STEVENS, *Editor*

THIS MONTH

THE NEXT ISSUE DATED SEPTEMBER WILL BE PUBLISHED AUGUST 21

Binders: A binder which holds a year's issues of TELEVISION can be obtained for £1 including post and packing from the Binding Department, IPC Magazines Ltd., Carlton House, Great Queen Street, London WC2. When ordering please state whether you want the binder blank or with the volume number—and which one in this case—printed on the spine. Volume indexes are also available at 10p each including post and packing from the same address.

TELETOPICS

WHAT'S NEW?

This year's trade shows took place against a background of dealer uncertainty caused by the continuing shortage of sets to meet the present high level of demand. Imports have now increased to take nearly 20% of the TV market as dealers cast around for new sources of supply. The main impressions left technically by the shows are of the steady advance in the use of varicap tuners and slider controls, the presence now in nearly all UK setmakers' ranges of mains-battery portables, the appearance of yet more c.r.t. screen sizes and of more solid-state chassis. The general lack of technical specifications and prices however suggests that to meet the present extraordinary demand setmakers are concentrating on increased production of current models. Although the colour receivers on show imported from Europe mostly featured 110° tubes no UK setmaker has yet taken the plunge. Probably a good thing we feel: it is best to concentrate on making the present generation of sets reliable before following the next craze.

BRC have now introduced in their **HMV** range a 17in. model using the 8000 chassis. This has a recommended retail price of £184·70. BRC also announced a new version of this chassis, the 8500, for use in 19in. models. The major panels used in the two chassis are identical and interchangeable. An innovation in the 8500 chassis however is a new line output transistor designed for use eventually with 110° tubes. BRC are to announce shortly their first models fitted with varicap tuners. They are also now fitting in their de luxe colour models a new 26in. tube which has nearly a quarter of a million more phosphor dots than the standard tube, i.e. an extra 80,000 holes in the shadowmask: the number has been optimised to give minimum moiré patterning. Featured in the **Marconiphone** range are Model 4713, the first model to be announced using the 8500 chassis with 19in. tube; also a new monochrome set, Model 4821, with 20in. tube and recommended price of £66·85.

RBM (Rank-Bush-Murphy) also announced their first models to be fitted with varicap tuners, the **Bush** Models TV309 and TV311. In the **Murphy** range a mains-battery portable, Model V1400, incorporating a 14in. tube, was shown. A new all-transistor monochrome chassis is used in the Murphy Model TV2029 which is fitted with a 20in. tube.

The main TV introduction at the **ITT** show was a new 26in. tube luxury model, the Feathertouch 100, featuring *touch-button* channel selection. Touching one of the channel selector buttons actuates a transistor latching circuit which by means of a bistable switch introduces the appropriate preset potentiometer into circuit to tune the varicap tuner to the selected channel. The recommended price is £339.

A new modular colour chassis making extensive use of i.c.s was displayed at the **GEC** show. The first model to use this is the 2115 (with 20in. tube). Other new colour models on show were the 2112 (22in. tube) and 2108 (26in. tube) which use varicap tuners. On the monochrome side there was a mains-battery portable, Model 2114, with 14in. tube; also Model 2117 with 24in. tube. There was no mention of new Sobell models which leads us to wonder whether this well-known brand has now quietly passed away.

A new range of colour models was shown by **Decca,** two of which feature varicap tuners. This range includes the first 18in. colour set, Model CS1830.

Alba now have a 14in. mains-battery portable, Model T14, in their range. This is fitted with the recently introduced BRC 1591 chassis and has the recommended price of £64·15. A further addition to the Alba range is the 22in. colour Model TC2222 which is fitted with the BRC 3000 chassis.

At the Pye-Philips group show new introductions included the **Ekco** luxury 26in. colour Model CT255 (697 chassis) at £329 and 24in. monochrome Model T546 (169 chassis) at £88·90. **Pye** were showing their new all-transistor colour chassis—no model numbers announced yet—and also a new 20in. monochrome set, Model 160 (169 chassis). A new solid-state chassis shown by **Philips** incorporates four i.c.s and is to be used initially in the 320 17in. transportable model, the 322 20in. model and 324 24in. model. In the **Invicta** range is a new 22in. colour set, Model 7052 (697 chassis), at £272.

On the import side **Teleton** are to add 14in. and 20in. colour models to their range while **Sony** have announced a new colour model which will be the first to be fitted with the 18in. version of their Trinitron tube. **B and O** now join the ranks of those offering 110° 26in. sets (Model 3400SJ). Further **Rigonda** Russian imports will include the 26in. Horizon, 24in. Temp 209 and 9in. mains-battery portable Yunost. **Elizabethan** have a new 12in. mains-battery portable, Model T12 at £70·46. Denham and Morley showed an all-transistor 20in. colour set from **JVC** and it was announced that a London-based rental company had ordered 12,000 of these.

Present at the **Hitachi** show was their "memory TV"—the stop-action model mentioned in our July *Teletopics* but this time fitted with 14 and 9in. tubes. The magnetic disc on which the image is stored has a diameter of $3\frac{15}{16}$in. and can be set to store and then change images automatically and continuously once, twice or four times a second to give a slow-motion display.

The trade boom is reflected in the set delivery figures for the first three months of this year—364,000 colour sets (154,000 in the same three months in 1971) and 475,000 monochrome sets (434,000 in 1971) were delivered, a combined increase of 43% over the comparable figure for 1971. Several setmakers said after the trade shows that their production for the rest of the year had been sold. At a time when UK made sets are competitive in price with those produced anywhere else in the world it's a pity we can't meet the home demand and have enough available for a worthwhile export drive, though full marks to BRC who have just landed a substantial order for the supply of colour sets to Yugoslavia.

TRANSMITTER OPENINGS

The ITA has now brought into service its one hundredth station. This is the **Brighton** u.h.f. relay which transmits Southern Television programmes on channel 60 (aerial group C, vertical polarisation).

The BBC-1 service from the **Ventnor** u.h.f. relay has now started on channel 39 (aerial group B, vertical polarisation).

DEVELOPMENTS

Toshiba in Japan have introduced a new c.r.t. for colour receivers called the Linytron. It employs the same principle of beam shadowing as the shadowmask and Trinitron tubes but has oblong holes in the mask and three horizontal in-line electron guns. Increased brightness, improved resolution, ease of adjustment and economy are the advantages claimed. The first set to be fitted with the tube is a 9 in. model from Sharp. Meanwhile we understand that in the UK a new range of shadowmask tubes is to be announced before long in which the areas between the phosphor dots on the tube face are darkened to reduce light reflection and thus improve the brightness of the picture. A new type of imaging device, the Cerampic, consisting of an electro-optic ceramic plate on which a photoconductive film is laid is being worked on by Sandia Laboratories of Albuquerque, New Mexico: an electron image on the photoconductive layer produces a variation corresponding to the optical image details in the ferroelectric domain orientations in the ceramic plate. The result can be viewed directly or projected as a picture. An erasure process removes the image and it may be possible to reverse this process so that a viewable image is produced on the plate. In this way television pictures could possibly be displayed.

A miniature, tubeless TV camera measuring only $2\times2\frac{1}{4}\times3\frac{1}{4}$in. has been shown by RCA Laboratories. It uses a solid-state image sensing panel consisting of an 0·2 in. square m.o.s. integrated circuit which has 1,408 photosensitive elements. Sony have given impressive demonstrations of a simple single-tube colour camera. The pick-up tube is a single-beam photoconductive type called—you guessed it!—the Trinicon, with a striped RGB optical filter and corresponding set of beam indexing electrodes. The beam scans the image produced by the optical filter in RGB sequence, being switched by the indexing electrodes. The resultant signal is processed in the camera to provide a standard NTSC signal output. Sony are also working on colour projection TV systems and have demonstrated publicly a system using a high-brightness 12 in. Trinitron tube with special lens projecting on to a $2\frac{1}{2}\times3\frac{1}{2}$ ft. screen: this is however a relatively high-cost (about $1,600 in Japan) system and the brightness level would mean viewing in almost total darkness.

While Philips continue to exude optimism about their VCRs—they have suggested that by the end of the decade the trade could be selling three times as many videocassette recorders as they are now selling colour sets—and have announced that limited production of their Model 1500 VCR has started with distribution initially at a recommended price of £298 to customers in the educational and training fields, Marvin Camras of the Illinois Institute of Technology Research Institute—which holds many of the basic magnetic tape patents—is working on a fresh approach to producing a cheap videotape recorder. Marvin Camras believes that new high-density tape and new types of head open up once again the possibility of using a fixed head with longitudinal scanning (as is used in audio recorders) and aims to have a system on these lines available for showing to prospective manufacturers later this year.

NEW COMPONENTS, ETC.

A number of new components and units that are likely to be found in the latest TV sets were shown by Mullard at the recent IEA Exhibition. A new varicap tuner, type ELC1043/05, uses two new transsistors—type BF362 in the r.f. stage and type BF363 as a self-oscillating mixer—to achieve a typical noise figure of 7dB, approximately 0·5-2dB better than earlier models. The tuner operates with a 12V supply for the transistors and 25V for the tuning diodes (0·3-25V will tune it through channels 21 to 69) and has a power gain of 22dB. A new series of Mullard power transistors has been developed for use in line output stages. The range, with maximum voltage and current ratings in brackets, is as follows: BU204 (1·3 kV, 3A); BU205 (1·5kV, 3A); BU206 (1·7kV, 3A); BU207 (1·3kV, 7·5A); BU208 (1·5kV, 7·5A); BU209 (1·7kV, 6A). A new series of electrolytics with large capacitance values is intended for use in transistorised power supplies for TV sets. A new Mullard component for automatic degaussing in 90° and 110° colour receivers contains two PTC thermistors for connection in series with the degaussing coil and the mains supply: the initial current of over 5A when the mains supply is connected falls to less than 2mA after three minutes. The high initial current considerably reduces the amount of copper required in the degaussing coil. A new fast (recovery time 200ns) 1A rectifier, type BYX70, is suitable for use as a line scan rectifier or efficiency diode. Mullard also showed an inexpensive miniature camera using their 20PE13 vidicon which has a diameter of only 0·65in. The camera itself measures approximately $19\times12\times5{\cdot}5$cm. and is suggested as being particularly useful for amateur TV use. As we had to mention in connection with our Colour Receiver project in the last issue the TAA350 i.c., which is used in a number of commercial TV chassis, has now been replaced by the TAA350A: the main difference from the user point of view is that the pinning differs slightly, being rotated by three pins relative to the tag—in making a replacement you merely move the i.c. round by three pin positions.

Avo have introduced the Mk 5 Multiminor which replaces their well-known Mk 4 but uses thick-film techniques to provide simplified serviceability and increased reliability. The specification of this handy, pocket-sized meter remains unchanged.

LETTERS

STOCK FAULTS

Your readers might be interested in the following two faults which we have frequently encountered but which we have not seen mentioned in your pages. First the problem of low width on 625 lines on the Thorn 950 chassis: we have found that in the majority of cases this is due to the S-correction capacitor (C98) on this system going short-circuit. Replacing with an 0·1μF capacitor rated at 1kV gives a permanent cure. Secondly hum on sound on the Bush TV161 series: we have found that a very common cause of this complaint is 3C44 (32μF) which smooths the h.t. feed to the audio output valve going open-circuit.—**D. Lane,** *Sutton-in-Ashfield.*

STANDARDS CONVERSION

Your June editorial "V.H.F. Rundown" makes the alarming charge that "a large number of v.h.f. transmitting stations are radiating inferior quality pictures . . . due to lack of alignment of the line-store standards converters." I would like to challenge strongly such a statement which in the context of your editorial will be interpreted by readers as implying that the performance of the current type of line-store converters used by ourselves and the BBC is being deliberately degraded to provide pictures unacceptable to discriminating viewers.

As far as our own transmissions are concerned I suggest there is no evidence of any such policy now or at any time since standards conversion began in September 1969.

It is true, as we have stated on a number of occasions, that the existing analogue line-store converters are not ideal and that they require considerable expertise in maintenance and operation in view of the very large number of heat-sensitive germanium semiconductor devices used in them.

But while we are aware of the problems and occasional failings of this type of converter we would stress that these are not of a magnitude that worries many viewers. Indeed we receive virtually no complaints from viewers about the quality of our 405-line pictures. By most standards—even exacting standards—the present electronic line-store converters are extremely high-performance equipments—and are kept that way by skilled station engineers.

As your readers will be aware we have developed and tested operationally an advanced digital line-rate converter which would undoubtedly provide even more consistent results without the need for frequent skilled adjustment. If the Government indicates to the Authority that it wishes the 405-line transmissions to continue for a period of time which would make the replacement of our existing 37 analogue-type converters economically worthwhile—remembering that these represented a capital expenditure of over £350,000 as recently as 1969—then we certainly anticipate that our digital design may well form the basis for industry to produce such replacements.

But we feel it is hardly fair to suggest that our engineers are part and parcel of a plot to force viewers unwillingly on to 625-line u.h.f. stations. It just ain't so.—**Pat Hawker** (*ITA Engineering Information Service*).

It seems then that the broadcasting authorities are not, in spite of earlier suggestions, going to "go digital" with their 625-405 standards converters. The present generation of line-store standards converters are not going to get better—only worse! What sort of 405-line picture are we to expect in, say, two years' time? And who exactly, the government or the broadcasting authorities, takes final responsibility for the expenditure/engineering policy decisions that determine what the viewer will eventually see?—*Editor.*

MODIFIED SYNC CIRCUIT

I have recently completed a single-standard 625-line receiver using circuits published in your series *Basic Circuits for the Constructor* by J. W. Thompson and while I am very pleased with the receiver's performance I would nevertheless like to mention a modification I found necessary—to the sync separator circuit shown in the instalment in the September 1971 issue. The trouble was persistent triggering on picture no matter what the setting of the "set sync bias" control, indicating that the sync separator stage Tr36 was not doing its job. As the difficulty was assumed to be the result of insufficient video at Tr36 base the circuit was modified as shown in Fig. 1: the job of sync separation was transferred to Tr37, Tr36 being used as a preamplifier. The gain of the preamplifier stage as initially tried out was found to be insufficient, with weak sync performance on low-key pictures: on increasing the gain, however, by using the component values shown in Fig. 1, good sync performance was obtained. The BA145 diode provides protection of course for the BF117.

I have also found that adding a 2,700pF capacitor across the two tags above tag A on the line output transformer (see Fig. 7, page 79, December 1971, left-hand side of diagram) helps to minimise vertical striations on the left-hand side of the raster. These tags are connected to a small winding which in other designs provides the flywheel sync feedback pulse.

I hope these comments will prove of use to other constructors—they are in no way intended as criticism of an excellent series of articles.—**K. G. Whitehouse, B.Sc.,** *Dudley.*

J. W. Thompson comments: Any problems with the sync performance of my original circuit are likely to be due to variation in transistor parameters. As there was not a great deal of safety margin in this respect I think Mr. Whitehouse's circuit constitutes a worthwhile improvement and I recommend that any constructor who has experienced weak sync should try it.

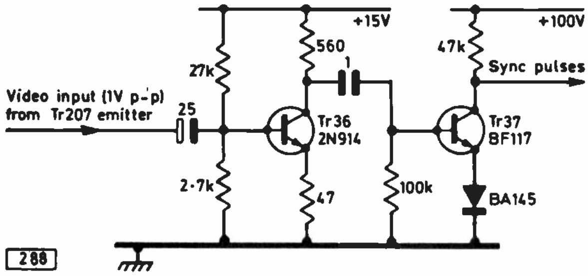
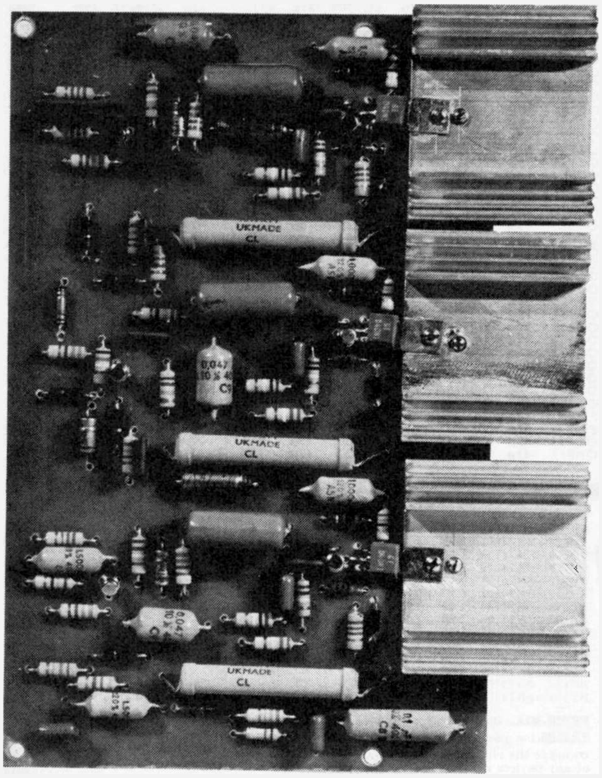


Fig. 1: Sync circuit suggested by Mr. Whitehouse

THE 'TELEVISION' COLOUR RECEIVER PART 5 RGB & AUDIO MODULES



AUDIO MODULE

THE design of a suitable audio output system for a television receiver presents a delicate question: should the quality aimed at be the best possible in order to give full justice to the transmitted sound or should the quality be satisfactory for the majority of viewers and little else?

The problem is not really one of cost—if an extra few pounds could result in hi-fi performance there would be little argument about which way to proceed. Unfortunately however the conventional television receiver as a sound reproducer inevitably leaves a lot to be desired. Although a reasonably sized cabinet could be made in order to incorporate a loudspeaker enclosure of hi-fi dimensions a television set is not really suitable for hi-fi levels of reproduction. The power considered necessary for hi-fi results is at least 8-10 watts: this would inevitably lead to microphony in a television set—particularly in the shadowmask tube. There is little point therefore in striving towards the design of a perfect audio output stage, although provision should we feel be made to enable the audio signal to be extracted to drive an external hi-fi system.

The drive level available for the audio module is about 23mV (as noted in part 4) and for reasonable reproduction we would like some 2·5 to 3 watts. Commercial receivers average around 2 watts at the present time and this is probably a little too low to give a reasonable dynamic range for transients. To get 2·5-3W using discrete circuitry we would probably need a five transistor amplifier with coupling, bias, load and feedback components plus a specially designed printed circuit board and suitable heat sinks. The total cost would be likely to be of the order of £3·50 to £4. It was therefore decided to use an integrated circuit amplifier instead though selection is rather limited for the gain required.

The General Electric GEL263S1 integrated circuit gives the required gain and output power with a possible 3·5W into 16Ω from a 30V rail and a maximum possible sensitivity of about 9mV. Cost too is right and although we expect some criticism about the choice of an integrated circuit from a manufacturer who has now pulled out of the i.c. market supplies of the chosen unit have been guaranteed for the project and for future replacement needs.

Audio Module Circuit

The complete circuit of the audio module is shown in Fig. 1—the integrated circuit is contained within the dotted outline. It consists basically of a differential amplifier Q1 and Q2 which provides the gain of the unit plus a quasi-complementary push-pull output Q4-Q8. The Darlington output configurations (Q4-5 and Q7-8) allow the differential amplifier to operate at low currents so providing high sensitivity, low noise and stability. The basic stability of the input stage is partially assured by integration but even so the d.c. base voltages of Q1 and Q2 must match closely to provide stability with temperature changes.

The load resistance of Q2 consists of the external resistors of R807 and R803 and the chain of forward biased diodes between the base of Q4 and the base of Q6. These diodes principally determine the bias current of the output stage and as long as the current exceeds 0·5mA crossover distortion is extremely small.

The symmetry of the output stage and the bias arrangements of the differential amplifier determine the voltage at pin 7 of the i.c. which will be half the supply rail (i.e., +14V in our circuit). The d.c. voltage from the potential divider R804/R805 (about 3·1V) sets the base bias of Q2 while the bias of Q1 is set to the same value by R801/R802.

The signal gain of the circuit is determined by the

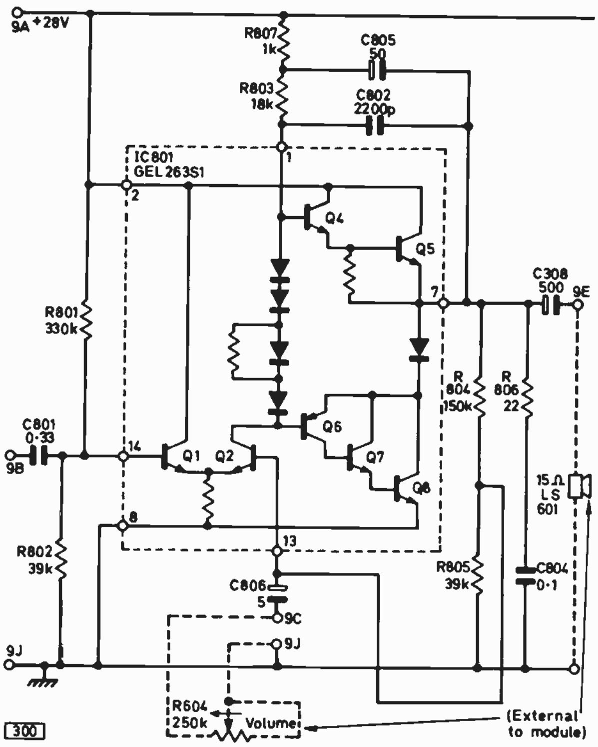


Fig. 1: Circuit of the audio module.

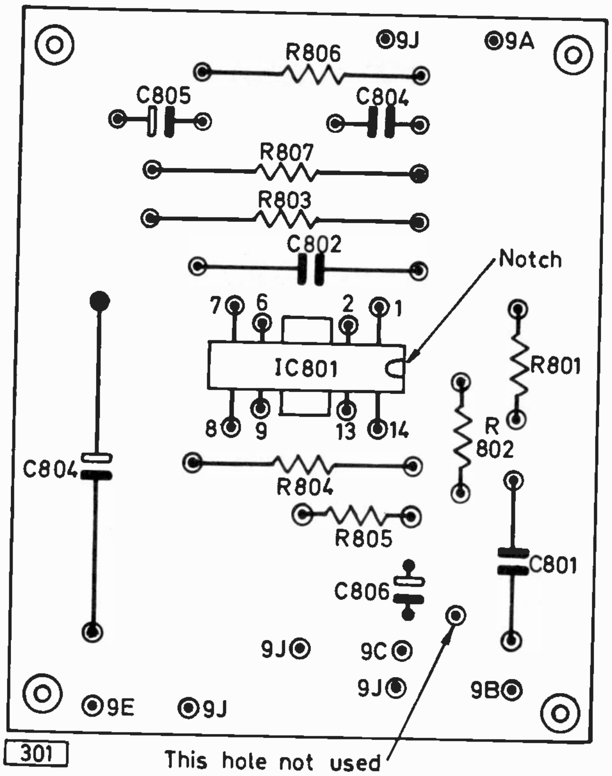


Fig. 2: Audio module layout viewed from the component side.

amount of negative feedback at the base of Q2. The signal is derived from the potential divider R804/R805, the volume control (R604) being effectively in parallel with R805. Because R604 is capacitively coupled by C806 it varies only the a.c. conditions of the circuit. When R604 is set to zero resistance there is no feedback signal since C806 completely decouples R805: the amplifier gain is then maximum. With R604 set to maximum resistance (i.e., 250kΩ) its effect is negligible in comparison to R805 (39kΩ): the feedback signal determined by the ratio R804/R805 is then maximum and the amplifier gain minimum. This arrangement gives a sensitivity range of about 30dB which is more than sufficient for normal volume control use. It also means that the volume control is not placed where the fairly low-level audio signal is coupled from the i.f. strip to the audio circuits, reducing the problems of noise and hum pick up and relieving some design problems in maximising the de-emphasis of the f.m. signal. The signal will however be fed to an audio break-jack to provide an auxiliary output.

Frequency Response

The upper −3dB frequency point of the integrated circuit itself is extremely high. The whole unit is internally d.c. coupled so there is no basic low-frequency roll-off point while the high-frequency point is about 150kHz. If the circuitry external to the i.c. had such a passband there would be grave dangers of instability on input transients and noise. External h.f. roll-off is therefore provided: there are two networks, a shunt path across the loudspeaker with R806/C804 and a feedback path through C802. It is important that the latter component is a low-inductance type to prevent possible resonant feedback. A more general frequency roll-off is provided by C805 across a smaller fraction of the bias determining network R807/R803 and this allows a greater positive voltage swing at the output, i.e., it introduces bootstrapping.

The earthed loudspeaker load must be d.c. isolated from the output point and C803 determines almost entirely the low-frequency performance of the amplifier. The value of 500μF was chosen as a compromise between low-frequency performance, cost and size.

Performance

The integrated circuit is used in slightly derated conditions with a 28V supply rail. Total harmonic distortion of 2% coincided with an output power of just over 3W. This output resulted in an internal package dissipation of just 2·5W—a 54% efficiency. The dissipation was therefore well within the allowable 5W maximum package dissipation.

The lower −3dB frequency point of the amplifier is about 30Hz while the upper limit is about 16kHz. Weighted noise on the module related to full output is −64dB.

Construction

The components list and Component-pack supplier (East Cornwall Components) for the audio module (Pack No. 7) were given last month. The layout of the module is shown in Fig. 2.

It is *vitally* important to note that the circuit board

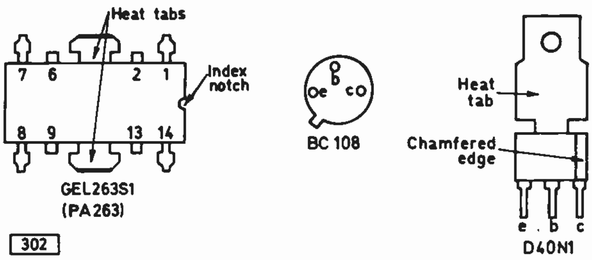


Fig. 3: Base connections: integrated circuit viewed from above, BC108 from below and the D40N1/2/3 looking down on the chamfered edge side.

used is designed in accordance with the i.c. manufacturer's recommendations for layout and heat dissipation. The board is double-sided with the upper side (the component side) acting as a heat sink for the integrated circuit. The pin connections for the GEL263S1 are shown in Fig. 3 and it should be noted that *it is possible to mount the package the wrong way round.* As a precaution against this the notch on the integrated circuit should be aligned with the painted "notch" marked on the circuit board. Note that if this board is obtained from anywhere other than the suppliers of Component-Pack No. 7 any other markings and circuit references on the board *must be ignored.* We do not advise the constructor to make his own board for this module—stability is maximised on the board supplied and instability and integrated circuits spell disaster when they occur together.

The integrated circuit should be mounted first on the board (note that notch position) and a gentle easing of the pins will be needed to mount all eight and the two tabs together. The i.c. package must next be soldered into place: the two heat tabs *must be soldered to both sides of the board* otherwise the heat sink effect of the top surface will be unused. You must make this soldering the most deliberate and careful thing that you do this month. If you have a temperature-controlled iron all the better. Apply solder to the vertical parts of the heat tabs only and as soon as it flows remove the iron. Cool the i.c. by blowing after doing the upper side of one tab, allow a minute for the ambient temperature of the package to reach room temperature again and then repeat the process for the upper side of the other heat tab and then again for the lower sides of the tabs. Slowness is the correct speed between solderings but don't be dilatory while you are actually soldering one of the tabs: don't panic, and hold the soldering iron nice and steady. Then go on to the other eight pins of the integrated circuit treating these as if you were soldering a transistor and leaving a generous cooling time between each pin.

You can now mount the other components in the positions marked in Fig. 2. Note the polarity and holes used by the electrolytics and note that C805 has to be mounted vertically: insert the negative lead end through the board as far as possible and solder, then bend the positive end over and through its mounting hole. The component is fitted with an insulating sleeve so there is no danger of it shorting.

Now go back and check the positions of all the components. R604 (the volume control) and the loudspeaker are part of the cabinet fittings and are not connected to the module at this stage.

RGB MODULE

There are a number of reasons why RGB drive may be considered an improvement on colour-difference drive in a colour receiver; on the other hand there are a number of factors that favour colour-difference drive (i.e. R—Y, G—Y and B—Y to the grids of the tube and –Y to the cathodes). With colour-difference drive a monochrome picture will always be displayed as accurately as the receiver has been set up, the colour-difference signals all falling to zero on monochrome. With RGB drive a monochrome display will only be obtained when the receiver has been set up correctly and each of the three channels is stable in gain and black level. The grey-scale too will be accurate only if the three channels all have the same linearity relationships. The signal levels required for colour-difference drive are however significantly higher because the grids are driven with the colour-difference signals leaving the conventional negative-going luminance on the cathodes: any colour-difference drive system requires about 70% more signal because of the +ve/–ve voltage swings of the signals.

In addition the cathode of any thermionic device is about 30% more sensitive than the grid for signal driving. A grid-drive system modulates the electron beam in sympathy with the applied signal but the velocity of the beam is dependent on the anode-cathode potential, which is constant. With cathode drive not only is the beam modulated by the signal but the negative-going signal increases the anode-cathode voltage thereby increasing the beam current. In fact where say 100V is required for cathode drive 130V would be needed for grid drive.

This difference in the drive levels required gives rise to a second difference—in the transfer characteristics of the electron gun. Although similar drive levels might be employed in alternative systems of grid and cathode drive the efficiency of cathode drive is higher resulting in a higher gamma. The transmission gamma used in this country is in fact matched to cathode drive of the shadowmask tube so RGB drive would logically give the correct grey-scale and colour-scale.

There is also the fact that with colour-difference drive the luminance and colour-difference signals cannot be matrixed perfectly because of the difference in gammas between the two electrodes. Even with a well set up colour-difference receiver there are occasions when this can be seen—e.g. with very low-level luminance signals the display can often be seen to be just colour-difference.

With RGB drive the lower peak-to-peak voltages required at the tube cathodes make transistor output circuits more practical while the presence of the grids between the high-voltage electrodes and the cathodes reduces the chances of destructive internal flashovers.

A much fuller comparison of RGB and colour-difference drive will appear in a later issue of the magazine.

RGB Amplifier Requirements

To comply with the transmission characteristics RGB drive is the correct solution but great care must be taken in the design of the output stages if distortions far worse than those with colour-difference drive

Table 1: Components List

Component-Pack 8

D201	BA145 or BA199/350	Tr201	BC108	Tr204	BC108	Tr207	D40N1*
D202	BA145 or BA199/350	Tr202	BC108	Tr205	BC108	Tr208	D40N1*
D203	BA145 or BA199/350	Tr203	BC108	Tr206	BC108	Tr209	D40N1*
D204	BA145 or BA199/350						

* The higher gain or voltage versions D40N2 or D40N3 may be supplied in place of the D40N1: it is vital that Tr207-Tr209 are all the same type, either D40N1, D40N2 or D40N3.

R201	330 Ω	R211	2·2k Ω	R221	220k Ω	R231	100k Ω	R241	18 Ω
R202	560k Ω	R212	270 Ω	R222	100k Ω	R232	100k Ω	R242	18 Ω
R203	1k Ω	R213	3·3k Ω	R223	220k Ω	R233	100k Ω	R243	1k Ω
R204	1k Ω	R214	3·3k Ω	R224	2·2k Ω	R234	5·6k Ω	R244	1k Ω
R205	3·3k Ω	R215	6·8k Ω	R225	2·2k Ω	R235	5·6k Ω	R245	1k Ω
R206	220k Ω	R216	1·8k Ω	R226	1k Ω	R236	5·6k Ω	R246	8·2k Ω
R207	2·2k Ω	R217	6·8k Ω	R227	1k Ω	R237	100 Ω	R247	68k Ω
R208	130 Ω	R218	100k Ω	R228	1k Ω	R238	100 Ω	R248	560k Ω
R209	3·3k Ω	R219	220k Ω	R229	12k Ω	R239	100 Ω	R249	27k Ω
R210	220k Ω	R220	100k Ω	R230	3·6k Ω	R240	18 Ω		

R234, R235 and R236 are 10W, 5% wire-wound, all others are ½W, 5% carbon film.

C201	1 µF	C207	27pF	C213	22 µF	C219	0·1 µF	C225	47nF
C202	15 µF	C208	27pF	C214	22 µF	C220	0·1 µF	C226	47nF
C203	1·5nF	C209	27pF	C215	47pF	C221	0·1 µF	C227	47nF
C204	680pF	C210	2·2 µF	C216	68pF	C222	1nF	C228	1·5nF
C205	6·8 µF	C211	2·2 µF	C217	0·1 µF	C223	1nF	C229	0·1 µF
C206	6·8 µF	C212	2·2 µF	C218	0·1 µF	C224	1nF		

27, 47, 68 and 680pF capacitors are mica or 5% polystyrene. 1 to 47nF capacitors are C296. 0·1 µF capacitors are C280 *except* C221 which is *400V* C296. 2·2 µF capacitors are C280. 1 µF is 40V electrolytic. 6·8 µF capacitors are 25V electrolytic. 15 µF is 25V electrolytic. 22 µF capacitors are 25V electrolytic.

Three 2⅓ × 2in. heat sinks.

Optional: 2oz Redpoint thermal conducting grease.

Component-Pack 9

L201, L202, L203 subminiature r.f. chokes 100 µH, *fr* = 7·1 MHz.

Miscellaneous

Printed circuit board.

Component-Pack Suppliers

No. 8 A. Marshall & Son Ltd., 28 Cricklewood Broadway, London, NW2.
Cost: £5·85 including postage (without Redpoint).
£6·05 including postage (with Redpoint).

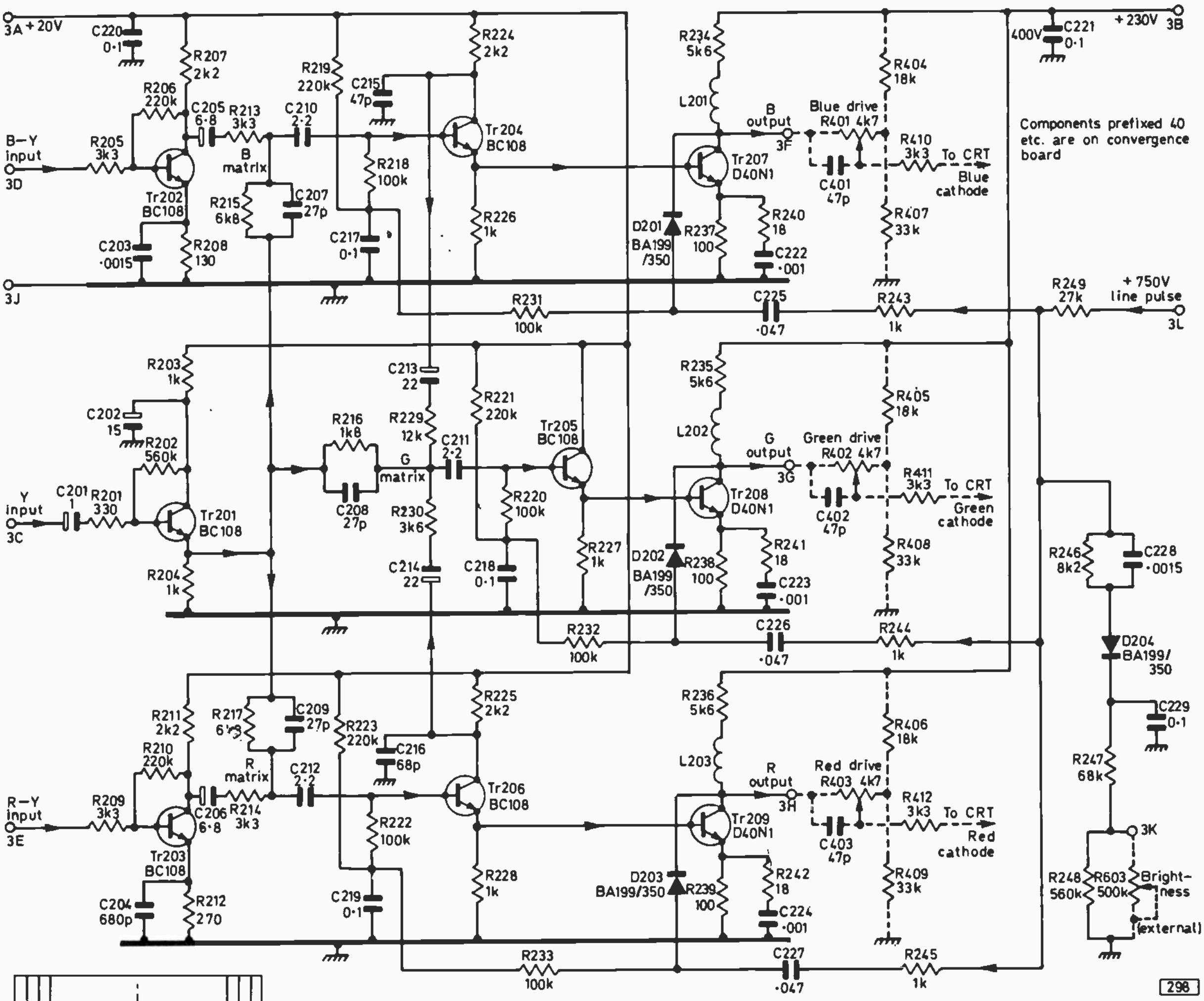
No. 9 East Cornwall Components, PO Box No. 4, Saltash, Cornwall.
Cost: 51p including postage.

Printed Circuit Board (TV RGB 1)
E. J. Papworth & Son Ltd., 80 Merton High Street, London, SW19.
Cost: £1·00 including postage.

Readers should order components from the suppliers as "Component-Pack No. . . ." for the TELEVISION Colour Receiver Project. For Component-Pack No. 8 it should be noted on the order whether the Redpoint Grease is required (see text).

are not to occur. The main difficulties are that the R, G and B amplifiers must match one another extremely well in terms of bandwidth, gain and any non-linearity. It should be remembered that each of the signals in an RGB system must be full bandwidth (i.e. 5·5MHz) in order to give the correct results.

The layout of the amplifiers must therefore be identical and the circuits precisely matched in order to achieve reasonable results. If the R, G and B amplifiers have different bandwidths (i.e. different rise



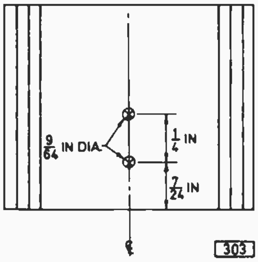


Fig. 4 (above): Circuit of the RGB matrix and output module. Components shown with dotted connections are on the convergence panel.

Fig. 5 (left): Heatsink drilling details.

times) there will be colour fringeing while different non-linearities (perhaps due to different gains) will prevent the grey-scale tracking being correct. The stages must also be extremely stable in terms of gain because any differential drift between them will cause inconsistencies in grey-scale; the same is the case if the black-levels should drift between channels. The stages must therefore be underrun so that they are in their most stable condition.

The sensitivities of the phosphors on the faceplate of a shadowmask tube are not equal in terms of the amount of beam current required to give a particular light output. The sensitivity of the red phosphor is usually the lowest with green falling second: the variations differ slightly between tube makers but are roughly in the proportion red:green:blue of 100:94:92. With an older tube the red phosphor may be even less sensitive compared with the other two. The need for slightly different voltage drive levels is not really compatible with the use of equal-gain amplifiers and it is preferable in an RGB design to operate the output stages at the same gain and to set the voltage differences by using potentiometers at the output points.

To get full beam current from the present range of shadowmask tubes each of the channel amplifiers must provide a peak-to-peak voltage swing of about 150V. The load resistance of the output stage is limited by the h.f. response drop-off that occurs due to the shunt capacitance across the load: this resistance limitation places quite heavy demands on the current capability of the output transistors.

Inputs to the RGB Module

The circuit of the complete RGB module is shown in Fig. 4 and is basically due to Graetz. The three inputs—luminance (3C), blue colour-difference (3D) and red colour-difference (3E)—come directly from the i.f. strip (Y) and the decoder (B – Y and R – Y). In order to simplify matters we will consider circuit gains etc. to a first order of accuracy only.

At the luminance input we have available up to 4V of positive-going signal (the exact voltage depends on the setting of the contrast control) while at the colour-difference inputs we have negative-going signals of up to 500mV peak-to-peak R−Y and up to 300mV peak-to-peak B−Y. The amplitude differences between the colour-difference signals are due to the signal weighting carried out in the studio coder before transmission. The quotation of 500 and 300mV is only approximate because the V and U signals that are detected are in fact in the proportion of 0·877/0·493 (i.e. 1·78) where V=0·877 (R−Y) and U=0·493 (B−Y). The amplitudes quoted are also the maximum because the exact values depend on the setting of the saturation control: the control reduces or increases both signals in their modulated condition so that they always remain in the correct proportions.

This weighting imbalance must be removed from the two signals and they must be brought up to a level suitable for matrixing. The circuit is a little unusual in that instead of first forming a G−Y signal and then matrixing to form R, G and B the red and blue signals are formed first and these are then used with the luminance to form the green signal directly. There are some advantages in this in terms of the accuracy of the matrix and the noise performance.

Only the luminance input is d.c. isolated (by C201) the other two inputs having already passed through isolation capacitors on the decoder module.

Input Stages

Each of the input stages has parallel-applied negative feedback in the form of a direct coupling resistor from collector to base—R206, R202, R210. These resistors in combination with the source resistors—R205, R201, R209—reduce the input voltages to the transistors. The luminance stage Tr201 is an emitter-follower and the decoupling capacitor at its collector (C202) means that the feedback will only be effective at low frequencies and for d.c. biasing. Because the feedback resistors are connected directly between the collectors and the bases the feedback factor is unity and the input resistance is reduced to approximately $Rf/(1+m)$ in parallel with $hie+hfe.Re$ where Rf is the feedback resistance value, m is the stage gain and Re the emitter resistance. For Tr201 the input resistance works out at approximately 100kΩ so that the inclusion of R201 (330Ω) hardly affects the signal level at the base and up to 4V is still available (still positive-going) at the emitter.

For Tr202 Rin is reduced to about 10kΩ and for Tr203 to about 20kΩ. With the series resistances R205 and R209 the −(B−Y) and −(R−Y) signals present at the respective transistor bases will therefore be about 230 and 435mV. The basic gains of the two stages also differ, with the B−Y amplifier having a gain of approximately R207/R208 (16·8) and the R−Y amplifier a gain of approximately R211/R212 (8·2). The emitter bypass capacitors C203 and C204 become effective only at the edge of the 1MHz band to give some h.f. compensation to the incoming signals and to compensate for the effect of the input capacitance of the transistors. C203 and C204 have different values because they are decoupling different values of emitter resistance but their effects on the two channels are similar.

The signals at the collectors Tr202 and Tr203 are therefore 230 x 16·8mV and 435 x 8·2mV—i.e. both are between 3·5 and 4V and both are positive-going. A more accurate analysis would show that they were equal in value at about 3·6V. Feedback to this great extent is necessary to even out the vast differences in $h$fe that can occur between samples of BC108.

Matrixing

Thus with the saturation control fully advanced there will be about 3·6V of B−Y at Tr202 collector, 3·6V of R−Y at Tr203 collector and about 4V of Y at Tr201 emitter. Let us assume for the moment that the saturation and contrast controls are reduced slightly so that all the voltages are equal at about 3V. The B−Y and R−Y signals pass through coupling capacitors C205 and C206 and matrixing resistors R213 and R214.

At the junction of R213 and C210 the B−Y signal is matrixed with Y signal coming from Tr201. The source impedance of the B−Y signal is about 5·5kΩ (R213 plus the output resistance of Tr202—i.e. about 2·2kΩ) while that of the Y signal is about 7kΩ (R215 plus the output resistance of the emitter-follower Tr201). To get a pure blue signal at the junction point therefore only the balance between the saturation and the contrast controls need be set up. A similar situation exists at the junction of R214 and C212 to produce the red signal. The fairly large size of the matrixing resistors is necessary to restrict crosstalk between channels within the matrix.

The 27pF capacitors C207 and C209 in parallel with the luminance coupling resistors give a little h.f. compensation to the luminance signal—compensation which could not be simply applied to the Tr201 emitter-follower stage.

The third luminance signal path (through R216 and C208) is to the green signal matrix—we will return to this in a moment.

Driver Stages

The blue and red signals are coupled through C210 and C212 to the bases of the driver emitter-follower stages Tr204 and Tr206. The polarity of the signals at the emitters is positive-going.

In addition to providing emitter-follower action Tr204 and Tr206 both act as common-emitter amplifiers giving −B and −R signals which are coupled via C213/R229 and C214/R230 respectively to the green mixing point (junction of C211 and R216).

The gain of both Tr204 and Tr206 is approximately 2·2 (ratio R224 : R226 and R225 : R228) and the values of R229, R230 and R216 are chosen to give at the base of Tr205 a green signal of similar amplitude to the corresponding blue and red signals at the bases of Tr204 and Tr206.

Now Y=0·3R+0·59G+0·11B so we could reform the equation in terms of green as follows:

$$G=(Y-0{\cdot}3R-0{\cdot}11B)/0{\cdot}59.$$

The phase reversal of the blue and red signals required to obtain negative signals is undertaken by Tr204 and Tr206 respectively. The proportions of 0·3 and 0·11 are provided by the ratio of R229 to R230 (i.e. 12kΩ : 3·6kΩ). The luminance feed to the G matrix not only has to balance with 0·3R and 0·11B but must also take account of the larger signals resulting from the gain of 2·2 in Tr204 and Tr206. The value of 1·8kΩ for R216 is also determined by the reduction in voltage of the B and R signals due to their own matrixing. The base resistance of the matrix is very small as it is due to the output resistance of the emitter-follower Tr201. This ensures minimum crosstalk between the colour channels during the matrixing process.

It will be noticed that the $-B$ feed from the collector of Tr204 and the $-R$ feed from the collector of Tr206 are decoupled by fairly small capacitors (C215 and C216). These are present because the reconstituted green signal is due in the main to the luminance signal, all the bandwidth above 1MHz coming from this luminance feed. It is not necessary therefore to pass full bandwidth blue and red signals to the G matrix point and indeed if this were done the noise on the reformed green would be unnecessarily high. The values of C215 and C216 are different because although they both remove the blue and red content above 1MHz the load resistors they feed through in the matrix are of different values. We have therefore a half-section low-pass filter with C215 and C216 chosen to give a -3dB point at about 1·2MHz.

RGB Output Stages

From each of the emitter-followers Tr204, Tr205 and Tr206 we have pure blue, green and red signals, all positive-going and all of a possible magnitude of up to 3V. The output amplifiers are identical in order to satisfy the stringent requirements of RGB drive.

The gain and voltage requirements of a single transistor output stage for full bandwidth signals are quite severe. The transistor should have a current transfer ratio of 50, an f_T of 60MHz, a dissipation capability of 5 watts and a *V*cer of 250/300V. If possible its capacitances should be extremely small as well.

Many would recommend the use of simpler devices in a cascoded output stage using two transistors, with the lower transistor carrying the burden of f_T and current gain and the upper one carrying the burden of dissipation and voltage capability. Indeed with some of the ever popular transistors this would seem not only desirable but necessary—e.g. with the BF179. But if a transistor exists that meets the required specifications it would seem pointless not to make use of it.

The chosen device—the General Electric D40N1—has a typical f_T at the working conditions of about 90MHz, a *V*cer of 250V and a typical current transfer ratio of 40/50. The collector capacitance is less than 3pF and the power dissipation using the correct heat sink is about 6·25W. This is an extremely satisfactory and economic solution to the problem. The higher gain or voltage types D40N2 and D40N3 are equally suitable and may be supplied in Component-Pack 8: it is vital to make sure that the three transistors used are all the same type, either D40N1, D40N2 or D40N3.

In common with all high-voltage video amplifiers the input impedance at the base of the transistor must be kept extremely low. The emitter-follower drivers (e.g. Tr204 for Tr207) have an output resistance of less than 10Ω (*h*ie/*h*fe) but compensation for the Miller effect input capacitance of the output transistor is still required. For Tr207 this is mainly provided by the emitter bypass capacitor C222. The two time-constants of the correction—C222 × R237 and C222 × the transistor's output resistance—are both low and the correction is active up to about 2MHz: the degree of correction in this stage is set by the value of R240. The same technique is used in the other two output stages.

The output capacitance of the transistor (about 3pF maximum), the cathode to earth capacitance of the c.r.t. gun (5-5·7pF), the protection spark gap capacitance (1pF) and the circuit strays (about 3pF) give rise to a total shunt capacitance across the output of about 12·4pF (mean). To get maximal frequency response flatness up to 5MHz demands a correcting shunt peaking coil of about 85μH. Some of the inductance required is provided by the wire-wound load resistance (R234 in the blue channel for example) and the output level control potentiometer (R401 for example) however, while the manufacture of a peaking coil inevitably involves the introduction of a proportionate amount of self-capacitance—unless the physical size of the inductor is of no consequence. Taking into account the inductances already present in the circuit then the requirement for the peaking coil is that it should be self-resonating at about 6·9MHz with an inductance of around 95μH. Allowing for some additional stray capacitance due to the leads to the convergence panel (on which the drive presets are mounted) and the leads to the tube base a commercially available choke of 100μH with a self-resonating frequency of 7·1MHz fits well with the calculation. On test the output stages had a response within 2dB up to 5·4MHz.

It should be noted that the calculations and tests made assumed the use of the particular type of choke selected and the drive level potentiometer which will be specified in the convergence module description. Any deviation from these conditions will inevitably give results that are not up to the test results.

Each of the output stages has a low-frequency gain of about 56 (5·6kΩ/100Ω) so the peak voltage swing at the collector of the transistor could be as great as 150V (this level would never be used but the system must be capable of it). This places a current demand on the transistor of about 20mA although peak currents of up to 30mA can be expected. The 5·6kΩ collector load resistance must therefore be rated at 5·5W at least and for stability of value 10W components are specified.

The output signal is coupled to the shadowmask tube cathode from the slider of the drive potentiometer in each channel (e.g. R401 in the blue channel). The d.c. conditions of the output stages remain unchanged whatever the setting of the potentiometer because of the d.c. block in the connection to the slider (C401 in the blue channel). Some source resistance is added in the leads to the cathodes (e.g. R410) to give added protection against flashovers which might otherwise damage the output transistors; the source resistance looks less inviting to the flashover than the spark gap also connected to the cathode!

The video signals at the output points are of course negative-going.

Clamping

Control of black level is vital in a colour receiver and it is particularly important that the control in each channel is the same.

A feedback clamp arrangement is employed: +750V line flyback pulses are taken from the line output transformer to point 3L in the circuit. They are fed to diodes D201, D202 and D203 through resistive coupling and d.c. blocking capacitors. Considering just one stage—the blue again for convenience—D201 conducts when the line flyback pulse is present and if the collector of the output transistor is at a lower voltage level at that instant the voltage difference is added to the bias voltage being applied to Tr204 base. The feed resistance of this d.c. control

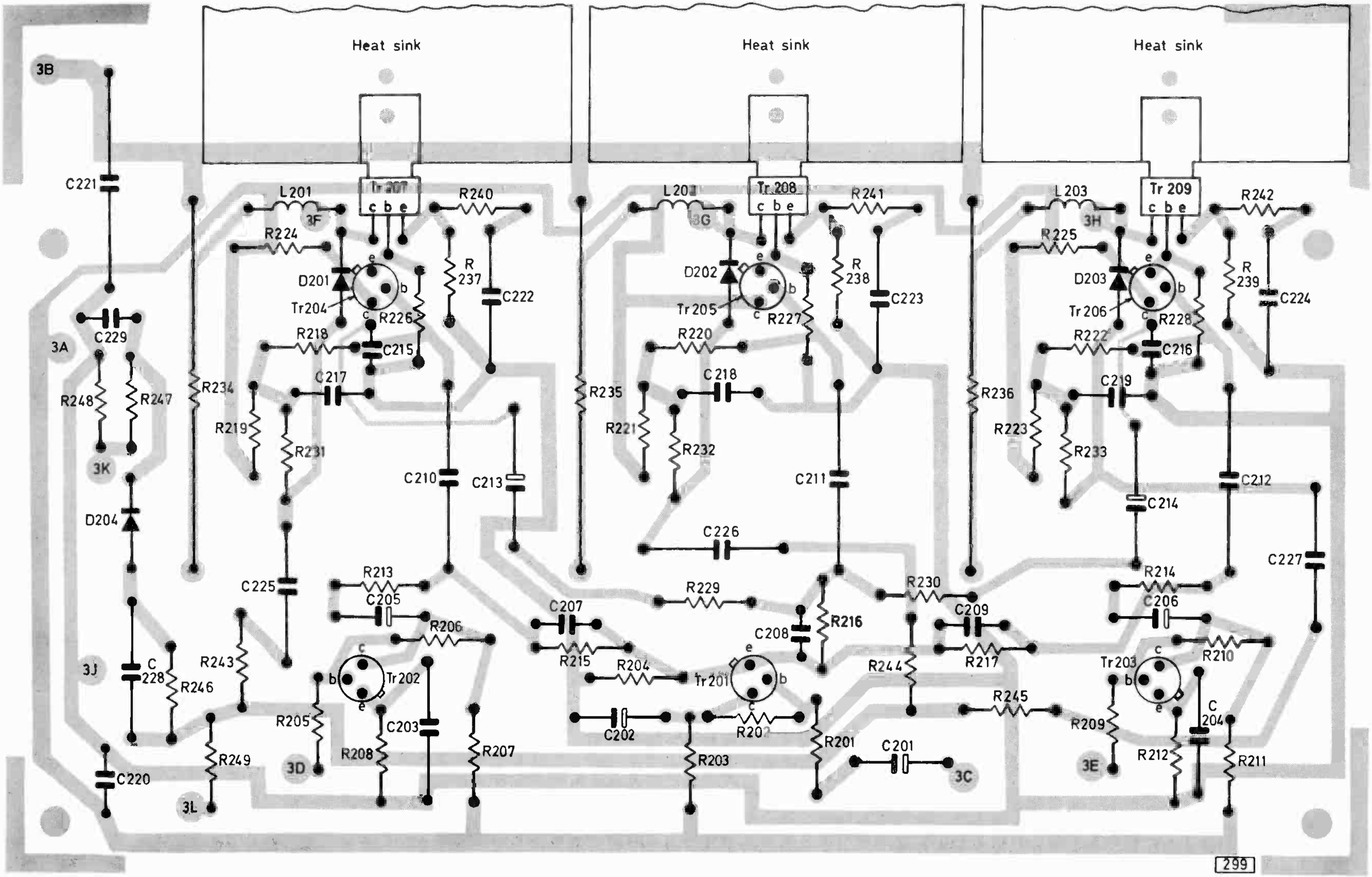


Fig. 6: Layout of the RGB colour output and matrix module, viewed from the copper print side. All components are mounted on the other side of the board. To scale.

path is high ($R231 = 100k\Omega$) to prevent the clamp pulses directly affecting the base of Tr204: C217 decouples the point as an additional precaution.

The effect of the feedback is to vary the d.c. level at the base of Tr204. If say the base bias is increased as a result of the feedback then the voltage at the emitter will also rise thereby reducing Tr207's collector voltage. The action results in a fairly heavy (i.e. high speed) clamping action. The types of diode available for this sort of application and with a high enough voltage rating are few and double-diffused silicon types are suggested in our module.

The amplitude of the clamp pulse applied to all three channels simultaneously is set by the external potentiometer R603 which forms part of the lower arm of a potential divider at the pulse input (R249 is the upper arm and R246/D204/R247/R248/R603 the lower arm). As this action varies the d.c. level of all the video output signals together R603 is used as the brightness control.

RGB Module Construction

We are well enough advanced in the project to make it unnecessary to repeat the basic constructional information given before. If you are making your own printed circuit board do ensure that the layout is symmetrical and in order to achieve the same stray capacitance as the commercially available board the layout around the output points should be closely adhered to. Fig. 6 is drawn to scale.

The complete list of components and suppliers for the module is given in Table 1. Note that an optional supply of thermal conducting grease can be supplied with Component Pack No. 8. We would strongly recommend the use of thermal grease when mounting the power transistors as it halves the thermal resistance of the joint between the transistor heat tab and the heatsink; the grease is listed as optional simply because a number of readers may already have suitable grease.

After obtaining your components and either buying or making your printed circuit board drill all the holes in the board except the pair required for each of the heatsinks. All but six of the holes for the components can be 1/32in. and the edge mounting holes are as usual 3/16in. diameter. The exceptions for component mounting are the holes for the 10W load resistors: these should be 1/16in. diameter.

Next the heatsinks: as can be seen from the layout diagram Fig. 6 the tolerances of the positioning of the heatsinks must be quite high. First make two holes in each sink as indicated in Fig. 5—and be warned that if you're out of practice drilling then you will almost certainly break the bit!

Mark an edge against which the front of the heatsinks will lie 5/12in. from the holes already made in the board for the output transistor emitter and collector leads. Centre the heatsinks on this line so that their lines of centre lie opposite the base lead. Now mark the board through the already drilled holes in the heatsinks and drill 9/64in. holes in the board on these six marks.

Mount all the components starting, we would suggest, with the capacitors, and then the resistors, the diodes and the subminiature chokes. When soldering the three high-wattage load resistors do this so that they don't rest on the surface of the board and space them neatly from the other components. The BA145 diodes slope towards the cathode end and may carry a printed legend while the BA199/350 diodes have a coloured band marking the cathode.

Next solder in the six BC108 transistors and then the output transistors (connections in Fig. 3). For the output transistors gently bend the heat tab back slightly (about 30°) and angle the pins approximately right to fall through the connecting holes. Apply a smear of the thermal conducting grease to the back of the heat tab of the transistor and then gently guide its leads into the mounting holes and put a 6BA bolt through the heat tab and heatsink. Bolt up at the back of the board using a washer between the board and the nut. Put in the second 6BA bolt in the hole provided behind the heat tab and tighten that up as well. Although a single bolt would hold the heatsink on the board quite well the second bolt is to prevent the sink swinging around to short-circuit with the other heatsinks.

And there you are—you should have a completed RGB output module with no presets on the board and no alignment necessary. With the transistors and heatsinks specified the output stage should be extremely stable and reliable.

Alternative Components; Supply Delays

Because of shortages in the supply of certain types and values of capacitors alternatives may be supplied in some Component Packs. Readers will appreciate that while some capacitor values are critical others are by no means so: the use for example of a 25μF or 22·5μF electrolytic is in most circuits quite immaterial. When alternatives have been supplied these have been agreed by the designer as suitable.

Many readers have experienced lengthy delays in the supply of Component Pack 3, the decoder coils. This has been due to shortage of some of the formers used. These are not in continuous production but are batch produced, hence the delay in completing packs. It has not been possible to use alternatives as there is little standardisation in this field and there are shortages from all sources.

Alignment Service

The alignment service is intended primarily to assist constructors of the colour receiver in setting up their i.f. strips since this is vital to the correct operation of the set and it is appreciated that many constructors will not have the equipment required to undertake this. Strips will have to be sent in and this raises the problem of damage in transit. Clearly we cannot be responsible for this but to reduce the likelihood of damage we have made arrangements for special polystyrene boxes to be made for the safe carriage of i.f. strips. The alignment service will begin in late August and as mentioned last month a booking service will be operated. Full details of the method of booking and despatch, together with a booking coupon, will be given next month. The despatch box will be forwarded with the notification of the booking. The total charge for the service will be £2·55 which includes the supply of the special box: readers will of course have to meet the despatch charge in addition. Special facilities are being arranged for the repair of faulty units.

Next Month: The sync separator, field oscillator and output and the line oscillator and component-part of the line output stage on the timebase board.

THE SINEWAVE LINE oscillator

KEITH CUMMINS

More and more television receivers employ a sinewave line oscillator circuit. Nearly all colour receivers use this type of circuit and an increasing number of single-standard 625-line monochrome receivers do so as well. This may at first sight seem strange. After all we do not want a sinewave to drive a line output stage—a modified sawtooth waveform is usually needed. Furthermore the sinewave oscillator uses an inductor which means the added expense of a special coil with many turns. It is obvious that there must be very significant advantages in the use of such an oscillator and it is the purpose of this article to investigate these advantages. The development of a suitable circuit for "The Constructor's 625 Line Receiver" is also discussed, concluding with practical details of a circuit which is suitable for this or a similar receiver.

Let us first consider the types of line oscillator circuit available. Over a period of years we have become used to seeing the blocking oscillator or multivibrator being used in most receivers. These oscillators can be directly locked from the incoming line sync pulses or controlled indirectly by a phase comparator —when they become "flywheel" timebases with improved immunity to noise and discontinuity of synchronisation. It is obvious that if a timebase is directly locked by the incoming sync pulses any disturbance to the pulses will directly affect the timebase, appearing as a horizontal displacement or jitter of the scanning lines. This naturally results in partial breakup of the picture, to a degree dependent upon the amount of interference to the synchronisation occurring.

The flywheel line sync technique was developed to improve the noise immunity of the line timebase. It operates as follows. The sync pulse frequency is compared with the line timebase output in a discriminator circuit which produces a d.c. control potential whose polarity depends upon whether the timebase is running faster or slower than the sync pulse frequency. The d.c. signal thus produced is used to control the speed of the timebase so as to reduce any error to zero and thereby synchronise the picture. The control line is connected to earth via a capacitor so that any rapid changes in the output from the discriminator are smoothed out. As a result the control system only responds to the aggregated comparison of several hundred sync pulses. Should some pulses be destroyed by noise or otherwise distorted there is, compared with the line tearing which would occur with a directly locked timebase, little effect on the displayed picture. This is because the instantaneous fluctuations are "ironed out" by the capacitance in the control circuit. The only effect observed therefore is slight bending of the verticals.

Pull-in Range and Noise Immunity

A prerequisite of any flywheel sync system is that the automatic frequency control (a.f.c.) circuit should be capable of pulling the line oscillator into sync taking into account the amount of oscillator drift that can occur between the cold and hot conditions and also over a period of running. The frequency-determining elements in blocking oscillator and multivibrator circuits are resistance-capacitance networks. These do not define the frequency precisely: valve or transistor characteristics and supply voltage fluctuations also have an effect. As a result the a.f.c. circuit has to be able to pull the timebase into sync over a range of several hundred cycles if the synchronisation is to be satisfactory under all conditions. Unfortunately the greater the pull-in range the poorer the noise immunity of the system becomes.

Advantages of the Sinewave Oscillator

It follows that if the line oscillator frequency stability is exceptionally good—to within a few tens of cycles for example—a very narrow pull-in range a.f.c. circuit will be adequate. As a result excellent noise immunity will be obtained. A sinewave oscillator satisfies these stability conditions since its frequency is determined by a tuned circuit. The inductance and capacitance can be made sufficiently large to swamp variations in voltage, valve characteristics and so on, so that the frequency no longer depends on these variable factors. Provided the tuning capacitor has good temperature stability, i.e. is either a polyester or polystyrene type, the conditions can be satisfactorily met. The use of a sinewave oscillator generally means that the line hold control can be dispensed with as a user adjustment: instead the line frequency setting consists of internal adjustment of the oscillator coil core.

It should also be noted that the tuned circuit employed with such an oscillator has a high Q factor which in this case means that even without the positive feedback necessary to make the circuit oscillate it will still "ring". The ringing frequency remains constant: only the amplitude of the waveform decays exponentially with time. The use of the tuned circuit therefore considerably increases the "inertia" effect of the timebase, giving a very efficient flywheel effect which assists even more in providing stable line scanning under difficult conditions.

So we have a very stable oscillator circuit with considerable flywheel inertia, needing only a narrow pull-in range from the horizontal phase discriminator circuit. This happy combination yields excellent noise immunity and great timing accuracy in the line circuit. As colour receivers use pulses derived from the line timebase for many important functions such as burst gating and blanking, a.g.c. gating, black-level clamping etc., a sinewave oscillator is the obvious choice for such sets.

A monochrome receiver also benefits from the use of a sinewave line oscillator: much improved stability of verticals against all forms of line disturbance is obtained and there is no difficulty in using a line-gated a.g.c. system. Generally the locking in is so good that the timebase can be synchronised before the picture is recognisable.

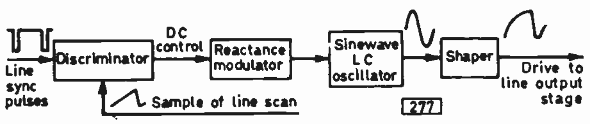


Fig. 1: Block diagram of a flywheel sync line timebase generator using a sinewave oscillator.

Let's now consider the basic system shown in Fig. 1. Moving from left to right we come first to the phase discriminator which compares the incoming sync pulse frequency with a sample waveform from the line timebase and produces a d.c. output proportionate to the error between them. The output will be either positive- or negative-going depending on the sense of the error, i.e. whether the timebase is fast or slow. This output is taken to the reactance modulator which is a circuit which "looks" to the oscillator like either a capacitor or an inductor (depending upon design) placed across the oscillator's tuned circuit. The magnitude of the modulator's reactance is set by the d.c. signal from the discriminator. So it is that the discriminator output controls the frequency of the oscillator—by varying the reactance present across the tuned circuit. The output from the oscillator is taken to a waveform shaping circuit which produces the correct drive waveform for the line output valve.

Most readers are familiar with the discriminator so we shall start with the basic oscillator circuit then go on to the reactance modulator and shaping stages. Readers may recall that the original design of the 625-line receiver avoided the use of inductors wherever possible. The approach employed in the present oscillator circuit avoids the use of a tapped coil or double coil assembly so that the circuit is still kept as simple as possible.

LC Oscillator Circuits

Figure 2 shows a basic oscillator circuit. A parallel tuned circuit LC is connected to the anode circuit of valve V1. A feedback winding provides positive feedback to V1 grid via C1. The grid is returned to chassis via a fairly high-value resistor R1. Rectification of the fed back signal by the diode formed between the grid and cathode of the valve stabilises

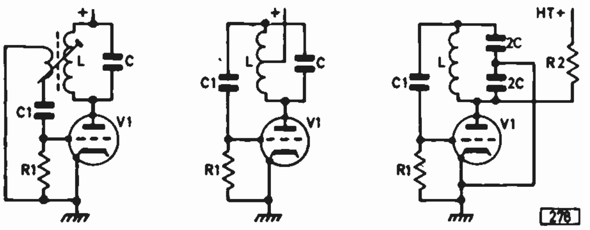


Fig. 2 (left): Basic LC oscillator with feedback via a secondary winding to the grid of the valve.

Fig. 3 (centre): By centre-tapping the winding in the LC circuit the need for a separate feedback winding is avoided as the upper end of the winding provides a feedback signal in correct phase to produce oscillation.

Fig. 4 (right): To avoid the need for a tapped coil the capacitive portion of the LC circuit can be tapped instead as shown here.

the valve's working point and biases it. It should be noted that because of the negative grid base anode current flows only when the signal applied via the feedback winding swings towards a positive peak: the resultant pulses of anode current cause LC to "ring", producing a sinusoidal waveform.

By rearranging things we arrive at the circuit shown in Fig. 3 which avoids the need for a feedback winding. L is tapped instead. As the centre of L is now at earth potential so far as oscillations are concerned (though it is of course the h.t. feed point) the end of the coil shown farthest from V1 grid-cathode diode moves in antiphase to the anode. This phase is of course correct for feeding into the grid via C1 to provide positive feedback—i.e. as the anode goes negative the grid swings positive.

As shown in Fig. 4 it is possible to use capacitive instead of inductive tapping. Here the capacitor C is replaced by two capacitors of value 2C connected in series and thus presenting the same effective capacitance C across L. The junction of the two capacitors is earthed, providing a centre tap for the tuned circuit. Capacitor C1 provides feedback coupling as before. As no suitable "dead point" in the oscillator circuit exists to which to apply the h.t. feed directly it is fed to V1 anode via R2. It will be seen that this resistor is effectively placed across one half of the tuned circuit and thus acts as a damper. Its value therefore should be as high as possible consistant with obtaining adequate supply to the valve.

We have now reached a circuit where a simple inductance is all that is required. The prototype of the circuit to follow used the width control from the early "Teleking" circuit—something which must date the writer! The point however is that this type of variable inductor can be used and many such items can be salvaged from the constructor's "junk tellies" or hoard of old components. For those who do not have access to such components or who do not wish to experiment with coils details of a suitable coil that is available are included at the end of this article.

Practical Circuit

The new line oscillator circuit for the 625-line receiver is shown in Fig. 5. Where possible component numbers have been reallocated. Those marked with an asterisk have been changed to new values. V4 is changed from a PCF80 to a PCF802 (the pin connections of these valves are the same). Valve type PCF802 is a specially developed type intended for use in sinewave line oscillator circuits: it has very low hum and microphony—appropriate to this application.

The oscillator section of Fig. 5 will be seen to be very similar to Fig. 4. The screen grid of V4B is employed as the oscillator anode, with feedback to its control grid. You will remember that the oscillator control grid biases itself back so that only the positive peaks of the feedback waveform cause the valve to conduct: the positive feedback pulses in this case cause current to flow in the screen grid circuit, exciting the tuned circuit, and in the anode circuit, discharging C30 to form the flyback portion of the drive waveform to the line output valve. During the time that V4B is cut off C30 charges through R46 to provide the forward-going part of the drive waveform. The waveform shaping problem is thus simply solved and the line output valve is driven in the normal way.

V4A is the reactance modulator. Its anode is connected directly to the oscillator anode (V4B screen grid). The bias network R42, R43 sets the cathode potential and coupling from the oscillator via Ca is applied to the cathode. Because the reactance of Ca at 15kHz is much greater than the input impedance of V4A the current flow in V4A is approximately in quadrature to that in the oscillator itself. The a.f.c. bias alters the conduction of V4A thus altering the apparent quadrature current flow in the oscillator "anode" circuit. This appears to the oscillator as a capacitance of value dependent upon the a.f.c. bias, so the bias controls the frequency of the oscillator.

The values of Cb and Cc can be changed to suit different components used in the L1 position. The two capacitors should be of the same value: a certain amount of experimenting may be necessary to obtain the correct frequency coverage. In any case L1 should have an adjustable core.

Initially pin 9 (the a.f.c. input) of V4 should be shorted to chassis and L1 adjusted so that the picture is just "running through": removal of the short-circuit will then result in the picture locking.

If this circuit is used in the 625-line receiver the discriminator circuit should be modified as follows (compare with circuit shown in Fig. 3, page 471, August 1971 issue): C25 is changed back to its original value of 1000pF, R40 is removed, R41 is increased to 68kΩ, C26 should be 2200pF as in the later versions and an extra capacitor of value 100pF (C36, Fig. 6) is fitted across D10.

These component changes are necessary to provide the correct frequency response at the discriminator output, bearing in mind the natural tendency for the sinewave oscillator to carry on in its own phase. Correction has to be more abrupt but of lower "cycles per volt" of a.f.c. The addition of the 100pF capacitor C36 reduces the no signal unbalance of the discriminator so that an almost instantaneous pull-in is possible. Note that the tuning of L1 should not be manipulated to correct for any phase error in the raster: if the picture is folded over at one side or the other replace R66 with a 50kΩ skeleton potentiometer as shown in Fig. 6 and adjust this for correct picture phasing within the raster.

Further Developments

The previously published (January 1972) gated a.g.c. circuit and the sinewave line oscillator form part of an up-dating programme on the 625-line receiver to a Mk II "de-luxe" version. A further article will deal with a transistor smoothing circuit which reduces h.t. ripple to negligible proportions and also lowers the working temperature of the mains transformer plus a modification to the brilliance control circuit so that the e.h.t. is completely discharged when switching off.

Coil Details

The measured inductance of the oscillator coil used in the prototype receiver when adjusted to the centre of the pull-in range is 31·7mH. A Mullard Vinkor type LA2311 wound with 303 turns of 34 s.w.g. wire can be used—this sets up right in the centre of its core adjustment. Alternatively P and R Windings, Industrial Estate, Happaway Road, Barton, Torquay, South Devon, can supply to special order (i.e. week-fortnight delivery) a suitable coil at £1·20: this uses a Siemens pot core type N22/250A wound with 354 turns of 34 s.w.g. wire.

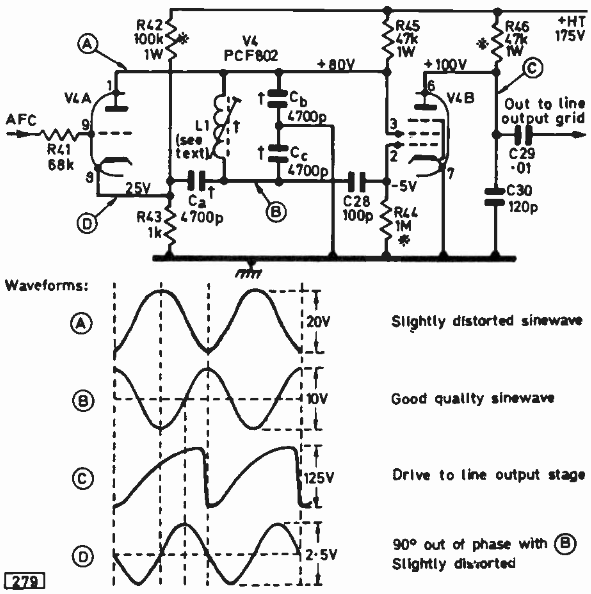


*Fig. 5: Practical sinewave line oscillator circuit developed for use in the Constructor's 625-line Receiver. Items marked † have no equivalent in the original 625 receiver circuit: items marked * have been given part numbers from the original circuit but have new values.*

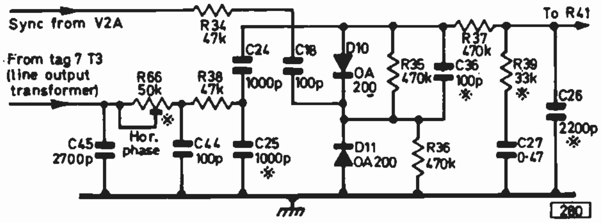


Fig. 6: Flywheel sync discriminator circuit used with the oscillator shown in Fig. 5.

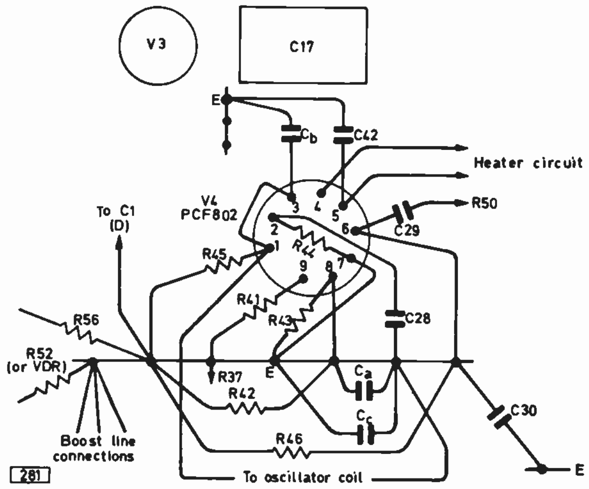
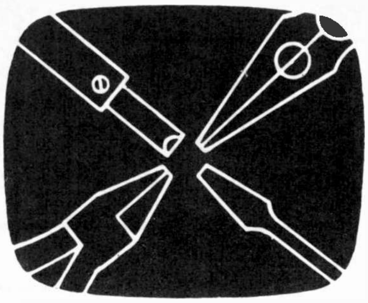


Fig. 7: Layout of the sinewave line oscillator for the Constructor's 625-line Receiver.



SERVICING television receivers

L. LAWRY-JOHNS

BRC 1500 CHASSIS

Ferguson Models 3800, 3801 3802 and 3803.
HMV Models 2800, 2801, 2802, 2803 and 2804.
Marconiphone Models 4800, 4801 and 4803.
Ultra Models 6800, 6801 and 6803.

THE above are some of the models which use the BRC 1500 chassis and give an idea of the coding employed. 17in., 20in. and 24in. models are included in the range. The differences are mainly in the e.h.t. supply, depending on the type of line output transformer and e.h.t. tray used. We show the 15kV unit in our main circuit—as coded with a pink or green dot. The basic arrangement used in the 1400 series—a single panel carrying all parts other than the tuner—is continued in this series. The line output section is now on the inside (hinged) edge of the panel. This is good in some ways and perhaps not so convenient (but safer) in others. All stages up to and including the video amplifier are transistorised.

Common Faults

The faults which we experience more than others seem to concern the tuner unit and the sync stage.

Since these are single-standard sets the i.f. stages are simple and uncluttered by switching. Few faults develop in the i.f. strip which cannot be tracked down by checking the transistor voltages against those shown on the circuit.

Where the sound is present but the picture is absent or very weak we have found C37 (feeding the base of VT9) faulty on several occasions. As it tends to become open-circuit, shunting a similar value capacitor across it immediately shows whether this is the trouble. For test purposes the value is not critical, anything between 20-100μF.

It is our experience that the majority of troubles on the 1500 chassis itself are due to capacitors becoming open-circuit or resistors changing value.

Tuner Troubles

As we are in an aerial group A area—channels 21-34—our tuner troubles may not be those experienced by others living in areas served by the higher channels. We say this because in order for example to receive channel 23 the push bar is almost at its maximum travel, extending the return spring fully and imposing a heavy load on the bar. The bar is soldered in a slot at either side and it appears that the constant pushing and shoving that goes on against the spring tension proves too much: the bar leaves the slot and the tuner no longer tunes. The obvious solution of resoldering the bar in the slots should be accompanied by a release of spring tension (stretch it a bit) so that the bar is not required to live quite so hard a life.

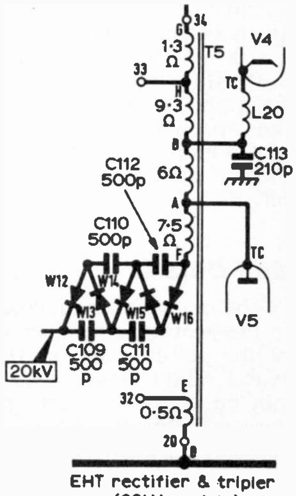
Apart from this the only other tuner troubles we have had have been resolved either by thoroughly cleaning out the grease around the spring washers on the tuner spindle or by changing the first stage r.f. transistor. This transistor is at the receiving end when there are storms about. When the complaint is weak and grainy reception it must be suspected. The type is a BRC TVT1 which is roughly equivalent to an AF139 or AF186. Replacement is not a job for the heavy handed.

Note the supply plug P1 at the lower part of the panel. Intermittent reception can be caused by a poor connection here. Clean and check. Also check the tuner unit gain control R74. The setting of this may require adjustment in areas of high signal strength to avoid cross-modulation. R74 can also be the cause of intermittent results due to poor wiper contact.

Poor Sync

Poor sync is one complaint which will be met on practically every set. The symptoms are that the contrast and sound are good but the picture cannot be held. In nine cases out of ten the trouble is due to R44 going high-resistance. It is a small 47kΩ resistor feeding the screen of the sync separator (30FL2): since it is in series with a 22kΩ resistor across the h.t.

Fig. 1: E.H.T. circuit used in models operating with an e.h.t. of 20kV. The main circuit (Fig. 3) shows the e.h.t. doubler system used in models operating with an e.h.t. of 15·25kV. Voltages shown on the main circuit (Fig. 3) are given as a guide—variations between 10% and 20% do not necessarily indicate a fault. They were measured on a 15kV model with 240V a.c. mains input, no signal and all controls set for normal operation using (except for the e.h.t.) an Avo Model 8. T1 anode winding 70Ω, grid winding 95Ω d.c. resistance.



EHT rectifier & tripler (20kV models)

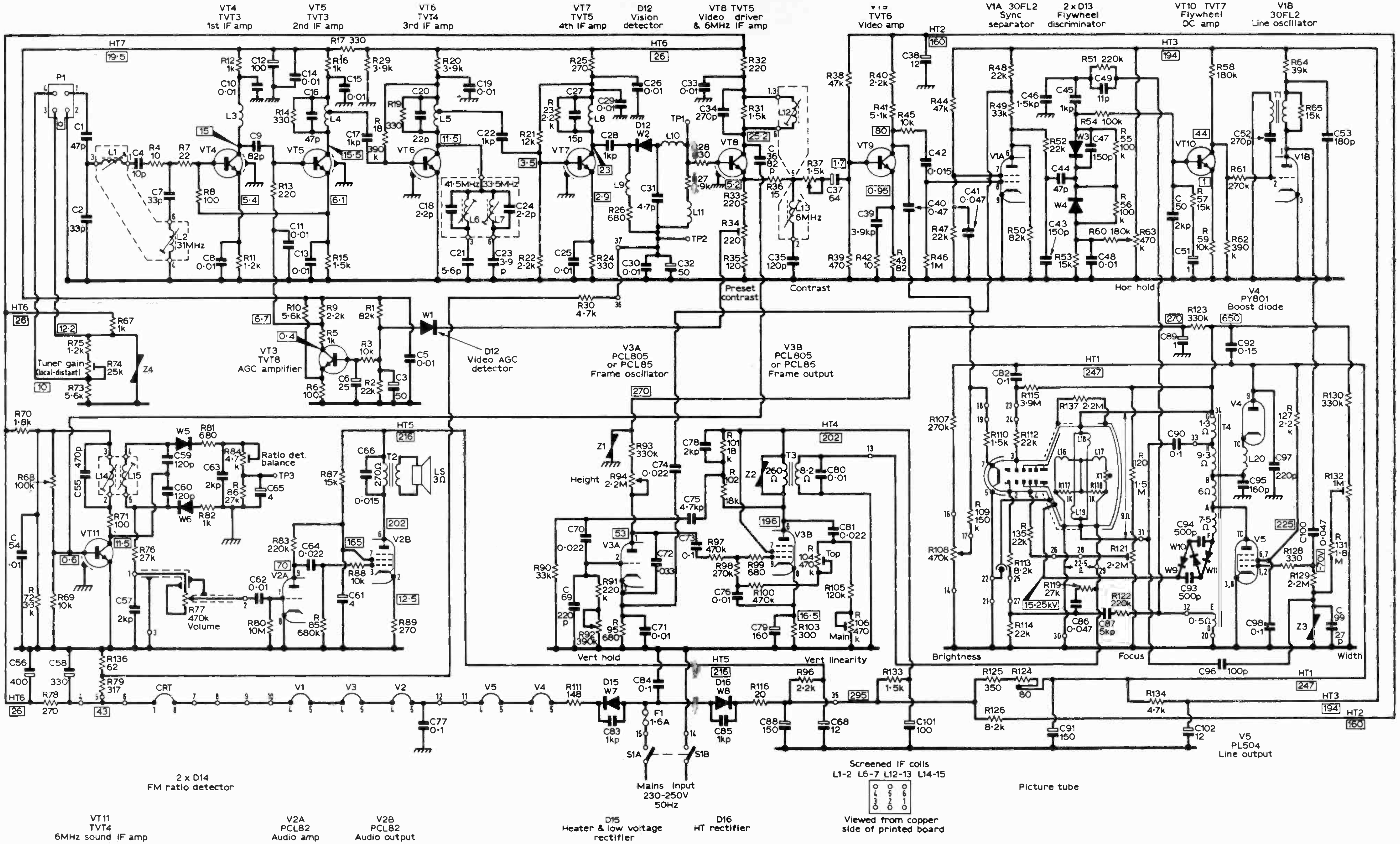


Fig. 3: Circuit diagram, BRC 1500 single-standard chassis. See also Fig. 1 and notes alongside.

If the fuse has not failed the cause of the no results condition could be a breakdown in the heater supply or in the h.t. supply. If the valves are glowing normally it's obvious that the heater supply is not at fault. Thus the h.t. supply requires attention. This is where the layout of the top centre dropper demands close attention. From the circuit it will be seen that R116 is the surge limiter, connecting directly from the rectifier D8 to the various h.t. smoothing elements —R96, R125, R126 and R133. It is R116 (20Ω) which is most likely to be found at fault. It is well worthwhile studying the make up of the dropper in order to know which section is which from an h.t. and heater point of view.

CONTINUED NEXT MONTH

the surprising semiconductors

PART 2 ELECTROLUMINESCENT SEMICONDUCTORS

I. R. SINCLAIR

In the first part last month we considered the electrical effects of hot carriers in devices where energy is put in electrically and taken out in the form of an electrical signal at microwave frequency. If the frequency of operation is raised, perhaps to the region of 10^{15}Hz, we should be able to detect the resultant radiation with that well-known receiver of such radiation the human eye.

The generation of light by semiconducting materials takes place when hot carriers "cool down". More precisely a carrier whose energy has been raised by any means such as a high electric field, collision, heating, etc., may at any time lose the energy and become a normal carrier again. Quantum theory imposes some rules here however: the energy must be lost in fixed amounts and there is a definite relation between the size of the energy packet (or quantum) lost and the frequency of the radiation to which it is transformed. This relation is Planck's Law though this application was discovered by Einstein and it was his use of it which earned him his first Nobel prize. The relation is $E=h.f$ where E is the amount of energy, f the frequency of radiation and h is a constant ($6{\cdot}625\times10^{-34}$ Joule-seconds) called Planck's Constant.

If we look at the difference between a hot carrier and a normal carrier in a crystal we may find that the energy difference, inserted into Planck's equation, would correspond to a frequency of visible light. We could expect that such a change of energy would cause light as an output but we may not be able to detect such light. It is possible for example that the hot carriers may travel through the semiconductor without losing their energy and may finally change energy in several steps giving lower frequency signals. We may also find that all the conditions for light generation are present but the semiconductor material is not transparent so that the light generated cannot reach us but is transformed into heat inside the crystal. Again the light may be at a frequency—infra-red or ultra-violet—which our eyes do not detect.

Despite these difficulties several substances which give a light output for an electrical input are known and are rapidly increasing in importance. With one group of substances the importance lies in their ability to generate light at very high efficiency and so with very little generation of heat; in another group of substances the interest is in being able to obtain coherent (laser-type) light beams from crystal junctions. It is particularly in the second group that some spectacular advances have been recently made. The solid-state TV screen, if it comes, will of course depend on arrays of light-emitting diodes that can be modulated in sequence.

Zinc sulphide is probably the best known example of the first group of light-emitting materials. For use in an electroluminescent device the zinc sulphide has to be activated by adding an impurity—often copper. The mixture is then baked at a high temperature for prolonged periods. In action high fields seem to form round the impurity atoms when an electric field is applied across the zinc sulphide and high-energy carriers are generated which then part with their energy in the form of blue-green light. The usual form of an electroluminescent zinc sulphide cell is shown in Fig. 11. Two layers of transparent conducting material, usually tin chloride deposited on glass, sandwich a layer of zinc sulphide crystals and a voltage is applied between the conducting layers. The whole device acts electrically like a leaky capacitor and the light output is much greater if a.c. is applied than if only d.c. is used. In addition the light output increases with the frequency of the a.c. since a greater current passes causing more carriers to be generated.

Such electroluminscent panels are now in common use as indicators—such as the electroluminescent frames which can be fitted round a light switch to indicate where it is—and similar applications. Electroluminescent wallpaper, powered by a 10kHz inverter, has been made and can replace other sources of light in a room if the colour of the light can be tolerated.

Much of the interest in electroluminescence in recent years has centred on the behaviour of diodes using gallium arsenide. Gallium arsenide is transparent and has energy differences between its bands which correspond to light frequencies. It was natural to expect electroluminscent effects from it therefore but what was not expected was that the gallium arsenide source could be modified to provide laser action as well.

When small forward currents are passed across pn junctions in gallium arsenide of the form shown in Fig. 12, a higher field exists at the depletion layer than elsewhere in the crystal. It is at this point that high-energy carriers are formed. The recombination of holes and electrons in the same region causes a light output which can be "seen" if the diode is suitably shaped. We use the word "seen" in inverted commas because the output is at near infra-red frequency and is normally invisible though by overdriving the device

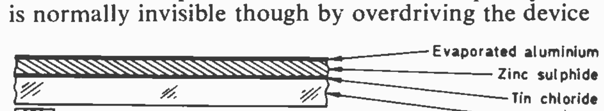


Fig. 11: One form of electroluminescent layer.

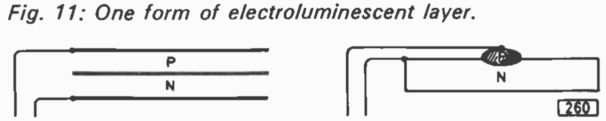


Fig. 12: Geometry of gallium arsenide junctions.

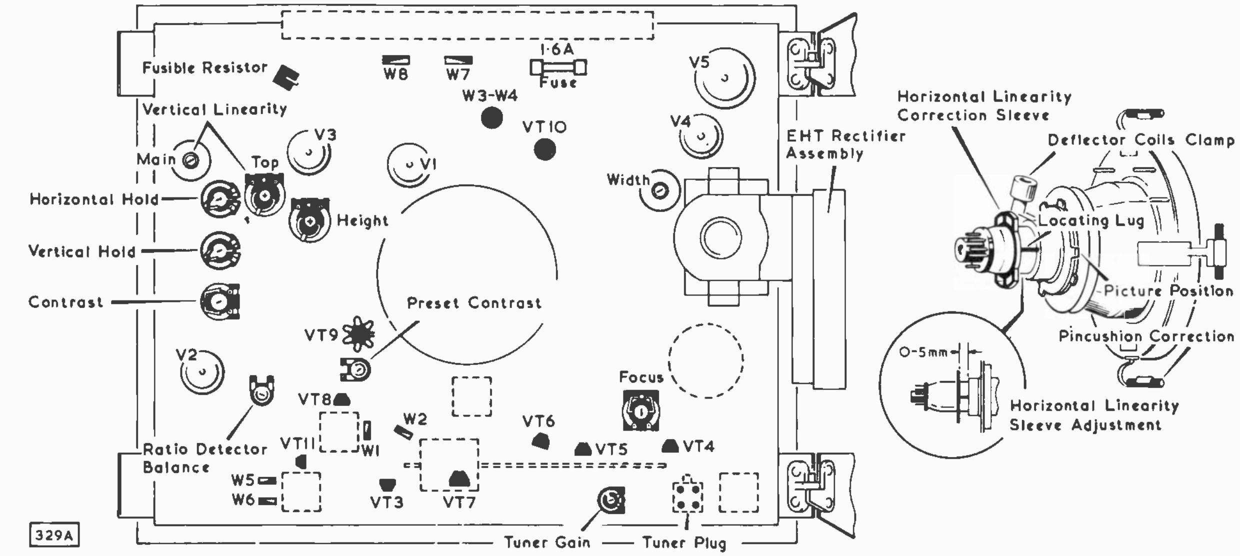


Fig. 2: Main chassis hinged open to show presets, valves and transistors.

line it is subject to a certain amount of load apart from the valve's screen current and a larger resistor (say 1W) is really needed in this position. The same could apply to the video stage base bias resistor R38 and this should be watched in the event of little or no picture: we haven't found this fault yet but it could well be the next one to show itself.

Having said that nine times out of ten R44 is responsible for poor sync we will now mention the tenth time! This turned out to be C42, the $0{\cdot}015\mu$F sync coupling capacitor. We are finding more and more capacitors faulty due to a fracture inside the moulding. Moving them will sometimes reveal which is at fault. Whether the defect is due to manufacture or to stress imposed by mounting on the panel is a matter for others to decide but it is a fact that component failure is far more common now than of yesteryear (yes Grandad, remember factor R?).

Faulty Presets

If it isn't fixed resistors changing value it's the presets which are acting up. These tend to develop poor contact and faulty tracks, particularly in the height circuit in this chassis where the complaint of loss of height is more often due to a defective $2{\cdot}2$MΩ preset (R94) than to R93 going high-resistance or C89 leaking (check all three anyway, it could be a bit of each!). Cleaning the preset is no answer, it has got to be replaced.

The same could be said for the width control (R132-1MΩ) but this doesn't seem to happen nearly as much. If the width is reduced and a touch on the control varies it drastically replace the control and save yourself a load of trouble later.

Faulty Electrolytics

It is mainly the smaller electrolytics which are giving trouble. We have already mentioned C37 in the video circuit which tends to go open-circuit. Far more regularly however it is C79 which fails. This is the 160μF cathode decoupling capacitor of the field output valve (PCL85). It will go open-circuit suddenly to produce drastic loss of height with more compression at the bottom than the top. The value isn't too critical—between 100 and 250μF—but the size needs to be kept about the same if appearances are to be kept up. We feel this is important both from an appearance and a safety point of view: bits and pieces hanging all over the place are not only untidy but dangerous.

The same could be said for C89, the 1μF capacitor which decouples the boost feed to the height control. Because of its size some engineers tend to replace it with an $0{\cdot}1\mu$F type which although it functions just as well doesn't hold enough charge to maintain the field scan long enough in the event of line timebase failure. This means that instead of a fading line across the screen a bright spot will linger to damage the fluorescent screen coating in the centre and leave a permanent black spot.

These then are the usual trouble spots which will almost certainly be encountered with some degree of regularity. We must now discuss the more routine fault-finding procedures.

Set Dead

Check the mains supply to the on-off switch. If present check each side of the $1{\cdot}6$A fuse holder. If the fuse has failed observe its appearance. If it has blackened the chances are that one of two things has happened. Either the h.t. supply diode W8 has shorted or more likely the mains filter capacitor C84 has shorted. Now note this point. If the diode has shorted it will in most cases remain so and a meter check will therefore reveal the source of the trouble. If on the other hand the mains filter is the cause of the trouble the short may not show up on a cold meter test, i.e. C84 will not break down again until the full mains voltage is applied. If therefore no obvious faults show up on an ohmmeter check replace C84 using an $0{\cdot}1\mu$F 1kV type: the fuse can then be replaced with some degree of confidence. All right, so it blows again. Now you work it out. Electrolytics, arcing between tracks, Joe's meter clip shorting the h.t. to earth?

a red glow can be seen which can be harmful to the eye. The hemispherical bead is now the preferred shape since more of the light is emitted. The angle of the beam is small however as rays striking the surface at more than a few degrees from a right angle are reflected back into the material. As more current is used the efficiency in terms of light power out for electrical power in becomes rather less but it is still higher than for other electroluminscent devices. Over a large range of output power the light power output is linearly proportional to the electrical power, particularly if the diode is cooled to a temperature well below room temperature by immersing it in liquid nitrogen at around −200° C.

We should stress that the light output from such a diode as it is normally used is *not* laser light but is normal incoherent light. To appreciate the difference between the electroluminescent diode and the injection laser which is derived from it we must know the difference between ordinary light and laser light. Ordinary incoherent light, whether from a lampbulb or from a gallium arsenide diode, consists of waves which stop and start at intervals, changing phase at each start. We can regard the atoms which are the source of the light as self-triggered ringing circuits with a very high *Q*, much higher even than a crystal ringing filter. We can even calculate the *Q* of an oscillating atom: it is around 10^8. An atom will thus radiate for about ten million cycles before the amplitude has dropped to 30%. At the frequency of light this does not take long and since the triggering is normally spontaneous there is no fixed phase relation between the firing of one oscillator and the firing of the next. This idea is at the very heart of the quantum theory since it was the idea that atomic oscillators might behave like this (before ringing circuits were known) that enabled Planck to demonstrate his first triumph of quantum theory in 1900. Ordinary light then, because of the starting and running out of various oscillators, consists of a number of wave trains each lasting only a fraction of a microsecond and each different in phase from any other. It is this phase inconsistency that is meant by the word incoherent.

Coherent light on the other hand consists of wave trains which remain in phase for a considerable (by atomic standards) time. Such light was unknown before the invention of the laser though its effects had been to some extent predicted and anticipated. Coherent light can be focused to smaller points, is obtainable in very pure colours, can be mixed with other beams of coherent light to form an "i.f." and can be modulated in ways which are impossible with incoherent light. In addition the whole technique of Holography is possible with laser light (see TELEVISION, January 1971). One of the most useful attributes of laser light is the possibility of making very accurately parallel beams which show an incredibly small amount of divergence over very long distances of travel—hence the use of lasers in space communication systems. The signal-to-noise ratio of the laser beam however is low and must remain so as this is a consequence of the same quantum theory which predicts its existence.

To transform the gallium arsenide diode into a laser we must persuade a large number of electrons into a high-energy state and then start them dropping into a normal state in phase with each other. What is wanted is some form of triggering which will make each electron give up its energy in the form of light of the correct phase at the correct time. To do this we use for the gallium arsenide diode the same sort of arrangement we use for the ruby rod laser and the gas-discharge laser, a tuned cavity working at light frequency. Typically for the diode laser such a cavity would consist of two perfectly plane and accurately parallel mirrors, one of them only partly silvered. Light reflecting to and fro between the mirrors will lose very little energy if the distance between the mirrors is a whole number of half-wavelengths of light and furthermore this light can be used as the trigger pulse which maintains the laser action, triggering off the conversion of energy. Because one mirror is only partly silvered the light can escape at high intensity forming a parallel beam. The beam is parallel to very close limits because the continual reflection to and fro inside the mirror system tends to reject any light which is not parallel to the axis of the mirrors (Fig. 13)—and also to reject any light which is not in the correct phase.

Fig. 13: The Fabry-Perot Etalon. If the distance d between the reflectors is a whole number of half wavelengths then light at this frequency will be "tuned" by the mirrors. The wavelength of red light for example is about 7 × 10^{-7}m so that the distance required between the reflectors would be a multiple of $3{\cdot}5 \times 10^{-7}$m, say $3{\cdot}5 \times 10^{-4}$m (0·35mm). This distance represents 1,000 half waves and must be accurate to at least 10^{-8}m—so the construction of an Etalon calls for great precision.

Such reflecting surfaces, technically known as Fabry-Perot Etalons (invented in 1913), can be formed on the gallium arsenide crystal itself and serve to turn the normal spontaneous incoherent emission of light into stimulated (the "s" in l.a.s.e.r.) coherent emission. The whole device, known as the injection laser, has the advantages of very small size (about 0·5mm. cube), low voltage operation, easy modulation by acting on the operating current, and comparative cheapness along with continuous operation. Though the output of the early injection lasers was very small the power output has been gradually increased with development though to nothing like the powers now obtainable from ruby or gas lasers. In this respect it should be remembered that the power output of the injection laser—typically 40% of the electrical power dissipated—is *light* power and the amount of light per surface area of the laser is very large indeed. Output powers are now available that can cause severe eye damage leading to complete blindness if a direct beam enters the eye. The Code of Safety for laser operation, obtainable from the laser manufacturer, should be studied before using any type of laser.

This ends our survey of the surprising semiconductors. There are more surprises in store for us, especially as we combine the effects we already know with the effects of magnetic fields, sound waves, supercooling, etc. to form whole families of new devices waiting for a technology to be built around them. Some such devices appear and are never heard of again. Others seem to hang fire, waiting for a suitable application to emerge. The ones which we have dealt with are some of those which have made it, perhaps 3% of the total number of invented devices over the past few years. There will be more. ■

COLOUR RECEIVER CIRCUITS

GORDON J. KING

SOLID-STATE FIELD TIMEBASES

HAVING dealt in previous instalments with the signal processing circuits of a colour receiver the plan is to commence next the exploration of the timebase, tube control and power supply circuits. Although possibly less exciting than the colouring circuits nevertheless some very interesting and novel configurations have in recent times been evolved using the latest solid-state devices.

Supplies and Stabilisation

A recent technique is to employ the line timebase to provide not only horizontal deflection and line convergence currents and the e.h.t. but also to generate some of the lower voltage supplies for transistors and for the vertical and horizontal (mostly the latter) shift of picture as well as for certain of the picture tube electrodes. As there is no equivalent in transistor line timebases to the well-known valve line/e.h.t. voltage stabilisation system based on bias control of the line output valve, full stabilization has to be provided by the power supply alone, and here lies one area in which new techniques are found.

The best way of getting to grips with all these things however is to start with the basic timebase circuits. We shall proceed from the field to the line timebase and thence to dynamic convergence, concluding with the main power supply and the various control circuits such as the beam current limiter.

Field Timebase Requirements

The prime function of the field timebase is, of course, to deflect the three beams of the picture tube linearly in the vertical sense in synchronism with the comparable happening in the camera tubes at the studio. From this viewpoint therefore the only difference between monochrome and colour is the three beams used in the latter—and since these are produced by 25kV of e.h.t. they are somewhat "stiffer" than the single beam of a monochrome set and thus require a little more electromagnetic energy for full deflection.

BRC 8000 Field Oscillator

An interesting solid-state field timebase is used in the recently introduced inexpensive BRC 8000 chassis. Fig. 1 shows the circuit of the oscillator section. Two power supply sources are connected to this circuit, a +45V unregulated supply and a 100V line derived from the line output stage and used to feed the height control. As a result of feeding the height control from a potential derived from the line timebase signal it follows that changes in aspect (i.e. width/height) ratio are minimised when brightness changes occur, in other words the arrangement provides corrective tracking.

During the field flyback period the two transistors are conducting and C430 charges from the 45V supply through W408 and the parallel paths R437 and R440 with the base-emitter junction of VT406. As C430 charges the base of VT406 rises positively with respect to its emitter so that it soon switches off. VT406's collector voltage thus falls to almost chassis potential so that VT407 also switches off. At this instant the forward scan commences.

When VT406 switches off the charge on C430 holds W408 cathode positive with respect to its anode so that the charging circuit is removed from C430. C430 then commences to discharge through R438 and the field hold control R439. The duration of this discharge is governed by C430 charge potential and hence by the potential at the junction of the divider R443/R444 and also by the time-constant C430/ R438 + R439.

Under free-running conditions C430 would discharge until the cathode of W408 became less positive than its anode at which point the diode would switch on again and the charging cycle would recommence. Before this happens however, a positive-going sync pulse arrives at VT407 base. This switches VT407 on before C430 discharges completely and the action initiates a negative pulse at R443/R444 junction which is coupled by C430 to W408 cathode thereby immediately switching the diode on. This starts the flyback and the subsequent recharging of C430.

Field sync pulse integration is provided by

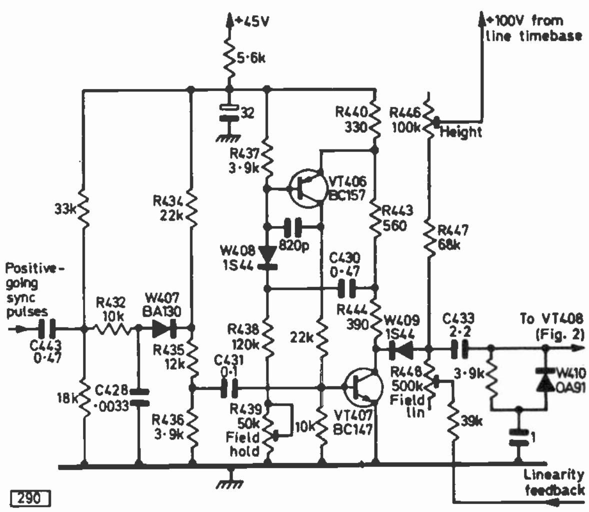


Fig. 1: Field oscillator circuit used in the BRC 8000 colour chassis.

W407/R432/C428 with the diode and the resistor chain R434/R435/R436 ensuring that the line sync pulses are completely removed from the field sync signal. The sync input comes from a fairly conventional sync separator stage.

BRC 8000 Field Output Stage

The complete circuit of the output and driver stages is shown in Fig. 2 with a simplified analogue in Fig. 3. The basic action of the circuit is based on the charging of capacitor C436 under the overall control of the oscillator output which, as shown in the analogue, is essentially a switching signal.

When the scanning stroke commences C436 starts to charge from the 100V source via the height control R446, R447, C433 (all in Fig. 1) and R469 in Fig. 2. During the scan the circuit acts as an amplifier which means that the potential across C436 will be amplified since one side of this capacitor is connected to VT408 base while the other side is connected virtually to chassis.

The result is a linearly increasing current through the output resistor R461 and a corresponding voltage rise across it. This voltage is fed back to the input through C436 so that the input receives a constant

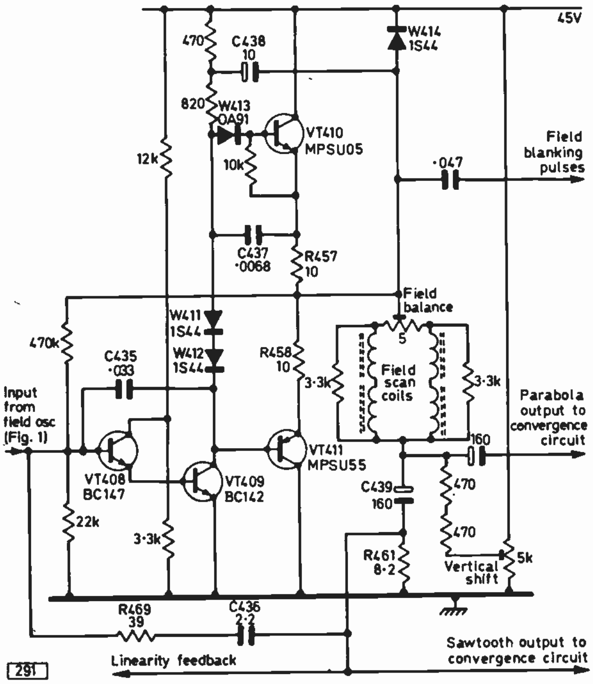


Fig. 2: Field output stage circuit used in the BRC 8000 colour chassis.

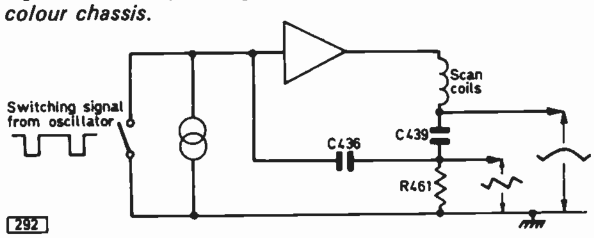


Fig. 3: Showing the basic operation of the field output stage circuit used in the BRC 8000 chassis.

feedback current which subtracts from the constant input current derived by way of the height control, etc. A linearised sawtooth current thus flows in the scanning coils.

It will be recalled that at the end of the scanning stroke VT407 (Fig. 1) switches on. This rapidly discharges C436 to give the flyback. At the instant when VT407 switches on VT408 (back to Fig. 2) switches off since its base bias is removed by virtue of W409 (Fig. 1) conducting to chassis via VT407. VT409 also switches off at the same instant since its base is d.c. coupled to VT408 emitter. This in turn switches off VT411.

As the current in the scanning coils cannot change direction instantaneously at the end of the scan there is a swing of voltage across the coils which makes the junction of R457 and R458 go positive. During this time VT411 remains switched off since this positive potential is reflected to its base through C438.

Current must of course be allowed to flow out of the coils and this is handled by W414 which conducts during this time, dissipating the inductively-acquired energy back into the supply rail. The scan coils are clamped to the supply line for the latter part of the flyback by the current reversal causing conduction of VT410. During this period VT410 is fully bottomed, its collector current rising rapidly as governed by the base current and its current gain parameter. As the scan subsequently builds up the driver VT409 turns on progressively and its collector voltage falls. As a result VT410 is driven towards cut-off and VT411, a pnp type, towards cut-on.

Transistors VT410 and VT411 constitute a complementary push-pull stage in essentially class B mode but with a little forward bias provided by diodes W411 and W412 to linearise the middle of the overall transfer characteristic of the stage and hence to minimise crossover distortion troubles. The resulting quiescent current is stabilised by R457 and R458 in the emitter circuit of the output pair.

The forward scan commences when VT408 and VT409 start to conduct—after VT407 switches off and C436 begins to charge. VT411 takes over from VT410 towards the middle of the scanning stroke.

Diode W413 protects VT410 from flashover damage while r.f. instability is prevented by C437 and

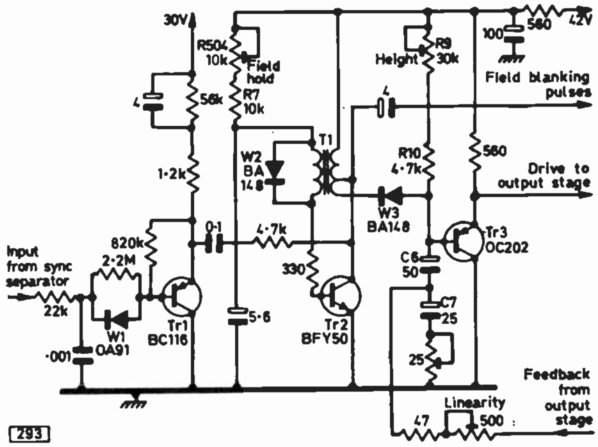


Fig. 4: Field blocking oscillator (Tr2 and T1) circuit used in the BRC 2000 chassis. Also shown are the field sync pulse shaper stage (Tr1) and the driver (Tr3).

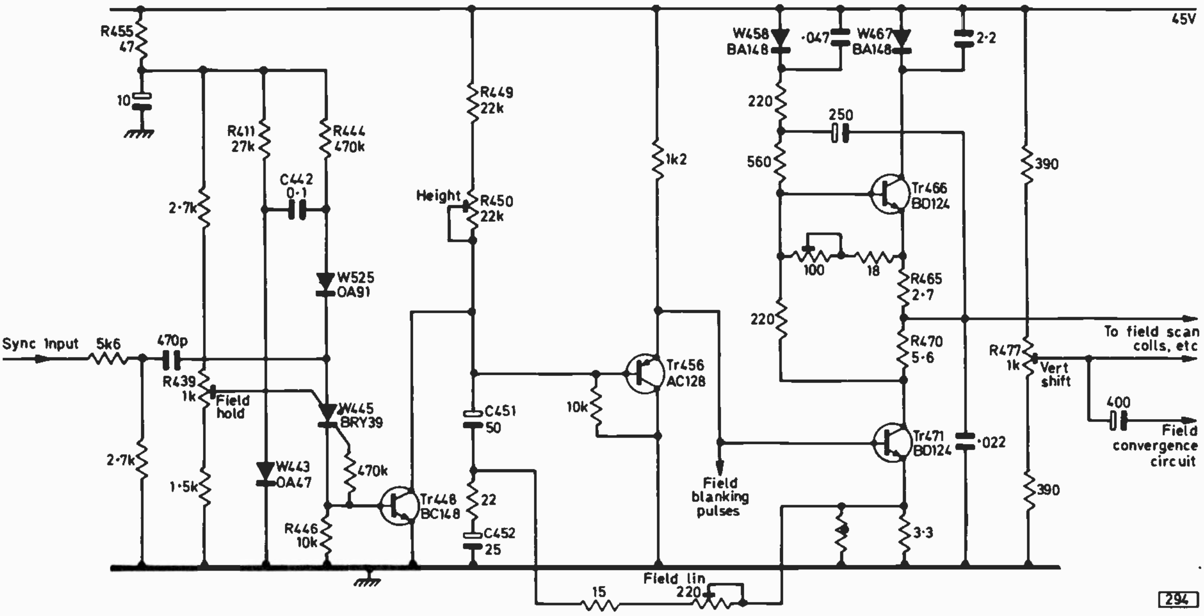


Fig. 5: Complete field timebase circuit of the Philips G8 chassis: this uses a silicon controlled switch (W445) as the field oscillator, operating in conjunction with the discharge transistor Tr448.

C435. C435 also provides negative feedback at field frequency.

The field output stage also delivers the sawtooth and parabolic waveforms required for vertical dynamic convergence, the latter from across C439 and the former from across R461. The sawtooth signal is in addition fed back to the oscillator (Fig. 1) to provide linearity correction.

BRC 2000 Blocking Oscillator

Quite a few transistorised colour receivers use techniques similar to those described. Indeed the first all-transistor (BRC) colour receiver (2000 chassis) had a very similar output stage. This however was controlled by a field blocking oscillator the circuit of which is shown in Fig. 4.

Tr1 is a sync shaper transistor which receives the sync waveform from the main sync separator stage via the integrating circuit in its base circuit. The blocking oscillator circuit proper consists of Tr2 working in conjunction with transformer T1. The primary and secondary windings provide the required positive feedback and the repetition frequency is determined by the setting of R504 which adjusts the time-constant of the base circuit and hence the switching time.

During the scan period capacitors C6 and C7 charge via R10 and the height control, the resultant sawtooth waveform being coupled to the output stage via the emitter-follower Tr3. C6 and C7 are discharged rapidly via W3 and Tr2 when this transistor conducts to give the flyback. Linearity correction is provided by feedback to the junction of the two charging capacitors.

The output stage consists of a pair of npn transistors, the bottom one of the pair being driven by Tr3 while the top one is driven from the collector of its bottom partner. During the scan period the conduction of the lower transistor increases linearly while the conduction of the upper transistor decreases linearly. The circuit is basically similar to that shown in Fig. 5, right-hand side.

Philips G8 Field Timebase

With the Philips G8 chassis we come to another interesting field oscillator circuit (Fig. 5, left-hand side). This uses a silicon controlled switch (W445) operating in conjunction with transistor Tr448.

During the scanning stroke Tr448 is without bias and is thus non-conducting. The silicon controlled switch W445 is also non-conducting. C442 charges from the 45V rail via R444 and R455 (as W443 is forward biased the junction of R411 and W443 is effectively at chassis potential). As C442 charges the potential at W445 anode rises and when this exceeds the voltage at its anode gate connection (set by the hold control R439) the device switches on immediately and heavy conduction occurs. The resultant voltage across R446 switches on Tr448, and C451 and C452 are rapidly discharged to give the flyback. During the scanning stroke these two capacitors charge from the 45V rail through R449 and the height control R450 to give the drive waveform for the output stage.

The appearance of the field sync pulse at W445 anode ensures the firing of the device at the correct time.

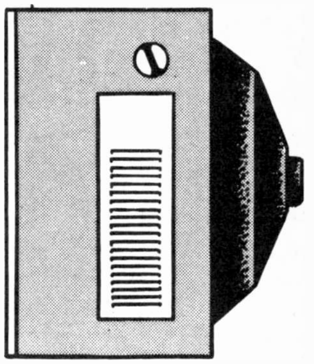
The emitter-follower Tr456 drives the push-pull output transistors Tr466 and Tr471 which in this circuit are of the same type (i.e. both npn): the output stage is in the form of a single-ended push-pull arrangement with the scanning current being taken from the junction of R465 and R470. The scan coils are returned to chassis via the raster correcting circuits, the convergence network and the vertical shift control R477 which regulates the amount of d.c. in the field coils.

Diode W525 in the oscillator circuit prevents the positive-going sync pulses being shorted to chassis via C442 and W443.

TO BE CONTINUED

Renovating the RENTALS

CALEB BRADLEY B. Sc.



6 DECCA CTV25 SERIES contd.

The Decoder Board

The decoder board is not very troublesome which is fortunate if your test equipment is limited. Video from the luminance board enters at pin 1 (Fig. 7). The chrominance component of the signal is filtered out and then amplified by Tr600 and Tr601 before being fed to the PAL delay line and thence to the demodulators. If there is no colour first check that the flying lead from VR600 slider (No. 5 in our list earlier) is not adrift. To disable the colour killer, short across D600. Note that on monochrome the colour killer action allows the luminance board to pass full bandwidth video by disabling the subcarrier (4·43MHz) trap (L201 Fig. 4).

On the majority of decoder boards there is no delay trim adjustment which makes one less thing to go wrong but may result in slight Hanover blinds on the picture. The delay matrix amplitude control VR601 can however normally be set for a virtually blind-free picture.

If the a.p.c. preset VR602 is wrongly set the reference oscillator Tr607 is not able to lock in quadrature to the average phase of the swinging burst, resulting in bands of colour on the screen or just a fast colour flicker. If the oscillator only locks with VR602 at one end of its travel, or will only lock into colour bands, try bridging one of the varactor diodes D615/D616 with a few tens of picofarads. Even if your scope is not really meant to stretch up to 4·43MHz it may just resolve the 5 to 6V peak-to-peak signal at Tr608 emitter, confirming that the oscillator is working and allowing L604 to be peaked up. Remember that reference oscillators usually stop because of a faulty transistor or crystal.

The PAL technique of using a phase-alternating (±45°) burst signal to control the reference oscillator results of course in an alternating error signal from the discriminator. This signal at the junction of R645 and R647 is but a faint hearted squarewave (0·25V peak-to-peak). It is of course the d.c. level of this, smoothed by C636, that the controls the oscillator by varying the capacitance of the varactor diodes—the oscillator does not try to leap about like the bursts, but settles in quadrature to the average burst phase.

The squarewave is amplified to a beefy sinewave called the ident signal by the tuned amplifier Tr602. L602 is the large coil at the back of the decoder panel and should be adjusted for maximum signal at Tr602 collector with a colour picture correctly locked. The most sensitive method of adjustment is to view this signal on a scope and adjust both L602 and VR602 for a maximum amplitude sinewave with the burst points, seen as small irregularities on the waveform, symmetrically placed on the steepest parts of the wave. When L602 is correctly tuned the core often stands proud of the former: beware that it does not foul the c.r.t. shield on the CTV25 table model. Sometimes L602 goes open-circuit—its d.c. resistance is about 100Ω.

Failure of the ident signal to put the bistable circuit Tr604/5 in correct phase results in green faces part of the time. Extremely severe Hanover blinds are the result when the bistable is stuck in one of its two states. In this case first check that a negative line frequency pulse is present at pin 6 and then suspect D604, D605 and D606 (all type OA81), also the transistors.

Otherwise, ghastly colours are usually caused by failure of a colour-difference valve (V600, V601, V602). The presets VR603/4/5 are hard to set exactly right unless you have a colour-bar signal and good artistic sense. It is instructive to note the effects of shorting pin 8 of each PCL84 to earth in turn since this helps identify colour defects in future.

Field Timebase

The field timebase rarely fails so we have not printed its circuit (those readers who have the April 1971 issue however will find it on page 273 of that issue). The main point to watch is a matter of poor design: there is a 400μF capacitor C311 that feeds a parabolic waveform from the cathode of the PL508 field output valve to the convergence circuits. It is positioned over a sharp-edged rivet (pin 17 in Fig. 9) which carries h.t. The rivet can pierce the plastic insulation of C311 and touch its metal case, applying h.t. to the convergence board where the R/G VCB and blue HT potentiometers (75Ω) usually burn out. Use two layers of p.v.c. tape to protect the replacement capacitor and for economy use replacement potentiometers from the 405 side where possible.

Line Timebase and EHT

The line timebase in all its glory is shown in Fig. 8. The pentode portion of the PCF802 operates as a Hartley oscillator (recognised by the centre-tapped coil L301). The flywheel discriminator diodes D302/3 compare the sync pulses with flyback pulses—integrated to form a ramp—from the line output transformer, controlling the oscillator speed by varying the grid voltage of the PCF802 triode portion. C324 drives the triode to pass current out of phase with the voltage at its anode; hence to the pentode oscillator

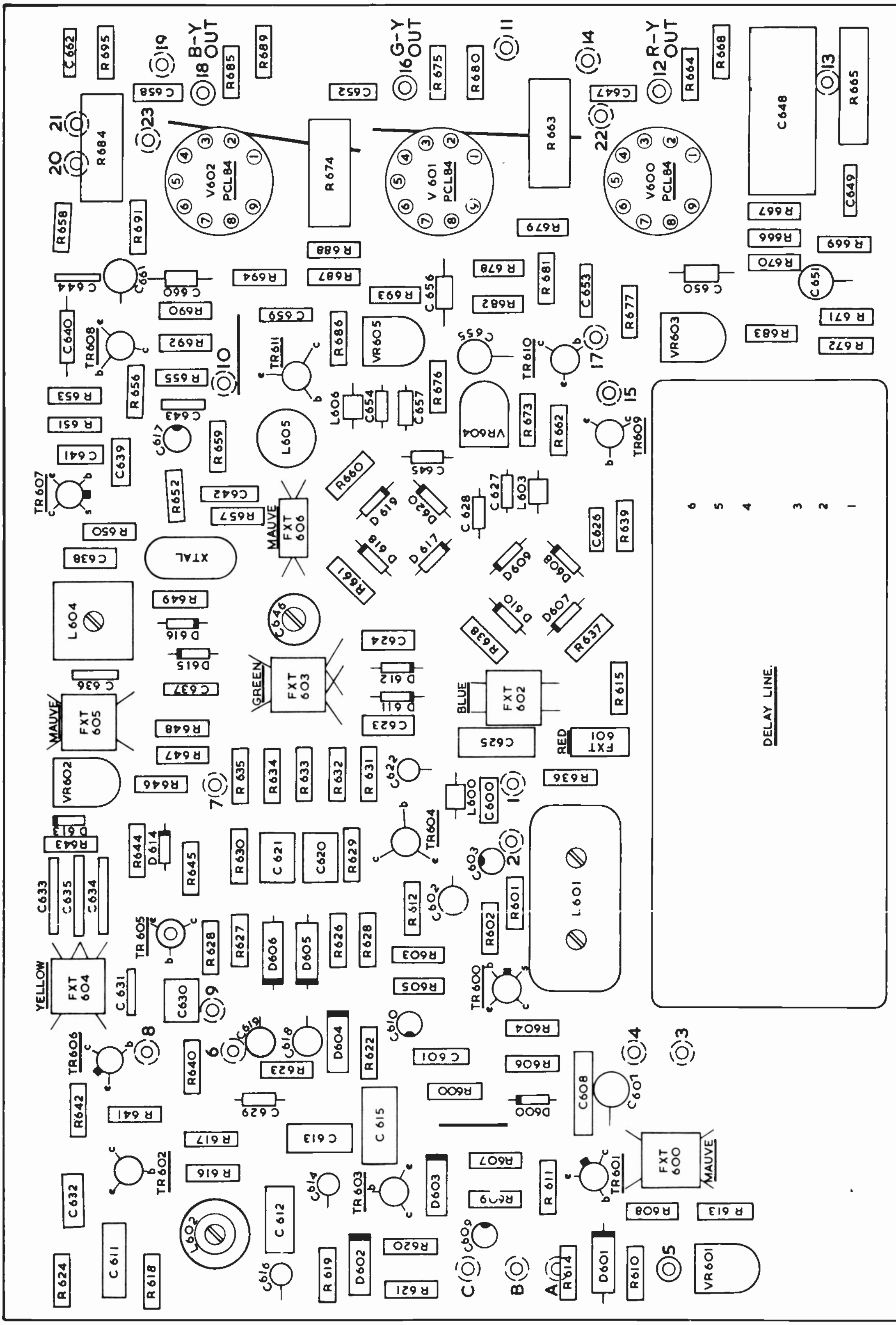


Fig. 6: Layout of the decoder board.

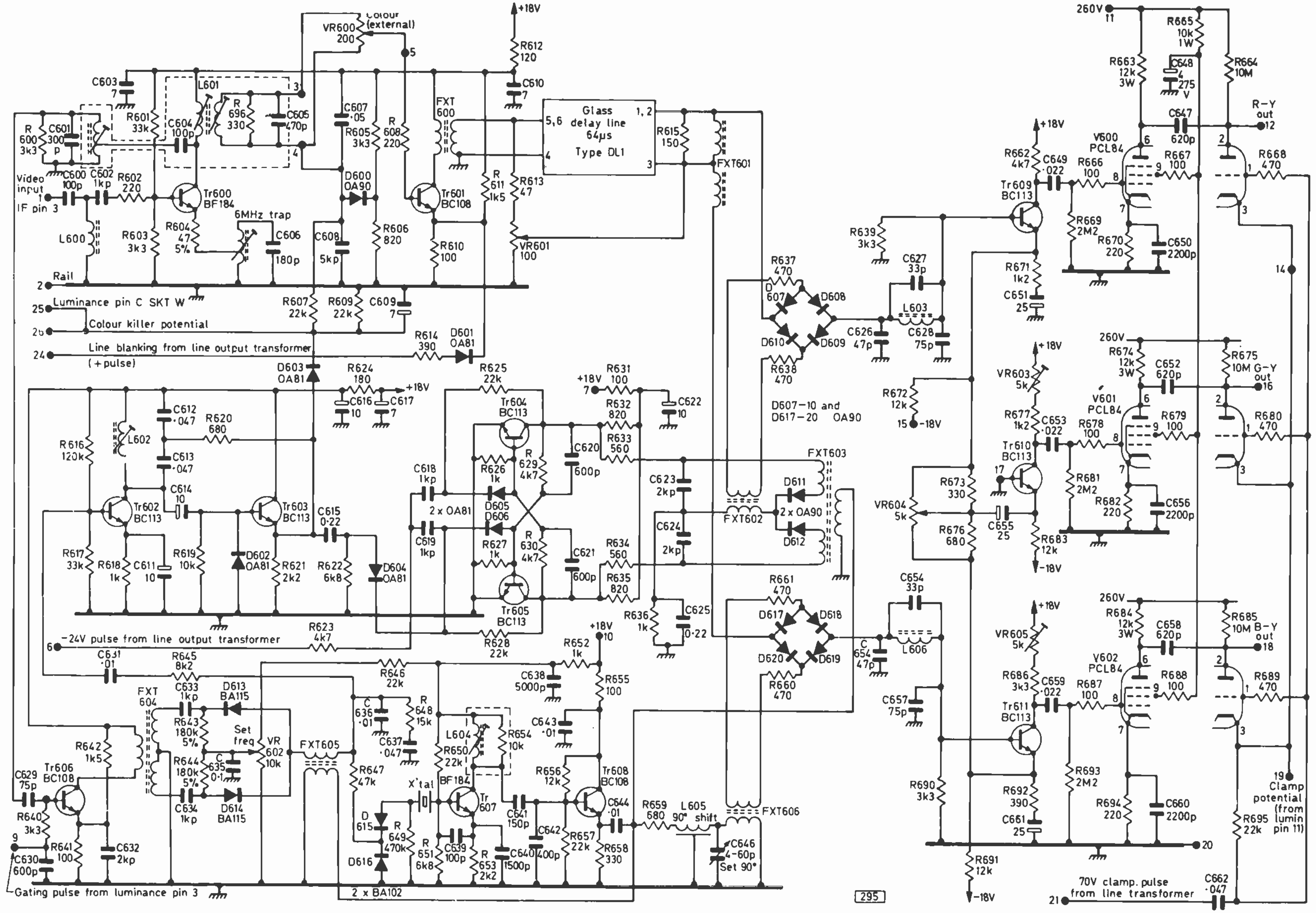


Fig. 7: Decoder circuit. Tr600 burst and chroma amplifier; Tr601 chroma delay line driver; Tr602/Tr603 ident amplifier; Tr604/Tr605 PAL bistable; Tr606 gated burst amplifier; Tr607 reference oscillator; Tr608 emitter-follower; D607-D610 R—Y demodulator; D611-D612 PAL switch; D613-D614 burst detector; D617-D620 B—Y demodulator; Tr609-Tr611 colour-difference signal preamplifiers; V600-V602 output stages and triode clamps.

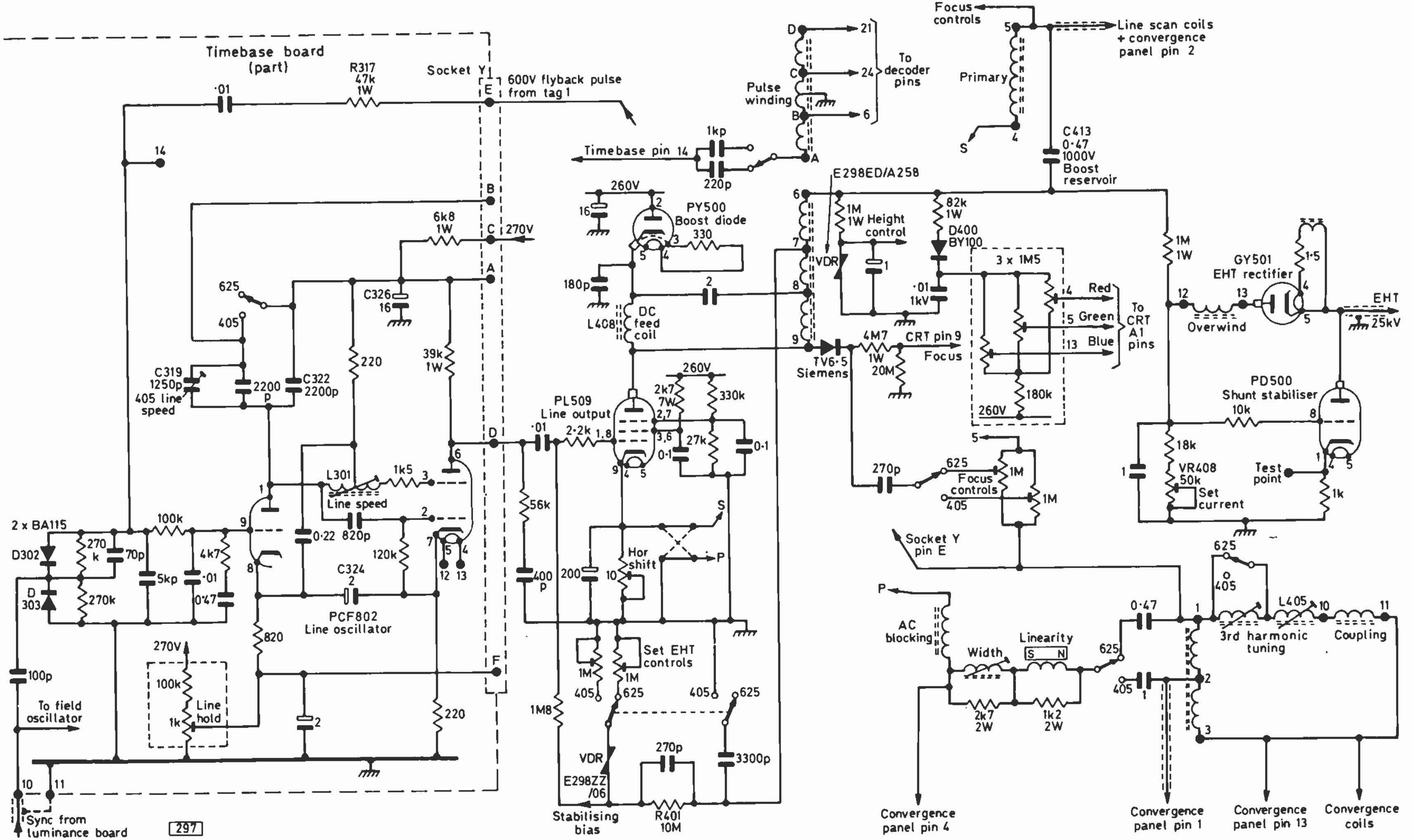


Fig. 9: Line oscillator, line output and e.h.t. circuits. Connections 1-9 and A-D are on the primary limb of the line output transformer while the coupling winding and overwind are on the other limb. Slightly different component values may be found in the grid circuit of the PD500 shunt stabiliser in some receivers. In later versions an e.h.t. tripler unit is used in place of the GY501, PD500 and TV6·5 focus rectifier.

Decoder variations: *A combined luminance-decoder board is used in 19in. models. Automatic chrominance control (a.c.c.) is added on later decoder boards; the circuit of this was shown in Fig. 5, page 32 of the November 1971 issue. The burst blanking circuit was also modified, see Fig. 6, page 35, November, 1971.*

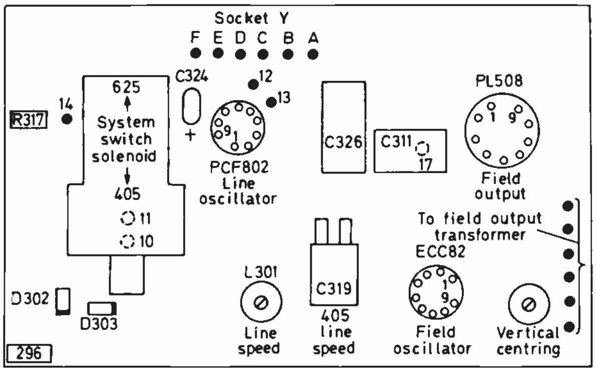


Fig. 9: Simplified timebase board layout.

the triode behaves as a variable reactive element in parallel with the 2200pF tuning capacitor C322 (625). In this area leap for R317 when there are sync troubles since it can change value (47kΩ or 50kΩ wirewound is a better replacement than carbon). In the oscillator circuit L301 must be set for correct 625 line speed with the line hold control at the centre of its range. Since flywheel sync is used be sure to set L301 to the centre of the lock-in range, or ideally adjust for 4V at PCF802 pin 8.

All manner of strange line troubles including low power, intermittent starting and vertical striations on the picture *may* have their root in C324—use a replacement of at least 25V working.

The line output section only looks hairy because of the large number of feeds taken from it. Basically it is a desaturated arrangement where no d.c. flows in the transformer but is instead fed to the PL509 output valve through a d.c. feed coil (or choke) L408. This component gets whacked by a massive voltage peak at the end of each line when the PL509 turns off, and thus often breaks down. The Decca replacement is not expensive, or a corresponding d.c. feed coil from another similar set might work. Bi-Pre-Pak Ltd. Southend recently had some surplus Philips dual-standard line output assemblies.

If due to failure of the oscillator there is no drive to the grid of the PL509 the valve will become red hot inside and its emission afterwards may be weakened, giving reduced width and low e.h.t.

The pulses appearing across the d.c. feed coil are fed into the line output transformer. The output of the e.h.t. overwind is rectified in the usual way by the GY501 and a PD500 shunt stabiliser is used to hold the e.h.t. at 25kV. Stabilisation is essential in a colour set as the picture is fully d.c. restored so that entirely black or entirely white pictures can be truly reproduced while good convergence depends on constant e.h.t. The set current control VR408 should be adjusted with a black picture for 1·25V at the cathode test point which is located alongside the PY500 boost diode. As the c.r.t. beam current increases the PD500 current should decrease.

Troubles in the line output transformer usually consist of shorting turns which cause obvious cooking because of the high power involved. The whole transformer can be replaced, or for economy just replace either the primary or the overwind, whichever has cooked. Do not lose the gapping papers between the two parts of the core.

The focus circuit is peculiar. A solid-state diode rectifies the pulses at the PL509 anode to give about 5kV to the c.r.t. Control of this voltage is achieved by potentiometers which add pulses either in or out of phase, obtained from two different points on the line output transformer. A difficult case of lost focus with general damping of the whole line output stage was eventually traced to intermittent shorting between the inner and outer of the focus coaxial lead. The TV6·5 focus rectifier was faulty and none was at hand: a satisfactory replacement was made up of seven 1N4007 diodes which were wired in a chain with a 10MΩ $\frac{1}{4}$W distributing resistor across each diode, and sharp points avoided on the joints.

Third Harmonic Tuning

The third harmonic tuning presents a slight problem. Although it does not matter too much if it is off nevertheless the e.h.t. may be slightly low as a result and the picture may suffer from striations. The 625 tuning coil L405 is mounted on the side of the line output transformer and can only be adjusted with the can off: but the working e.h.t. valves should **never** be exposed. The author's procedure is as follows. Remove the GY501 e.h.t. rectifier. Sink the top cap connector in a ball of plasticine and position it away from any metalwork. Connect a meter, on the 1kV d.c. range, across the boost reservoir capacitor (C413) on the side of the line output transformer. Switch on, watching for arcing at the overwind. After warm-up adjust the harmonic tuning slug with an insulated tool for maximum boost volts. Use some plasticine to fix it in this position.

First Anode Presets

The c.r.t. first-anode potentiometers are at the rear of the chassis and each wipes from 260V h.t. to about 800V rectified by D400. First set the red gun control for 650V on c.r.t. pin 4 then adjust the other two controls for neutral dark greys in a monochrome picture. It is a shortcoming of this chassis that there are no individual beam off switches, useful for convergence adjustment, and instead the first anode settings have to be upset.

Stabilisation

The line amplitude and hence the e.h.t. are stabilised by applying flyback pulses to a v.d.r. which rectifies them to give a negative bias to the PL509 grid, thereby reducing the portion of the line over which it conducts. The amount of control is varied by the set e.h.t. controls which should be adjusted for 25kV using an e.h.t. meter (constructional details given in Part 4) or failing this for 860V between chassis and the high side of the boost reservoir capacitor C413. Apart from a burnt track on one control this circuit has not been found troublesome and it is a waste of time trying to cure low e.h.t. by replacing the v.d.r. The first suspect—after the valves of course—is the high-value resistor R401 (10MΩ) in the width circuit.

Sources

These ex-rental colour models usually appear on the stock list obtainable from R-B Television whose address was given in Part 4. All spares and

—continued on page 472

TV TEST REPORT

E. M. BRISTOL

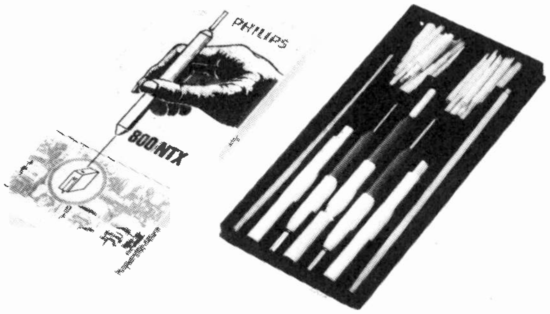
PHILIPS 800NTX TRIMMING TOOL KIT

A SMALL though important item in the TV and radio service engineer's kit is a set of trimming tools. The ground-down knitting needle has for many years been a traditional part of the outfit for dealing with slotted coil cores. I once purchased a pair of needles for the purpose from a wool shop near a large TV service depot: after serving me the assistant commented that it was remarkable how many men seemed to have taken up knitting as they were always coming in for needles!

With the present wide variety of cores—both in type and size—something more is needed however and a comprehensive kit is really essential. Trying to make do with an unsuitable tool usually ends up with the core damaged, rendering it untunable. Then comes the fuss of getting it out of the coil and finding a replacement. Some cores get stuck even when the correct tool is used so the chances of getting away with a makeshift tool without trouble are not good.

The Philips kit brings together a goodly number of tools to cater for many different types of core and trimming device. Let us see just what it offers. First there are three nylon holders each consisting of two detachable sections, one grey and the other cream. These holders will take any of the tool bits in the kit, one at each end. Thus the six bits most commonly used in the workshop—these will vary from one workshop to another depending on the type and make of equipment handled—can be fitted to the holders and left in place.

The tool holders are 2¾in. long and can be extended by means of a couple of extension pieces also 2¾in. long. These can be fitted between the two halves of the holder, either singly or both together to give a double extension. The latter gives a holder length of 8¼in. and with the longest tool bit of 5in. long we can make up a length of over 13in. When working in confined spaces, which is the more likely these days, the holders can be separated into their halves to give an average length with the shortest bits of just over 2in. So there is a wide variety of lengths available.



The Philips 800NTX trimming tool kit.

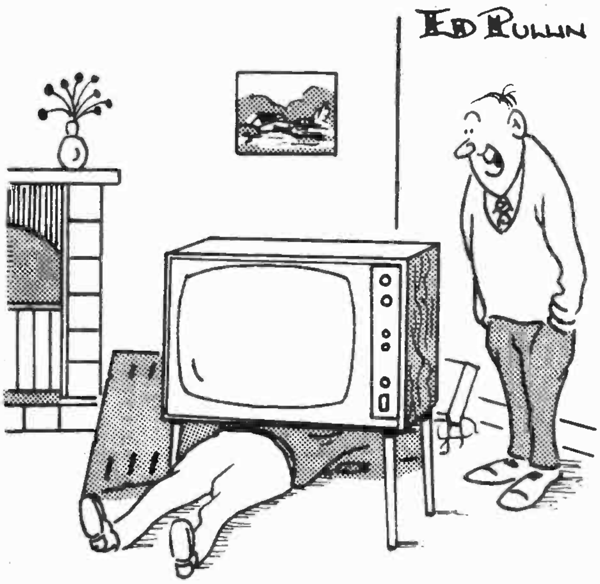
There are six basic types of bit and in some cases these are provided in different sizes and materials. Also some of the more frequently used ones are duplicated. Each bit has a round shank with a flat cut through half the shank diameter. This engages with a mating hole in the holder to give a good non-slip fit. All the tools engage quite easily into their holders yet do not drop out in use. There are three materials used: polycarbonate, all metal (non-magnetic, appears to be brass, plated) and low-inductance metal tips set in polycarbonate. Altogether there are 26 tools.

The six types are: (1) Hexagonal tool for beehive trimmers and similar applications (all polycarbonate). (2) Tool with centre spigot and two flanges set at 180°, also all polycarbonate. (3) Type consisting of a tube with a blade bisecting it: these are for adjusting slotted screwed rods where an ordinary screwdriver keeps slipping out of the slot. There are two small ones in polycarbonate, another of the same size of all-metal construction and a slightly larger all-metal one. (4) Slotted polycarbonate rod for adjusting those cores that have a raised flange—a slot in reverse. There are two of these. (5) Tools for dealing with those cores with small star-shaped holes that are sometimes encountered on tuners. One is made of metal set in a polycarbonate shank and there are two of clear plastic.

(6) Finally the sixth and largest division comprising screwdriver type tools. These are in seven different blade widths and a variety of shank widths and material compositions. The smallest are 1·6mm. wide, metal tipped in polycarbonate. There are two of these, one the short standard bit length and the other 5in. long. For some strange reason the shanks of these are thick, thicker than many of those with wider blades. This prevents them following the core down into the coil former beyond 2mm. from the top. The next size, with a metal-tipped 2mm. wide blade, does not suffer from this defect and has a thin shank. There are two of these as there are of the next size, 2·2mm. all polycarbonate. Here the shank is extra thin—the same diameter as the width of the blade. Also in this width is a further metal-tipped one with a thicker shank.

Next there is an all-metal 2·4mm. tool with shank of the same size and two polycarbonates of the same size but with a wider shank. In my sample one of these was broken. Then comes an all-metal 3mm. tool with shank of same diameter, and a metal-tipped one with thick shank. There are two all polycarbonate 3·5mm. tools and finally a long 5in. one with tapered blade width. This is a general-purpose tool for use where a long shank is more important than the blade width; its principal use is for tuner oscillator cores.

Maximum durability is of course provided by the all-metal tools but if these influence the tuning the metal-tipped ones are the next choice. For critical circuits or ones where the shank of the others is too thick to penetrate the coil formers the all polycarbonate tools should be used. Where the cores are stiff the metal or metal-tipped ones can be used to start with to prevent undue wear on the polycarbonate tools: once the core has been moved and tuned approximately it can then be tuned finely with



"Do you ever fancy going back to garage work?"

a plastic one if necessary.

So much then for the tools provided. We should next say a word about omissions. A core for which no tool has been provided has a triangular hole. These cores are used on the continent and are not often seen over here (although they may well be in the future). I would not have mentioned them except that they are used in Philips sets! Next there is no tool for the screwed-rod-with-flattened-sides-at-the-top type of trimmer often encountered on tuners as well as in some i.f. coils. These need a metal tube flattened into an oval and should be included in any trimming-tool kit.

The final and perhaps most surprising omission is that of the hexagonal-hole core tool. This type of core is very widely used. It is true that tools for use with them soon become rounded so that most engineers will have a stock of several to hand but one would nevertheless have thought that a couple could have been included in the kit for the sake of completeness. A metal version would have been welcome as a means of shifting stuck cores, something the plastic ones with slender shanks are not too good at doing.

The kit is contained in a plastic tray with compartments to house the tools, holders and extension pieces. The compartment partitions have cut-away portions so that the fingers can be easily inserted to remove the tools but I still found it not too easy to reach some of them—clumsy fingers perhaps! A detachable lid is provided but as this is a loose rather than snap fit it is more suitable for bench work than carrying in the field unless a rubber band is used to hold the lid in place.

The retail price of the complete kit is £4·08 and is subject to normal trade discounts. Some of the tools are available singly as replacements and these are indicated on a list included with the kit. Altogether this is a useful and worthwhile addition to the bench equipment.

Availability of the kits: Members of the public should contact their local radio and television dealer. Trade enquiries should be made to CES franchised wholesalers or to local CES Cash-and-Carry shops.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

MAY has been an eventful month! Conditions opened up for Sporadic E from the 15th—at least for really intense openings—and only these past two days has there been a lull (28, 29th May). So far it has been difficult to draw any conclusions about a definite reception pattern as signals seem to have arrived from all points of the compass! There has been a tendency for medium/long hop signals to be favoured while reception in Band II (TV) has not been favoured. Reports are beginning to trickle in and all tell the same story of excellent sustained openings. Without further ado my log for the period: where known I have indicated activity which I missed.

1/5/72 USSR R1; MT (Hungary) R1; CST (Czechoslovakia) R1—all Sp.E.
3/5/72 SR (Sweden) E2—MS.
5/5/72 USSR R1; TVP (Poland) R1; RAI (Italy) IA—all Sp.E.
6/5/72 BRT (Belgium) E2; NOS (Holland) E4—both trops.
7/5/72 USSR R1; possibly TVE E2—both Sp.E.
9/5/72 WG (West Germany) E2; SR E2—both Sp.E.
10/5/72 SR E2; NRK (Norway) E4—both Sp.E.
11/5/72 TVP R1—MS.
12/5/72 BRT E2—trops.
14/5/72 DFF (East Germany) E4—MS.
15/5/72 SR E2—MS. (Sp.E activity reported USSR R1, 2; CST R1, 2.)
16/5/72 SR E2—MS; WG E2; TVE (Spain) E2—both Sp.E. Also unidentified signals. (Good Sp.E reported during day—ORTF (France) F2, 4; RAI IA, B; TVE E2, 3, 4; JRT (Yugoslavia) E4; MT R1.)
17/5/72 USSR R1 twice, R2; TVP R1, 2; SR E2, 3 4; NRK E2; YLE (Finland) E2; RUV (Iceland) E4 (very good Sp.E day).
18/5/72 CST R1; TVP R1; DFF E3; SR E2, 4; NRK E2 (fair Sp.E).
19/5/72 RUV E4; USSR R1—Sp.E.
20/5/72 USSR R1; MT R1, 2; YLE E2; SR E2, 3, 4; NRK E2; RAI IA, B; JRT E3, 4; ORF (Austria) E2a; also unidentified signals (good Sp.E day).
21/5/72 TVE E2, 3, 4; RAI IA B; JRT E3, 4; MT R1; USSR R3; also many unidentified signals on all channels (very good Sp.E opening).
22/5/72 Unidentified Sp.E in evening R1, E4.
23/5/72 BRT E2—trops.
24/5/72 RAI IA, B; JRT E3, 4; TVE E2; RTP (Portugal) E2, 3; RUV E2, E3, E4 twice; also unidentified signals.
25/5/72 TVE E2, 3, 4; RAI IA; MT R2; CST R1; TVP R1, 2, 3; also unidentified signals.
26/5/72 SR E2; TVE E4; also unidentified signals.
27/5/72 RAI IA, B; TVE E2, 4; JRT E4; RUV E4; NRK E2; SR E2, 3, 4; USSR R1; MT R1, 2; also many unidentified signals (a good Sp.E day).
28/5/72 BRT E2—trops.

The opening mentioned above on the 16th was reported by our colour expert Graham Deaves of Norwich. He noted ORTF on 625-line tests in Band I with SECAM colour between 1000-1200 at which time the normal 819-line transmissions recommenced. In passing, Graham has noted other SECAM signals from Eastern Europe with colour bars and at lesser distances colour (PAL) from NRK. The opening here on the 17th included the familiar PM5544 electronic card with an identification in extremely fine characters; it was not until the following day (during another opening!) that the same card was again noted on ch.E2 and the identification deciphered as Norge Televerket — in the top and bottom black rectangles respectively. Incidentally the YLE TV2 Finnish reception lasted for nearly three hours on ch.E2 and was the strongest I have ever seen here in Hampshire. The signals faded out after lunch.

The opening on the 21st was rather remarkable. Strong harmonics were noted from Arabic short-wave transmitters in Band I—surely indicating the ease with which any North African Band I transmitter could be received if and when one opens. I had been spending some time during this opening on Band II—since conditions seemed to favour the South and South-East—in the hope of possible Albanian reception. Alas no luck with that country but at 1820 on ch.R3 there appeared as a floater over the programme being received on this channel a Russian caption which when translated into English type letters gave the town name BAKU. This is rather mysterious as if indeed this originated from that area (on the Caspian Sea) I would have expected Arabic type script being that in the area there are the two languages/dialects Georgian/Armenian. However the photograph awaited shortly will be studied closely for possible clues.

The next day of note here was the 24th. From about 1800 things became interesting. RUV Iceland had been noticed on both chs. E3 and E4 and at 1828 the same test card was noted on ch.E2. At present there is no high-powered transmitter listed on this channel, only a relay, so possibly there is a new transmitter in operation. As a bonus for this new station a floater was noted over the E4 transmissions thus making a double event—two new stations! In the same opening RTP Portugal had been seen using various white squares/circles on a dark background preceding the test card (type E).

A busy month!

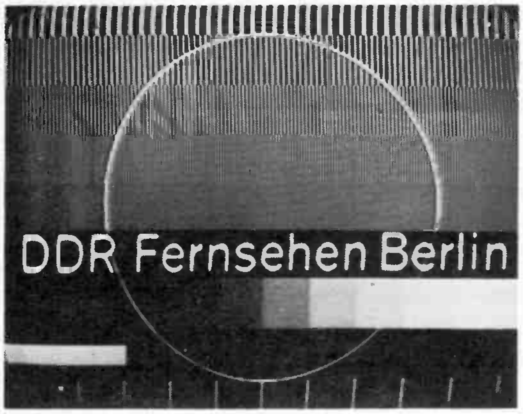
News Items

Spain: We have rather sad news from our friend Maurice Opie. He has heard from a contact in Spain that the TVE-2 second chain transmitter at Santiago (ch.E2) is to close, reopening on u.h.f. only. At present we do not know when this will take place (if not already!). I suggest that extra vigilance is taken on ch.E2 as this may be the last opportunity to log this transmitter.

Eire: We have now received official notification from

Main news captions of Intervision: TV Hirado, Hungary. Courtesy OIRT Prague.

DATA PANEL 13 - 2nd series — EAST GERMANY (GDR)



The two test patterns in use. The identification "DFF Berlin" has been noted on the test pattern until recently.

Transmitter identificaticn slide.

First network identification slide.

Photographs courtesy of Ralf Erler, Parchim, GDR.

RTE regarding their test card. The PM5544 is now used (as recently mentioned by a correspondent) and carries the identification RTE in the centre of the lower black rectangle. We hope to feature this card shortly.

West Germany: Several West German u.h.f. transmitters have reduced powers. Amongst them are: Nuernberg ch.34 down to 410kW from 460kW; Spessart ch.35 down to 175kW from 230kW; Cloppenburg ch.37 down to 42kW from 50kW; Heidelberg ch.53 down to 420kW from 500kW; Nuernberg ch.59 down to 400kW from 460kW; Hoher Bogen ch. 59 *up* to 330kW from 220 kW; Pforzheim ch.59 down to 160kW from 250kW.

All aerial polarisations horizontal. It would seem that the u.h.f. service as originally planned is having to be revised. One has heard talk of such an eventuality in the UK.

Portugal: New transmitters: Lousa RTP-2 ch.26 540kW; Mendro RTP-2 ch. 27 560kW; Muro RTP-2 ch.27 500kW. All transmissions horizontally polarised.

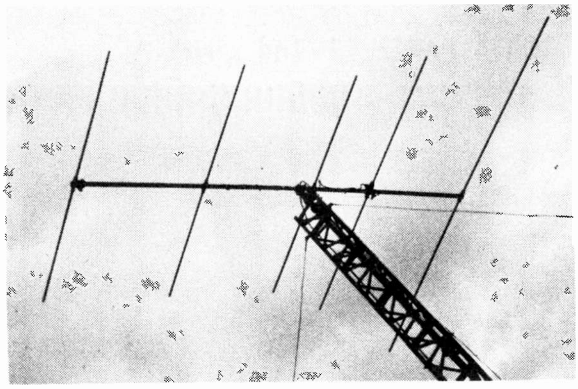
From Our Correspondents

A very full post-bag this month. Rym Muntjewerff of Beemster, Holland, sent us a very long log detailing his reception: activity has been very good despite problems from his local Band I (Lopik) transmitter. We have sent details of a notch filter that may help with this problem. Rym also tells us that the West German networks WDR-1 and NDR-1 will be using the ZDF/SWF/YLE type electronic card from the Autumn. He also notes that the Danish card is now carrying the identification DR and Danmark as featured in our January 1972 Data Panel.

The continuing story of F2 reception in Cyprus—it's still going on!! A letter from the now familiar A. Papaeftychiou indicates that Gwelo E2 Rhodesia provides the evening news and topics programme quite regularly at 1800 local time. Apparently the receiver can be left running and Gwelo will often appear. The letter dated 25th April also gave news of improving Tropospherics with Beirut ch.E4 "fine reception" and the first signs of Jordan ch.E3. If Sp.E conditions in Cyprus have been anything like the UK, it's been a busy time.

A Chingford enthusiast D. Hammond has modified a Thorn 850 chassis to enable him to select either 5·5MHz or 6·5MHz f.m. intercarrier frequencies for the various reception standards. Further modifications have provided good reception of French Television. Several photographs confirm that this receiver seems highly suitable for modification for DX work. It appears that his particular location is partially screened for really effective u.h.f. work but I feel that such circumstances can be used to advant-

Roger Bunney's wideband Band I dipole.



The Ian Hickling wideband Band I array described in the May issue (page 303).

age. In a screened area the signal strengths of locals and semi-locals can be quite low thus making improved reception via Sp.E and MS (Meteor Shower) possible.

Channel Allocation Chart

An unfortunate error occurred in the information given beneath the channel allocation chart in the June column (page 376). System D is the East European system with 625 lines, negative vision modulation and f.m. sound. System E is the French 819-line system with positive vision modulation and a.m. sound.

VHF to UHF Converters

As mentioned last month there are now available a number of units that convert the 40-230MHz spectrum up to u.h.f. (approximately chs. 33-56) thus enabling the complete v.h.f. spectrum to be tuned in via a conventional u.h.f. tuner. Such a unit has obvious applications in receiving the difficult channels that are outside the normal UK coverage, including chs. R3, 4, 5 and IC. Two such units, the Labgear CM6022/RA and the Teleng DN6328, have been tested. As the results obtained were virtually identical the following comments apply equally to both.

Stability throughout the bandwidth is good. Gain/noise tests were taken on the Ventnor relay ch.B5 some 20 miles distant and on Cherbourg ch. F12. Noise figures for the Teleng unit were given as 6·5dB for Band I and 8·5dB for Band III. Acceptable results were obtained for such marginal signals but it should be noted that a slight insertion loss occurs. A signal tuned via the converter is slightly weaker than if tuned directly on the receiver: thus for DX work either an aerial amplifier or an amplifier between the converter and the u.h.f. tuner must be used for best results. Other tests were made to check the overload/cross modulation performance. At this particular location very high signal strengths are encountered from Band I and III transmitters. With no amplifier in circuit performance was good but with any amplifier preceding the unit overloading was experienced particularly l.f. of the channel in question. In an area with lower field strength I would expect little problem with such overloading. The problem was further aggravated by using a transistor u.h.f. tuner as comparison checks with a valve unit certainly provided improved performance.

On the whole I found the device useful for coverage as detailed above but would suggest the use of a valve tuner to minimise overload problems. The problem of front-end overload could be minimised by feeding the aerial straight into the unit and adding amplification with Group A amplifiers (for Bands I and II) and Group B amplifiers (for Band III).

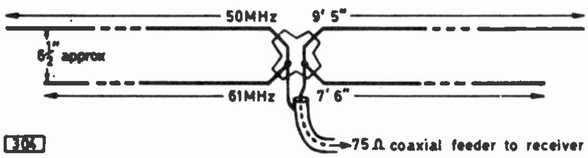


Fig. 1: Wideband Band I dipole details.

Wideband Band I Dipole

Following the recent article on wideband Band I aerials (May TELEVISION) I have been giving thought to a form of wideband Band I dipole. Although the final result (Fig. 1) is very much a compromise array it works quite well and during recent conditions gave excellent service over the ch.E2-4 bandwidth. The arrangement uses parallel elements mounted on an X insulator. The elements must each be bent through 45° so that they are parallel when fitted to the insulator. The 45° bend should be made as close to the insulator as possible and great care should be taken when bending the alloy—we suggest that some practice in alloy bending is got before working on the elements themselves. Half-inch diameter alloy elements cut to 50MHz and 61MHz are used. A suitable X insulator incorporating a mast clamp is available from S. A. Collard Ltd., Wetherby Road, Derby, DE2 8JQ and costs 55p plus 15p post/packing. Quote "X Insulator A/1029." Depending on the type of X insulator used some modification may be required to provide for the cross connections within.

RENOVATING THE RENTALS

—continued from page 467

a service manual are obtainable from Decca Radio and Television Ltd., Ingate Place, Queenstown Road, London SW8, telephone 01-622 6677. Salvaged spares can sometimes be found on the surplus market.

Puzzler

A serviceman was dismayed when first a diode and then a resistor fell out of the colour set he was installing. The fact that the set performed perfectly when plugged in did not help him discover where they had come from. Both sound and vision were faultless, with good interlace, good convergence, natural colour and proper a.g.c. action on different signal strengths. In fact all systems were definitely "go". The set was a single-standard one so one would not expect any components to be redundant. Yet the two components had come from somewhere in the set. Where? (Answer next month!)

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 475 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 CTV184S

With the colour control correctly adjusted the picture constantly switches momentarily to monochrome. With slight reduction in the colour control setting colour is lost completely. The colour can be held if the colour control setting is increased slightly but the colours are then too strong.—L. Pertwee (Stoke).

We suggest you note the effect of adjusting control 3RV7 mounted at the bottom of the decoder panel: this may be the only adjustment needed. The control is called "bistable phase" but also controls the colour killer action. If this does not solve the problem try increasing the setting of the preset contrast control (i.f. gain control 2RV2) on the i.f. panel provided this does not introduce any other ill effects.

KB FEATHERLIGHT KV003

Picture and sound are perfect on 405. On 625 however the picture appears to be folded several times with the sides of the screen blank.—J. Rogers (Sevenoaks).

It appears that the 0·15μF S-correction capacitor C139 on 625 lines is defective: unfortunately however the line output transformer could be at fault. Adjust the core of the PCF802 line oscillator anode coil L74/L75 for 625 hold and the preset capacitor C126 for 405 hold with the main hold control at mid-position before taking further action.

DECCA MS2000

The brightness on this set cannot be reduced to black level—in fact the brightness control has to be set at minimum to obtain a reasonable picture. The grid circuit of the video amplifier has been checked and everything here seems to be all right.—B. Saunders (Luton).

It appears that the v.d.r. (VDR301) wired from the earthy side of the brightness control to chassis is at fault. The type number is E229/DD/P340. Shorting it out, i.e. connecting the brightness control directly to chassis, will prove whether this is so but will of course result in a residual spot lingering after switch off. Check the tube cathode voltage (135V approximately at pin 7) and the grid voltage (pin 2 or 6) which should swing from 150V down to 50V unless the v.d.r. or possibly tube leakage prevents this.

EKCO T418

I used a standard 25kΩ potentiometer instead of one with a tapping as originally fitted when replacing the high level contrast control R32 on one of these receivers. After a few hours' viewing this burnt out, obviously due to excessive current. I would be grateful for your comments on this and as to whether a tapped potentiometer is important in this position. The tapping on the original was connected to a 22pF capacitor.—G. Hammond (Pudsey).

The contrast control is connected across the 4·7kΩ anode load resistor R31 of the video output stage. We assume R31 has gone open-circuit, causing excessive current through the contrast control. It is not all that important to fit a tapped potentiometer. The 22pF capacitor C36 previously connected to the tapping is to compensate for loss of fine detail at low contrast and can be connected to the slider of your replacement.

PETO SCOTT TV960

Both picture and sound on u.h.f. gradually faded away. The raster however is still present. The set is not used on 405.—R. Widler (Kirkby).

It seems that one of the valves in the u.h.f. tuner is faulty and in view of the age of the set it would be worth replacing both (PC88 and PC86). Also check the voltage supply to the tuners: this is via a 1kΩ resistor (437) on the left side near the red and black electrolytic capacitor (457). This resistor often changes value on this (Plessey) chassis leading to loss of signals.

GEC 2039

The fault, a distinct nasal tone which reduces in volume, develops after the set has been on for five-six hours—if the back is left off it does not develop. The PCL84 audio output valve and EF80 sound i.f. amplifier valve have been replaced and there are no visible signs of capacitor leaks.—R. Grunwood (Bedford).

The fault is most likely to be in the EH90 stage and we suggest you change R92 (18kΩ 2W) to the left of this valve and R93 (5·6kΩ) to the rear of it as both these can change value with heat.

BUSH TV181S

Since new this set has been subject to loud, sharp arcing, the only effect of this on the screen being a momentary change in brightness. Recently however after a severe crack the line gradually collapsed until the width was about a third of normal. The picture then slowly expanded but at the same time dimmed until it disappeared altogether, indicating that the line output stage was not operating as the transistor supply is rectified from a tapping on the line output transformer. I used a temporary DY86 as a replacement for the DY802 e.h.t. rectifier and this restored the picture to normal. The crack however still occurs and the width is then slightly affected but recovers.—J. Sothern (Exeter).

Attention should be directed to the e.h.t. compartment in the vicinity of the DY802 valve base or the e.h.t. lead out. The other line output stage valves—PY88 and PL504—should be checked. A further possibility is a breakdown between adjacent tracks on the panel.

GEC BT454

The set works perfectly on v.h.f. On u.h.f. however the sound and picture are OK for about 20 minutes after which the sound changes to a loud rushing noise while the picture changes to snow. After the set has cooled off for say half an hour it is possible to obtain another 20 minutes viewing on u.h.f.—A. Grand (Leicester).

It appears that the u.h.f. local oscillator—the PC86 in the u.h.f. tuner—fails to function after 20 minutes and we suggest you change this.

RGD DEEP 17

The sound is OK but there is no picture. The line whistle appears after the set has been switched on and there is e.h.t. but just as one expects the picture to appear the whistle stops and there is no e.h.t. spark. The valves in the line output stage and the line output transformer have been replaced but still the problem remains.—T. Wykhurst (Ealing).

The most probable cause of the trouble is the boost capacitor (C47, 0·1μF). The easiest way to check this is to remove the PY81 top cap: if the capacitor is short-circuit this action will restore some e.h.t. This test is not however completely conclusive. The next suspect is the ceramic third-harmonic tuning capacitor C45 (220pF).

BUSH TV135R

This set gives a good picture and good sound quality. The audio output seems low however—the volume control has to be well advanced.—J. McReady (Dundee).

There are two resistors 3R55 (120Ω) and 3R56 (470Ω) in the cathode circuit or the audio output pentode. The larger value one is decoupled by a 50μF electrolytic (3C41). If this has deteriorated there will be increased negative feedback and as a result reduced audio output. If this is not the case check the value of the two resistors—they may have been damaged by a previous valve. If necessary check the anode load resistor (3R51 100kΩ) of the triode section of the audio valve.

ULTRA 6618

This set will only give results when the voltage setting is reduced to 220V. At the correct setting the raster remains but there is no picture or sound. Also the picture sometimes jumps up and rolls, leaving a black border at the bottom of the screen. This can be corrected by moving the field hold control.—J. Cardwall (Upminster).

There appears to be loss of h.t. to the tuner unit. There are two feeds, via two resistors which are situated to the right of the mains supply fuse (swing open the left side mains dropper panel). These two resistors (R169 and R170) should both be 5·6kΩ (1W). One will be found to have changed value—rarely both do. For the field trouble check the value of the anode load resistor R138 (22kΩ) of the section of the 6-30L1 (ECC804) used in the field timebase. This resistor is at the front centre of the lower deck—use a 1W type as a replacement. If necessary change the PCL85 field timebase valve, also the PCF805 on the tuner to ensure stable sound and picture.

SOBELL ST283DS

The main fault with this set is S-shaped verticals—the line lock is solid. The main smoothing components have been tested and found to be OK.—J. O'Neil (Cublington).

We suspect the electrolytic which smooths the h.t. feed to the sync separator and line oscillator: this is C109, 24μF. Alternatively the trouble could be due to a noisy line oscillator (V11 ECC82) or line output (V12 PL36) valve.

CHALLENGE C505

The screen went blank and on checking there was found to be no e.h.t. The line timebase valves have all been replaced, but still no results. On removing the top cap of the e.h.t. rectifier there is a very small spark. This set incidentally uses the same chassis as the KB VV10-VV80 series.—E. Woods (Dover).

If the e.h.t. rectifier is not lighting up first check the 2Ω resistor in its heater circuit. If this is in order check the boost reservoir capacitor C126 (0·1μF 750V). If this is OK check the line drive at the grid of the line output valve: this should be between −30 and −40V. If the line drive is absent the line oscillator stage and flywheel sync diodes should be checked. If the line drive is OK check the screen feed resistor (R141, 2·2kΩ) to the line output pentode—also check the system switching here. If these checks fail to reveal the cause of the trouble suspect the line output transformer.

ULTRA 6606

This set is used on 405 lines only and has excessive contrast. The tuner and video valves have been replaced without altering the situation while adjusting the contrast and local/distant controls makes very little difference.—C. J. Wells (Tottenham).

The problem is due to excess gain. Check C8 (300pF) since if this is leaky a positive voltage will appear at the grid of the first i.f. valve V3. Then check the a.g.c. line clamp diode W3 (type M3). If these do not put matters right you will have to check the a.g.c. line generally.

FERGUSON 3653

This set, fitted with the Thorn/BRC 1400 chassis, has suffered since I have had it from sound buzz on u.h.f. I have tried all the usual checks—the valves, detector balance control, detector diodes, the detector load circuit components and the 6MHz tuning. Is there anything more I can do?—G. Ayer (Hythe).

A double cover for the sound detector can is available from BRC or your local agent and we suggest you obtain and fit this. If the trouble persists try removing the bonding strips from the u.h.f. tuner and check the chassis bonding of the screened leads.

McMICHAEL 3011

The field timebase in this set is giving a lot of trouble. There is cramping at the top and bottom and also foldover at the bottom of the picture. The presets are set to the ends of their travel—otherwise the picture shrinks still more. The field flyback lines are visible on dark pictures and sometimes the picture flutters as if about to turn upside down. The PCL85 has been changed with little improvement.—D. Levy (Brentwood).

To get the picture stable we suggest you replace the field sync pulse integrating capacitor C156 (0·05μF). To get the size of the picture right check the components in the boost feed to the field oscillator R132 (1·2MΩ) and C179 (0·01μF), the cathode components of the output pentode R108 (330Ω) and C154 (250μF), C151 (0·01μF) in the linearity feedback circuit, the coupler C149 (0·1μF) and charging capacitor C147 (0·05μF).

MURPHY V849

There is no picture and the PL36 and PY88 line output stage valves are red hot. Sound is still present but is very distorted. I have tried valve replacement without improving matters.—S. McGannon (Dagenham).

As the PL36 and PY88 are red hot there is absence of line drive so the trouble lies in the PCF80 line oscillator stage. We suggest you check the voltages in this stage to see where the fault is and try adjusting the preset capacitor 3TC1 in this stage as it sometimes shorts to produce the symptoms described.

MARCONIPHONE 4615

After about half an hour the bottom creeps up some 1¼in. while the top reduces by about 1in. This set is fitted with the Thorn/BRC 950 chassis.—S. Oliver (Aylesbury).

The fault lies in the PCL85 field timebase stage. Check the valve then the following: R112 (270Ω) and C89 (100μF) the cathode bias components, C88 (0·01μF) in the linearity feedback circuit and C81 (0·02μF) the field waveform charging capacitor.

QUERIES COUPON

This coupon is available until August 21, 1972, and must accompany all Queries sent in accordance with the notice on page 473. Don't forget the 10p postal order!

TELEVISION AUGUST 1972

TEST CASE

116

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 troubles this month were distorted sound on 625 lines on a dual-standard receiver using a ratio detector for f.m. and distorted sound on both 405 and 625 lines on a dual-standard receiver using a locked oscillator discriminator (EH90 valve) for f.m.

The receiver with the ratio detector was checked for intercarrier alignment which proved to be correct. During this process it was noticed that the distortion decreased but would not clear completely when the ratio detector a.m. rejection preset was set to the end of its range. Tests were then made on this potentiometer and the resistors associated with it but to no positive effect.

Since the sound on both 405 and 625 lines was affected on the receiver with the EH90 valve it was considered that the fault must lie somewhere in the audio channel proper. Voltage, current and valve checks failed however to reveal the cause of the trouble.

Why is it that some receivers are affected in this way on both line standards while others are affected on only one line standard, mostly 625 lines?

Next month's TELEVISION *will give the answer to this and feature another item in the Test Case series.*

SOLUTION TO TEST CASE 115

Page 427 (last month)

This was the case of the overheating desaturating coil in the line output stage. Since this coil is effectively in shunt with part of the line output transformer it must have a high impedance at the line timebase frequency and a fairly low resistance to d.c. to allow the anode of the line output valve to receive h.t. supply from the boost diode cathode.

The d.c. resistance of the component was found to be acceptable but its "impedance" had fallen badly thereby putting a heavy load on the primary of the line output transformer. The trouble was caused not by a leak to chassis but by short-circuited turns, the effect being rather similar to shorting turns in the line output transformer. Such a short generates high-value circulating line frequency currents and these were responsible for the overheating and the failure of the line timebase. Replacement provided a perfect cure.

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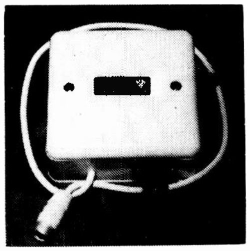

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