

PRACTICAL TELEVISION

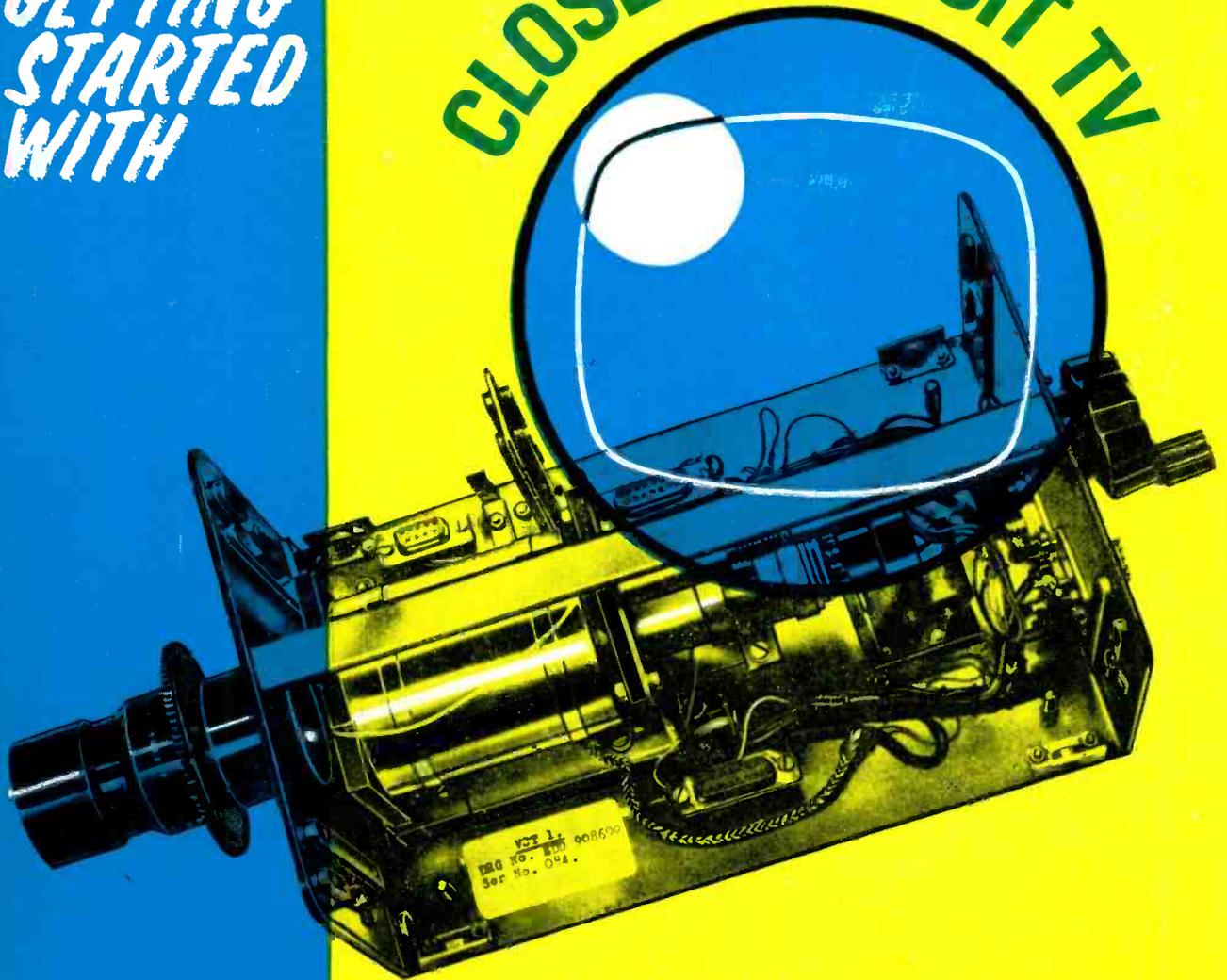
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NOVEMBER
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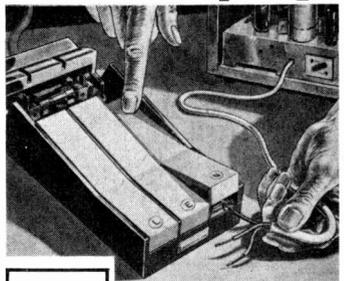
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PRACTICAL TELEVISION

VOL 20 No 2
ISSUE 230

NOVEMBER 1969

THE NEW BREED

HAVING dutifully done the rounds of the recent trade exhibitions and "at-homes" it is obvious that we are going through a period of rapid technical change and that even greater developments are round the corner. The way things are moving these days is pinpointed by the fact that after only a year on the market (and with relatively small sales) the first batch of colour TV receivers has already given way to a second generation.

Apart from the fact that the pictures are markedly better on the new single-standard models the consistency of colour from one to another was quite remarkable—even when banks of receivers were running side by side, an exercise which would have been disastrous a year ago. And from the servicing point of view technicians, even if not throwing their hats in the air, will heave a sigh of relief.

One glance at the interior of a typical model and another at the appropriate circuit diagram will be sufficient to confirm that life is going to be much easier. Gone are the nightmares of the dual-standard jungles with the complex systems switching, the various compromises, the varied pass-bands—and much of the ironmongery.

When one of these sets comes in for service you will be faced with a chassis that will bring back memories of the good old days before dual-standard operation, with circuit diagrams you can take in at a glance. The new breed of receivers has a single tuner followed by a complex filter and a high-gain 3/4-stage wideband i.f. strip (with printed coils that require no trimming in one example) for the vision section. And in the sound i.f. section, with only one standard to worry about the dual-channel valve or transistor circuit is being replaced with a single i.c. chip such as the Mullard TAA570. The timebases are of course simpler and we may soon see the simple silicon controlled-switch oscillator and, on the power side, the thyristor power unit. As for lining up the colour circuits, with no 405 operations to worry about this is going to be that much easier. For once it seems that the trends are towards simpler circuitry, easier fault-finding and improved performance. And for that let us be grateful.

W. N. STEVENS, *Editor*

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THE NEXT ISSUE DATED DECEMBER
WILL BE PUBLISHED NOVEMBER 21

TELETOPICS



PIRATE TV BROADCASTS

The promoters of private commercial television still appear determined to start transmitting early next summer from two foreign-registered aircraft circling at 20,000ft. above the North Sea. The intention is to transmit on 625 lines at u.h.f. and to reach between 70 and 80% of the population. Special receiving aerials would be needed.

Whilst television broadcasting from the air is technically practicable the Postmaster General has pointed out that there are serious legal and technical problems. The sponsors would be up against the Marine, etc. (Broadcasting) Offences Act of 1967 and would be acting contrary to the International Telecommunication Convention. The use of a pirated channel could cause widespread interference both in the UK and on the Continent.

CRTs MUST GO!

J. P. Collis, Rank-Bush-Murphy Managing Director, predicted at a recent press conference three dimensional colour television displays using holography, a process of lensless photography and projection involving the use of laser beams. The idea is to find a new type of display device of compact design and without the need for an e.h.t. system. Other solutions are under consideration and whilst the replacement of the c.r.t. is at present largely a matter of speculation the industry is certainly looking ahead to new engineering solutions to the problems of television.

TV LICENCE

The combined radio-TV licence fee will be increased to £6.10.0d. from April 1st 1971 and at the same time the radio-only licence will be discontinued.

THE NEW SETS

Most setmakers revealed single-standard colour receivers at the Trade Shows and many showed single-standard black-and-white ones as well. This means a rash of new chassis to get acquainted with. The new **Pye/Ekco** single-standard colour chassis is known as the 691 series whilst their single-standard monochrome chassis is the 169. More news is given in the *Show Report* on a later page and the details will be filled in next month.

We now have additional model numbers and prices for the sets fitted with the Thorn/BRC 3000 single-standard colour chassis. These are the **Ultra** 6703

and **HMV** 2703 19in. models at £239.5.0d., the **Ferguson** 3706 and **Ultra** 6706 25in. table models at £272.10.0d. and the **Ferguson** 3705 25in. console at £296.10.0d.

A number of imported portable models have been on show including a **Philco** 12in. model at approximately 89gns., a 7in. model from **Crown** at £73.15.0d. and a 9in. model from **National** at about 85gns. National also showed a 1½in. battery model that looks like a cine camera.

The much talked-about **Teleton** £150 colour receiver turned out to be a prototype which has not yet reached the production-line stage.

We were interested to see at the **Sony** show sets fitted with the 13-in. Trinitron tube. It is difficult to compare the results obtained with this small-screen tube with those obtained with the large-screen shadowmask tube. The colours were good but we felt the system did not provide such good resolution.

BRC SERVICE DEPOT MOVES

The British Radio Corporation (Thorn Group) Edmonton Service Depot moved to new premises at Lea Valley Trading Estate, Angel Road, Edmonton, London N.18, on September 16th. The postal address is British Radio Corporation Ltd., P.O. Box No. 121, London N.18. Telephones: 01-807 3060 general, 01-807 0791 spares, 01-807 6332 24-hour Ansafone spares order service.

BATC 1970 AMATEUR TV CONVENTION

The British Amateur Television Club celebrates its 21st anniversary next year and has decided to hold its 1970 Convention at Cambridge with a two-day programme during the weekend 25th-26th July. Accommodation will be available at Churchill College. Further details will be announced as soon as they are available.

NEW UK SEMICONDUCTOR GROUP FORMED

GEC-English Electric have formed GEC Semiconductors Ltd. to bring together under a single management company the semiconductor interests of Marconi-Elliott Microelectronics Ltd. and AEI Semiconductors Ltd.

Marconi-Elliott Microelectronics Ltd. and AEI Semiconductors Ltd. will continue to trade separately and will retain their existing facilities. Integrated circuits and work in that field will continue to be carried on at Witham, Essex and Glenrothes, Fife with microwave and power devices handled at Lincoln.

LOW-LIGHT LEVEL TV CAMERA TUBE WITH FIBRE-OPTIC COUPLING

The latest addition to the range of TV camera tubes manufactured by the English Electric Valve Co. Ltd. (Chelmsford, Essex) combines the low-noise read-out of a 3-in. image-isocon tube with the additional light amplification of a single-stage image intensifier. The resultant type P8012 tube will give good pictures under overcast starlight conditions.

The P899B intensifier stage has a curved faceplate for use with a mirror optical system though with a corrector lens fitted it can also be used with a refractive optical system. The intensifier output screen and the 3-in. image-isocon (type P887) photocathode are both fitted with fused fibre-optic faceplates which coupled together provide an efficient transfer of the intensifier output image on to the photocathode of the isocon. Both the P899B and P887 can be supplied separately if required.

The photocathode illumination under typical operating light-level conditions is 10^{-1} to 10^{-2} ft.-candles and the spectral response S20, red enhanced.

GRUNDIG PAL COLOUR GENERATOR

Grundig announce the FG5 fully-transistorised colour generator providing numerous combinations of test signals for use in checking colour television receiver operation. The r.f. output at 10mV maximum into 60Ω covers the v.h.f. channels 5-12 and u.h.f. channels 21-60. Video outputs are variable up to 3.5V p.p. at 75Ω with positive or negative output selected by push-buttons—as are all the other functions. Test signals provided are: (1) grey-scale with defined white level; (2) chessboard pattern with black-and-white squares; (3) grid pattern with separate push-button selected vertical and horizontal lines; (4) electronic circle with or without grid pattern; (5) red, green and blue signals push-button selected; (6) four vector colour-difference signals for PAL system checking; (7) cross bar or beam signal which can be blended with the four vector signals; (8) colour test picture according to the NORM (PAL) standard—three primary, three complementary plus black and white—line or bar pattern as selected; (9) sound carrier with or without kHz modulation.

RTRA LONDON EXHIBITION NEXT YEAR

The Radio and Television Retailers Association is to hold a comprehensive trade show in conjunction with its annual conference next year which will take place at the Grosvenor House Hotel from March 31st to April 2nd. Previous conferences have been held in the provinces and there is speculation as to whether the move to London with a comprehensive spring trade show may end the present system of numerous independent shows held in the autumn. BRC, Pye, GEC, Rank-Bush-Murphy and KB are among the major groups supporting the show.

ANTIFERRECE INCREASE AERIAL PRICES

Antiferrence announce with regret that due to increased costs they have decided to increase the recommended retail prices of their TV aerials and associated accessories. A new price list is available from Antiferrence Ltd., Aylesbury, Bucks.

NEW TRANSMITTERS IN OPERATION

The **Hemel Hempstead** BBC-2 relay station was brought into operation on September 15th on channel 44 with vertical polarisation. The correct receiving aerial is one in Group B. The other channels assigned to the station are 41, 47 and 51.

The BBC-2 television service from **Sandy Heath** also started on September 15th, on channel 27 with horizontal polarisation. A Group A aerial should be used and the other channels assigned to the station are 21, 24 and 31. This has brought BBC-2 to a further estimated million people in the area including Bedford, Northampton, Wellingborough, Kettering and Cambridge. To the north and west the service area overlaps to some extent with the service areas of the BBC-2 Waltham and Oxford stations.

The ITA announces that its low-power **Newhaven** v.h.f. (channel 6) relay station at present being built to improve ITV reception in the Newhaven Sussex area is not now expected to be in operation until about May 1970. The postponement is the result of the diversion of equipment to the Sheffield station following the collapse of the Emley Moor mast earlier this year.

RANK CINTEL PAL ENCODER

Rank Cintel announce a new broadcast-quality encoder which provides six coded outputs plus a separate luminance output and contains an integral colour-bar generator. The price, including colour-bar generator, is £750. The unit is self-powered and the colour-bar generator can provide bars of either 100%, 95% or EBU saturation levels. Further details: Rank Precision Industries Ltd., Broadcast Division, Welwyn Garden City, Herts.

CONTINUED FALL IN RADIO AND TV TRADE DELIVERIES

Despite a slight increase in monochrome television receivers delivered to the home trade during the first six months of this year the overall radio and television position continues to show the falling trend indicated towards the end of last year, according to the Economic and Statistical Division of the British Radio Equipment Manufacturers' Association.

June figures for monochrome receivers show a fall of 23,000 compared with the previous month and are 13,000 less than for the same month last year. For the period from January to June however the overall total of 816,000 is 11,000 higher than for the first six months of 1968.

Colour television estimates of deliveries for the first six months of this year at 42,000 show a drop of 21,000 compared with the same period of last year.

Radio receivers are considerably lower for January to June this year at 356,000 compared with 531,000 for 1968, giving a fall of 175,000 for the period. Car radios were also lower than for the same period last year at 182,000 compared with 220,000 for the first six months of last year, and radiograms at 77,000 show a drop of 28,000 overall for the same period.

These estimates are net figures of deliveries by manufacturers to the home market on firm and other accounts including those to specialist rental and relay companies.

TRANSISTORS IN TIMEBASES



PART 4

H. W. HELLYER

LAST month we took a look at transistorised line oscillator stages and the associated flywheel sync circuits found in conjunction with them, ending up with the circuit used in both the Thorn/BRC 2000 (dual-standard) and 3000 (single-standard) chassis. This uses a configuration that looks likely to become a "standard" circuit in all-transistor receivers, a Hartley-type oscillator with the tuned circuit coupled to a reactance stage linked via a flywheel filter to an unbalanced phase discriminator which compares the phase relationship between the incoming sync pulses and a waveform fed back from the line output stage. Transformer coupling is used between the oscillator and the driver stage, which is again transformer coupled to the output stage which consists of a pair of power transistors in series across the supply.

We are indebted to Mullard for further information on this subject and will start this month by taking a look at the line oscillator and driver circuits they have adopted for their latest single-standard all-transistor colour television receiver design. We must at the outset make it plain that Mullard do not produce or market television receiver chassis, but as manufacturers of many of the components and devices used by the setmakers nevertheless undertake considerable design work to enable them to test the performance of the many devices they make. In fact their research results in a constant stream of technical information for designers and engineers and has considerable influence in the design departments of the setmakers. As H. J. Hoare pointed out last month this is likely to be a growing tendency as basic design increasingly becomes the province of the semiconductor device manufacturer. We have also been asked to add a word of warning: some of the devices used in Mullard prototype designs are still in the development stage and subject to specification amendment. So don't go to your local dealer and ask him for the devices shown in the circuits we are about to describe.

But first let us lay the ground. It is estimated that a valved line timebase for a colour receiver consumes about 125W, about 80W of which is dissipated in the line output stage screening can. In the new Mullard solid-state line output stage however the dissipation in the screening can is reduced to about 20W and most of this is in the transformer and not the transistors. The reduced strain on components and lower temperatures should give considerably increased reliability. In the output stage a pair of transistors in series across a stabilised 200V h.t. supply is used. Further supplies for other sections of the receiver can be obtained by rectifying the

scanning voltage waveform in the manner we saw used in the Pye TT1, Philips T-Vette and Sony TV306UB circuits shown in Part 2. The disadvantage of this is that the interdependence of so many circuits can lead to difficulties in servicing so that it is preferable to obtain all supplies direct from a mains transformer.

MULLARD LINE GENERATOR CIRCUITS

The line generator circuit shown in Fig. 1(a) is for use with a stabilised 20V supply while that shown in Fig. 1(b) is for use with a stabilised 200V h.t. rail. The main difference is that in the former an emitter-follower stage Tr3 is incorporated between

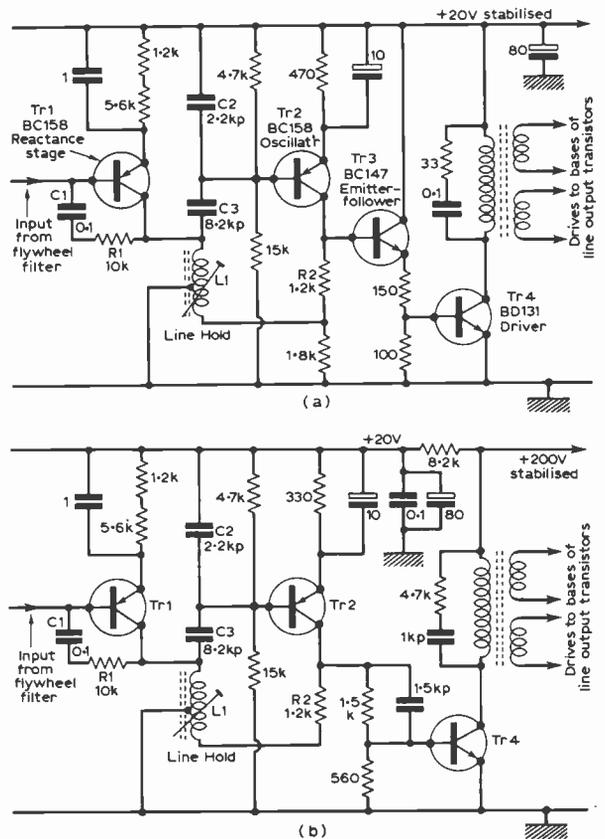


Fig. 1: Line generator circuits of Mullard design, (a) with a low-voltage driver stage and (b) with a high-voltage driver stage.

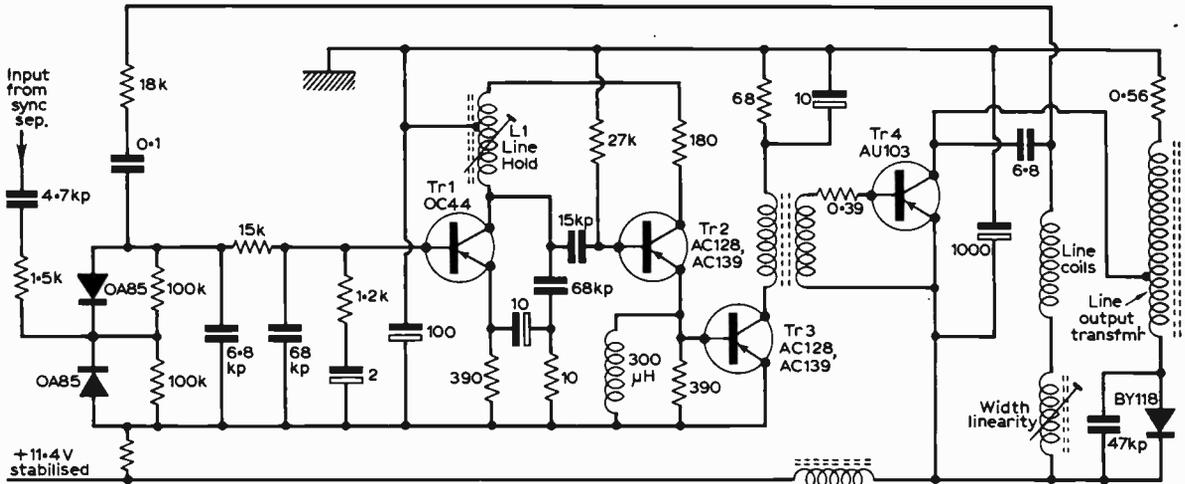


Fig. 3: Complete line generator and output circuit used in the GBC 11in. portable Model UT110.

on Tr3 and Tr4 remain conducting. If an excess current is drawn from Tr2 there will be an increased voltage across R1 and thus across the trip circuit terminals. This makes Tr3 emitter positive with respect to its base and as this is a pnp device controlled by the zener Z1 it switches on. Tr4 is also thereby switched on, shunting the zener and locking the combination Tr3, Tr4 on and thus bypassing the base drive to Tr1 and effectively cutting Tr1 and Tr2 off. Thus when tripped the circuit locks in this condition and even with the overload removed we have to switch off the receiver, wait about 30 seconds, switch on and try again. Some early models were fitted with a manual reset, a microswitch which disconnects the load and grounds the base input. D1 protects Tr3 against reverse bias breakdown under normal working conditions.

COMPLETE LINE TIMEBASE

To get back to the line timebase circuits themselves and illustrate the wide use of the type of

circuits we have been discussing Fig. 3 shows the complete line timebase of a Continental 11in. all-transistor portable model, the GBC UT110. Here again we have a reactance transistor, Tr1, in the tuned circuit of an LC oscillator, Tr2, and an unbalanced phase discriminator. The oscillator is direct coupled to the driver stage Tr3 which is transformer coupled to the output transistor Tr4.

BISTABLE CIRCUITS

While on the subject of line oscillators we may as well take a look at the bistable circuit (a member of the multivibrator family) generally used in PAL colour television receiver decoders to control the line-by-line R-Y signal inversion. An example—from the Decca colour chassis—is shown in Fig. 4. The bistable circuit has two stable states, either Tr1 conducting and Tr2 cut off or vice versa, and is driven by line frequency trigger pulses applied to the base circuits. In the example shown npn transistors are used and negative-going line-frequency pulses are used to cut off the transistor that is conducting. Suppose that Tr1 is conducting and Tr2 cut off. The biasing is so arranged that in this condition Tr1 is bottomed and its collector voltage is thus almost at chassis potential. This potential is linked to Tr2 base by R1 holding Tr2 cut off. When a negative-going line trigger pulse arrives at the base circuit this is fed via C1 and D1 to Tr1 base, cutting it off. Tr1 collector voltage then rises to the supply rail potential and Tr2 base is taken with it so that Tr2 is rapidly driven to full conduction. Tr2 collector voltage is then almost at chassis potential so that Tr1 is held cut off. This condition remains stable until the arrival of the next line-frequency trigger pulse which cuts off Tr2 so that the circuit reverts to its original condition.

Capacitors C3 and C4 (not always used in this type of circuit) produce a spike on the waveforms in the cross-coupling networks to speed up the on-off switching of the transistors. Diodes D1 and D2 are also used to speed up the switching action, presenting a low-impedance path to the transistor next to be switched off and a high-

—continued on page 76

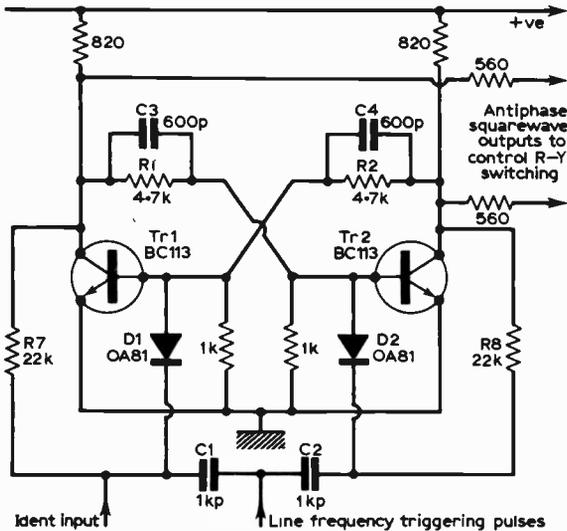


Fig. 4: Typical bistable circuit used to control the R-Y phase reversal in a PAL colour receiver. This example is from the Decca Model CTV25.

Book Reviews

Questions and Answers on Colour Television, by J. A. Reddihough. Published by Butterworth & Co. Ltd. 108 pages, 6½ × 4½in. Price 10s (postage 1s.).

ASKING questions is one way to achieve a little learning—but a dangerous process unless one knows what questions to ask. Fortunately the author is not one to bludgeon us with unassimilable data nor to skate so lightly over his subject that little is retained. Mr. Reddihough is an editor of some experience. He was associated for some years in the preparation of the well-known series of Newnes volumes *Radio and Television Servicing* so we may safely assume that his material will be both attractively presented and fundamentally accurate.

No space is wasted on basic radio and television theory. The first section of the book deals with the principles of colour transmission and reception, applicable to the NTSC system as well as to the PAL method now adopted in this country. A close reading reveals that the first chapter and part at least of the second were written with the earlier system in mind, and the Phase Alternation Line argument has developed naturally from this—a technique that I find effective. Indeed as early as page 24 we find a nutshell explanation of PAL that I have seldom seen bettered.

After a second section dealing with the shadow-mask tube and the problem of compatibility we come to the question of encoding and decoding, matrixing, delay lines, demodulation, bursts and colour killers, all aspects of television that will be new to many engineers. I was happy to note that transistorised circuits are taken as a natural thing, not stuck like plums in the technical pudding as we find too often in books of this nature. Examples that are given of circuit sections are as up-to-date as things can be in this rapidly changing subject.

A final section treats convergence very fully, the author having accepted that this will be the most important field service job. This 20-page part of the book could well be regarded as a useful guide for servicemen.

This handy and informative pocket book is a worthy addition to a growing list of Question & Answer books, now ranging from automobile engines to basic electricity. Line illustrations are clear and plentiful, the text is concise and readable and commendably well planned. At its modest price Q.&A.C.TV. is a bargain for engineer and student alike. *H.W.H.*

Soldering Handbook by B. M. Allen. Published by Iliffe Books Ltd. 120 pages, 8¼ × 6in. Price 45s.

CONSTRUCTIONAL projects have been appearing in the pages of PRACTICAL TELEVISION much more frequently of late and many readers must have been flexing their soldering muscles afresh. For them and for newcomers discovering that soldering is one of those deceptive arts that can result in a heck of a mess when badly applied, Mr. Allen's practical textbook on soldering methods, standards and applications should be worth perusal.

The author, Senior Works Chemist for Multicore

Solders Ltd. (surely sufficient qualification?), is writing mainly for industry, but much of what he has to say is useful to us. The more we know about printed circuit soldering techniques or the methods of bonding semiconductors, or the types, grades and standards of materials, the more fully equipped we are to deal with manufacturers' foibles as well as our own precious projects.

The first section of the book is aimed at the operator, with some very decided instructions summarising each portion. There follows a detailed look at methods and materials which omits, I regret, the necessary warnings about leakage when using an electric iron on transistorised circuits, but which covers just about everything else the television engineer is likely to want to know about the practical side of solder and materials. Finally a section of tables, conversion charts and other reference material leads to a short glossary with, inexplicably, the headings alone in three languages. A comprehensive index closes a book that is extremely well laid out, never too abstruse, yet very informative. Mr. Allen and Iliffe are to be congratulated on a work that is the first type of its kind in this country and destined I suspect to become a standard reference.

If the price is a deterrent it may be worth noting that a limp-cover copy is to appear at 21s. *H.W.H.*

The Art of Stage Lighting by Frederick Bentham. Sir Isaac Pitman and Sons Ltd., London. 447 pages. Price 70s.

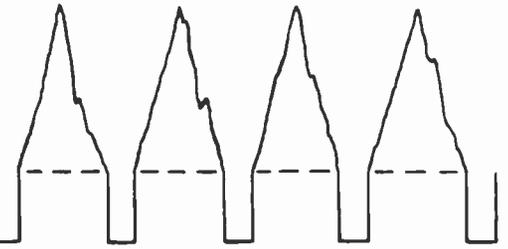
THE author in his preface to this vade mecum of lighting starts by stating that many diverse subjects have to be covered by a book on stage lighting, other than *acting*. How right he is! *Acting* excepted, the book spotlights every aspect of the technical and artistic trimmings for the live theatre plus television plus films. Planning, architectural design, stage layout, production and electrical technology, physics, optics, colour, industrial processes and economics all play their part not only in the theatre but in television too. Even film making is involved.

With such a wide range of subjects the book is likely to appeal to a wide range of readership from those who are basically and technically erudite to those who are completely nontechnical. The latter may be concerned with the creative, production sides of show business; which cover television and films (and their hybrids) as well as the live theatre. Frederick Bentham switches within a chapter from elementary terms such as "direct current (d.c.)" and "alternating current (a.c.)" to more sophisticated saturable-reactor dimmer circuitry, thyatrons and thyristors. In the next chapter he deals with preset dimmer consoles, memory systems and group controls, most items having been used for years in television studios in elaborate forms but have not yet been achieved nor are necessary in film studios.

The Art of Stage Lighting is a valuable reference book, with its 180 illustrations and diagrams, plus its glossaries, lists and descriptions of equipment in common use, together with its appendices on colour filters and basic symbols for studio luminaires (used on lighting plots). All these are helpful for those coping with lighting procedure on stage rehearsals, "painting with light," special effects and the weird problems arising with "thrust" and "theatre-in-the-

—continued on page 61

STABILISING the BLACK LEVEL



ROY PRINCE

IN THE early days of television when the high-definition system was restarted after the 1939-45 war designers of television sets took considerable pains to hold on to the d.c. component of the vision signal all the way from the detector to the picture tube. In many cases this was accomplished by d.c. couplings from the detector to the control grid of the video amplifier valve and from the anode of the video amplifier valve to the cathode (or grid) of the picture tube. To ease design and make sets less vulnerable to video amplifier troubles capacitive-coupling was sometimes adopted to the picture tube grid, and since a capacitor passes the a.c. components of the video signal but blocks the d.c. component a so-called d.c. restoration diode was often

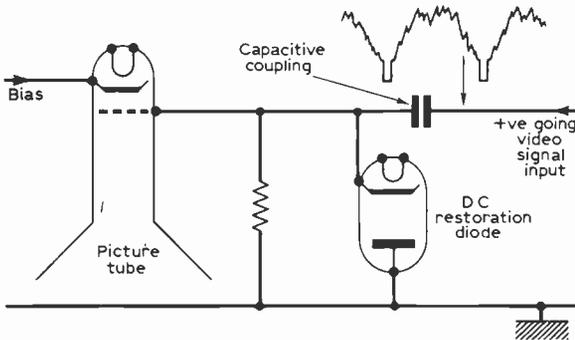


Fig. 1: This diode circuit restores the d.c. component of the video signal—which is lost because of the capacitive coupling—by rectifying the signal on the tips of the sync pulses.

found tied to the tube grid as shown in Fig. 1. Such a diode has the effect of creating a d.c. component representative of that lost in the coupling.

Loss of DC Component

When a video signal is passed through a capacitor the d.c. datum corresponding to black-level is lost,

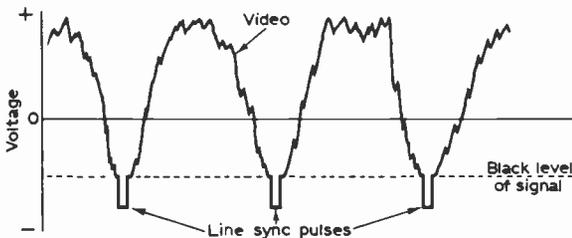


Fig. 2: Waveform showing how the video signal balances about a zero d.c. datum when the coupling deletes the d.c. component. The black-level of the signal then fails to coincide with zero d.c. or the d.c. reference.

the waveform becoming balanced relative to zero voltage value as shown in Fig. 2 where the area of signal above the zero d.c. line is equal to that below it. It is obvious therefore that with changes in the mean signal level, due to changes in scene content, so also will there be changes in the black-level when the d.c. component of the signal is lost. The effect produced by three different lines of

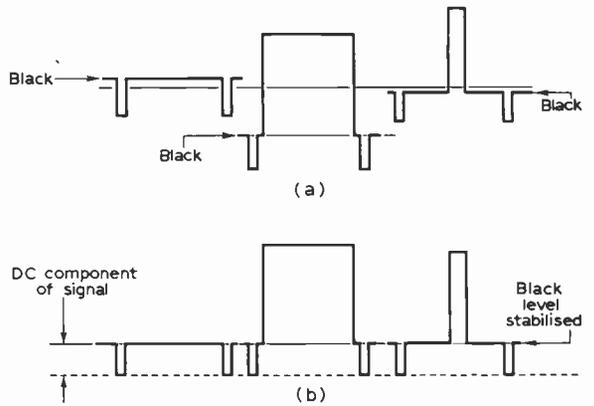


Fig. 3: Three different lines of video signal showing at (a) how the black-level varies when the d.c. is lost and at (b) how the black-level stabilises when the d.c. component of the signal is retained.

picture signal is shown at (a) in Fig. 3, while (b) shows the stable black-level obtained when d.c. coupling is employed throughout.

Figure 4 shows the effect of the simple d.c. restoring circuit in Fig. 1. The restored signal appears at the cathode of the diode (which is usually a semiconductor diode nowadays) and the action is such that the negative tips of the sync pulses assume a position a little negative with respect to the anode potential, thereby giving the picture information a stable black-level datum in spite of the fact that

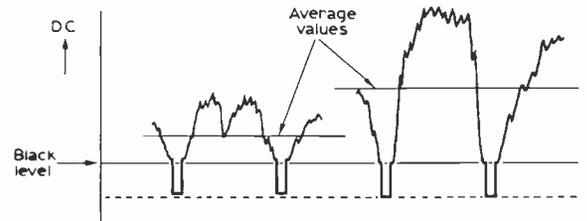


Fig. 4: These waveforms illustrate the action of the d.c. restoring diode in Fig. 1. Notice that the black-level is stabilised in spite of large swings in average signal values. This effect is equivalent to that shown in Fig. 3 (b) when d.c. coupling is used in the video stages.

the average value of the signal changes as its amplitude varies with scene and brightness. Notice that Fig. 4 is equivalent to Fig. 3(b). The action of the d.c. restorer diode is that when the signal is at zero, i.e. on the negative tip of the sync pulse, the diode conducts, shorting the coupling capacitor to chassis so that once each line the charge on it is restored to zero.

Dual-standard sets often have a.c. coupling from the vision detector or phase-splitter stage to the video amplifier, but sadly not all manufacturers take positive steps to restore the d.c. component, the result being deleterious to the displayed picture as we shall see.

Reducing Aircraft Fading

Even though d.c. couplings might be employed designers have found it desirable in the past to reduce the response of the video channel as a whole towards the d.c. end of the video spectrum to reduce the effects of aircraft fading. The basic technique is to use a capacitor for the video coupling to the picture tube and to add a little d.c. component by putting a resistor in parallel with the coupling

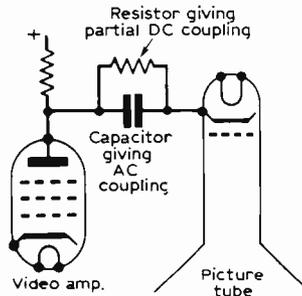


Fig. 5: Partial d.c. coupling is often provided by bridging a coupling capacitor with a resistor as shown here. This technique has been employed to reduce the effects of aircraft fading.

capacitor. In this manner a compromise between fair black-level and the disturbance due to aircraft fading is achieved. It is noteworthy that stabilised black-level does in fact aggravate the fading symptom subjectively owing to the tube biasing swinging in sympathy with the fading. This of course is avoided by a.c. coupling or minimised by partial a.c. coupling of the type shown in Fig. 5.

Mean-level Vision AGC

Effective suppression of the d.c. component of the video signal is also produced by the use of so-called mean-level vision automatic gain control (a.g.c.). Although for best results the a.g.c. potential should be geared to the true signal level, for many years—especially with the advent of the dual-standard set—there has been little use of true black-level and gated a.g.c. systems. With positive-going vision modulation, as on the 405-line system, the only true measure of the strength of the received video signal is the signal amplitude at the black-level intervals, such as the back porches following the sync pulses. Some extremely interesting circuits were evolved in the early days of television to gate the a.g.c. system so as to make it responsive only during the periods when the signal was at black-level. In this way the influence of the picture information on the a.g.c. action was avoided.

It is well known that the a.g.c. potential for the sound channel is on a.m. obtained by smoothing the

output from the sound detector diode. The resultant d.c. potential is geared to the carrier amplitude and is fed to the controlled valves as a bias to adjust their gain accordingly. The system is possible on sound because an amplitude-modulated signal varies about a mean signal level.

With the video signal however there is no equivalent mean level because the signal amplitude rises with the brightness of the transmitted scene (assuming positive modulation). Nevertheless mostly for the sake of simplicity simple mean-level systems are to be found in most sets, the control potential being derived from the control grid of the sync separator valve.

It has been said—as an excuse!—that because the “average” modulation level of a programme is substantially constant the mean-level type of a.g.c. system can be exploited in the vision channel as well as in the sound channel. The system certainly works objectively, so that in spite of significant differences between the input signals from the aerials over the various channels the display “contrast” holds fairly constant without the need for contrast control readjustment. The system also ensures that the various stages work within the linear parts of their characteristics, thereby keeping overload and cross- and intermodulation effects under control.

Poor Black-level Symptoms

However, what of the effects on the display? Briefly the result is that the gain of the set (on 405 lines of course) tends to increase during low-key pictures, thereby increasing the black-level unnaturally until a normally dark picture assumes a dirty-grey appearance. It has been said that an engineer once described the effect as “an over-exposed picture taken by an amateur with a box camera on a cloudy day”! This is a very good description of the symptom and one which most of us have been troubled with at some time or other even though we might not have been completely aware of its cause. However some more recent sets have circuits which very adequately combat the symptom and we shall next look at a couple of examples.

Mullard System

A few years back an engineer from Mullard, Peter Mothersole, set out to investigate the problem and discovered that good black-level correction and stabilisation could be achieved by feeding a d.c. correction signal to the picture tube along with the ordinary video signal devoid of a d.c. component. Waveforms leading to the required d.c. correction signal are shown in Fig 6 (they are negative-going since this is the signal polarity at the cathode of the c.r.t.). The waveforms at (a) represent three different lines of correct signal corresponding to all black, all white and shaded (i.e., sawtooth). The waveforms at (b) show how these are altered at the picture tube input due to mean-level a.g.c. action. Those at (c) represent the input to the picture tube with mean-level a.g.c. and black-level clamping, while those at (d) signify the d.c. correction required to compensate for the input signal misrepresentation.

Although the *tips* of the sync pulses are clamped to a constant potential at (b) the real d.c. component remains unstable owing to the action of the mean-level a.g.c. system in varying the *amplitude* of the signal in an effort to hold the signal's mean-level

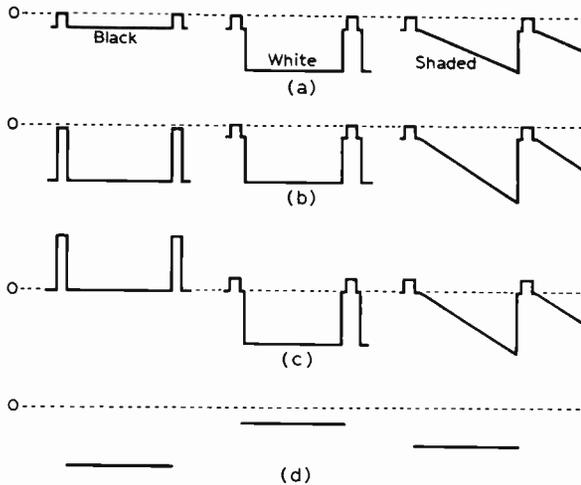


Fig. 6: Three lines of different video signal, showing the principle on which the Mullard black-level correction system is based. See text.

constant. While a keyed clamp in the video input to the amplifier valve would give the effect of the black-level stabilisation as shown at (c), the scheme does not readily lend itself to application in domestic receivers for various reasons, which is why the alternative technique of generating a correction or brightness-control signal as at (d) was developed.

Mullard Circuit

A circuit which does this is shown in Fig. 7. Here V1 and V2 are the video amplifier and sync separator valves normally used, together with their associated components, and the mean-level a.g.c.

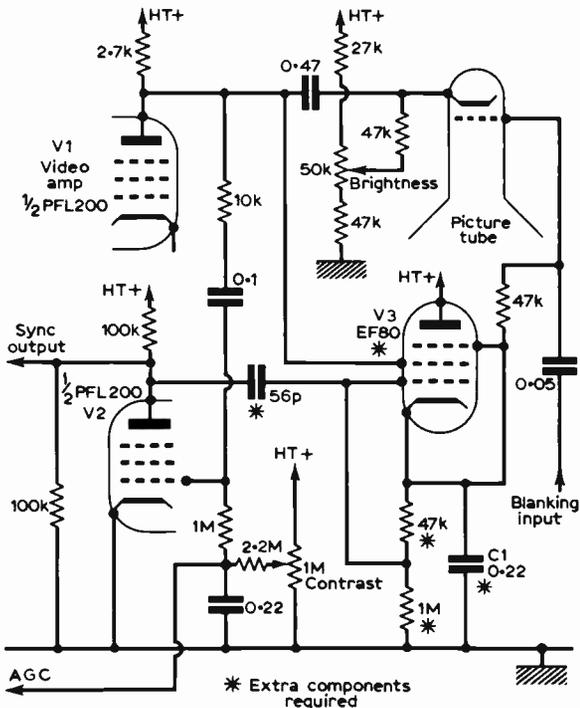


Fig. 7: Mullard black-level correction circuit.

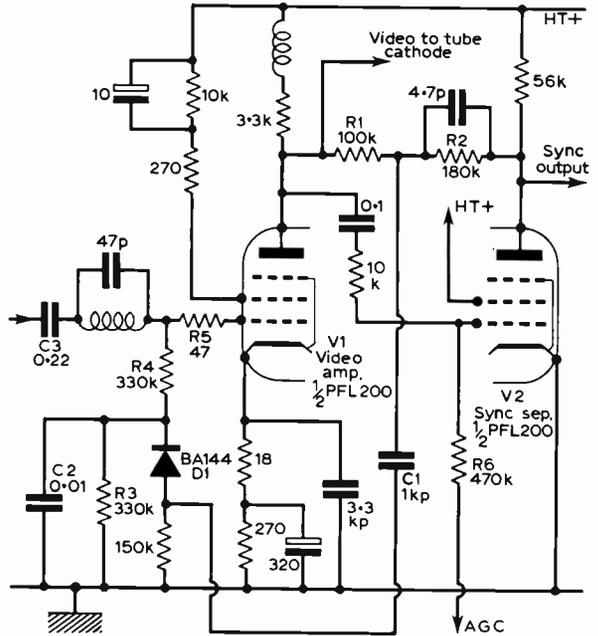


Fig. 8: Circuit of the black-level clamp used in many Bush-Murphy models.

is taken from the grid circuit of V2 in conjunction with the contrast control. The extra components are indicated on the circuit and merely amount to an EF80 valve, a couple of capacitors and a couple of resistors.

The circuit works in the following manner. V3 acts as a peak-detector valve, receiving d.c.-coupled video from V1 at its screen grid and differentiated sync pulses from V2 at its control grid. The valve conducts on the positive-going edges only of the sync pulses and because these edges occur at the time of the back porches or black-level of the video signal the cathode capacitor C1 charges to a d.c. level proportional to the signal black-level (as in Fig. 6(d)), and this is applied to the tube grid as the brightness-correction signal.

It will be seen that the tube control circuit is a little rearranged in comparison to the usual system to provide manual brightness control by regulation of the positive bias applied to the cathode.

Bush-Murphy Circuit

A somewhat different approach is found in recent Rank-Bush-Murphy sets, the circuit being as shown in Fig. 8. Here the video signal from the anode of V1 and the sync signal from the anode of V2 are fed to a matrix comprising R1 and R2. V1 and V2 are the pentodes of a double-pentode PFL200, the former acting as the video amplifier and the latter as the sync separator.

The sync pulses of the composite waveform from V1 anode are positive-going while the sync pulses proper, separated from the picture information, are negative-going at the anode of V2, owing to the phase-reversing action of this valve. The values of the matrix components are selected so that the positive- and negative-going sync pulses are of equal amplitude. This results in the cancellation of the sync pulses at the junction of R1 and R2, the peak value of the waveform at this point corresponding

to the signal black-level. This black-level component is fed via C1 to the rectifier D1, whose load is R3. The resulting d.c. potential, which is proportional to the signal black-level, charges the reservoir capacitor C2 and is applied via R4 and R5 to the control grid of V1 as a d.c. bias to counteract the loss of the d.c. component of the video signal arising from the action of the video input capacitor C3. In this manner the black-level is stabilised in spite of changes of signal amplitude and the employment of a form of mean-level vision a.g.c.

The a.g.c. potential derived from the control grid of V2 is fed via R6 and the base-emitter junctions of the a.g.c. amplifier transistors to the controlled stages and it is in this area of the circuit that the contrast controls (one for each standard) operate.

A single vision detector diode is used in these dual-standard models without switching. This is made possible by the use of a phase-splitter transistor receiving the detector signal at its base. Thus by switching from one phase to the other at the output of the phase-splitter (i.e. taking the video from the collector or the emitter) both positive and negative modulation are catered for, the selected polarity then being applied to V1 control grid through the a.c. coupling capacitor C3 as already explained.

Introducing the black-level synthetically so to speak can never be quite as good as the true black-level systems sometimes found in high-quality studio monitors, but there is no doubt at all that circuits providing black-level stabilisation or correction are well warranted and this, as we have seen, applies particularly to those sets embodying mean-level a.g.c. in the vision channel and total or partial a.c. coupling in the video channel.

Word of Warning

While it is impossible to detail ways of adding such correction to the diversity of existing sets displaying poor black-level performance it is hoped that this article will at least give the more advanced experimenter sufficient information for him to make his own additions and modifications—though unless one is well versed in the arts it may be unwise to start on the main domestic set. This could well upset the domestic balance without improving the black-level balance! ■

BOOK REVIEW

—continued from page 57

round " stages, lights for which tend to dazzle the audience on the far side of the stage unless pointing downwards from the "flies" if there are means of supporting the lamps and scenery by flying them. The author waggishly implores readers to spell the word in this manner instead of "flies", which suggests insects.

Anything to do with theatrical presentation is a matter of opinion and controversy, whether concerning the theatrical or the TV stage. The author skilfully picks his way through every point of the many views—a fact which should appeal both to students at art colleges, engineering colleges, technical schools and—yes—the engineers of film, television and closed-circuit studios who keep things operational in a professional manner. This is a fine bedside reference book, a solver of problems, liable to keep one awake by turning over (and over) just one more page.—*B.H.*

NEXT MONTH IN

Practical TELEVISION

LINEAR TIMEBASES

In receiver timebases linearity of scanning waveform is not a main consideration. However in other applications, such as oscilloscopes, the linearity is of prime importance. Generating a linear scanning waveform is not simple. The basic waveform produced by the charge or discharge of a capacitor is exponential. A number of intriguing circuits have been devised at various times to overcome this basic deficiency, and next month we shall start to examine timebase circuits such as the bootstrap, Miller, transatron, phantatron and sanatron.

TEST EQUIPMENT LIMITATIONS

A meter never lies—but do you know how to interpret readings correctly? They are not always what they seem. Next month the basic limitations of commonly used test equipment are explained to enable you to avoid the pitfalls caused by misunderstood readings.

TV FILTERING CIRCUITS

Filters are found throughout television circuits, in the power supplies, i.f. sections, a.g.c. feeds and so on. Next month we highlight this aspect of television receiver circuitry, explaining how filters act and the different types used, including those found in the chrominance sections of colour receivers.

SERVICING THE THORN 1400 CHASSIS

The Thorn/BRC 1400 chassis has been used in a very large number of models from 1967 to the present time. Next month L. Lawry-Johns takes a look at this chassis and the common faults associated with it.

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TRANSISTOR AND DIODE ANALYSER

MARTIN L. MICHAELIS, M.A.

PART 2

OPTIMUM transformer secondary voltages are 8.5V 1A and 100V 50mA. Figure 5 shows how a small standard transformer may be used to obtain these voltages. The 100V supply can be taken between the 250V and 350V taps on a normal h.t. winding. The 8.5V supply is obtainable by connecting in series one 6.3V winding and the top end of another 6.3V winding tapped at 4V, or a 5V rectifier winding and one half of a centre-tapped 6.3V winding. Alternatively a bell transformer may be used for the 8V supply and a separate transformer for the 100V supply (a 50V supply with voltage doubler rectifier circuit is also usable).

The 100V supply peaks up to nearly 150V d.c. This is larger than really necessary as source potential for constant-current base drive, and for base drive currents less than $5\mu\text{A}$ it is divided down by R7 and R8 to obviate the need for unmanageably large resistors in the appropriate positions of S6A. The actual value of 150V was selected as a compromise between various requirements.

Both the 150V supply and the 12V supply are available for external use via corresponding power output sockets, a transistor analyser being more versatile if it can be used to power any interim circuits hooked up between the end of systematic tests on a transistor and the start of tests in an actual television receiver or other equipment in which the transistor is to be used. In this sense the 12V supply via the internal meter and limiting resistors is most useful because it prevents any currents in the external circuits rising above the setting of VR1 (VR1) in relation to the selected meter range.

The 150V supply with a current rating up to 50mA is required because many modern transistors intended for oscilloscope circuits, video stages in TV receivers etc. are rated for collector

voltages in this range. Also zener diodes up to at least 100V may be encountered.

To test a zener diode use the ordinary diode test for the forward polarity: for the reverse polarity, in which the zener

voltage appears, connect the diode between the 150V supply and chassis via a 20-30k Ω 1W resistor and read the zener voltage by connecting a multimeter set to the appropriate voltage range across the zener diode.

FUNCTION SWITCH S2

S2 is the function switch comprising four single-pole changeover contact sets. Two switch over the 12V supply between the β , D circuits and the oscillator module whilst the other two switch over the meter between the current range switch and the detector output of the oscillator module. The function switch also serves as standby switch whilst connecting and disconnecting transistors. It should always be set to the other function when inserting or removing transistors from the test sockets Sk2 and Sk4.

VR1 AND CURRENT LIMITERS

Wafers A and B of the meter range switch S3 select VR1 and the current limiters R2 to R6. Note that VR1 is in circuit only for the four lower ranges up to 100mA. It is disconnected in the 1A range for which R2 alone is present as series limiter, in this case restricting the short-circuit current to just over full scale deflection to avoid overloading the power supply and to restrict the power dissipation in large power transistors for which this range is intended to definitely safe values.

The current limiter resistors R2 to R6 must be selected by connecting two or more resistors in series/parallel for each position so that with nominal mains input voltage the meter reads just full scale in each respective range when VR1 is set exactly midway. This is most important because adequately accurate identity between the setting on VR1 scale and the actual short-circuit meter reading is necessary for using the circuit. The power supply and meter shunts must be finalised before finally adjusting the current limiters.

METER RANGE SWITCH S3

This is a six-pole, five-way switch in three wafers each containing two poles. Four poles are necessary to switch the shunts R10 to R13 to ensure that the meter embraces no switch contacts carrying the main current. Otherwise such switch contacts with their fluctuating contact resistance would function as part of the active shunt and give rise to unsteady readings. This would impair the transistor electrode

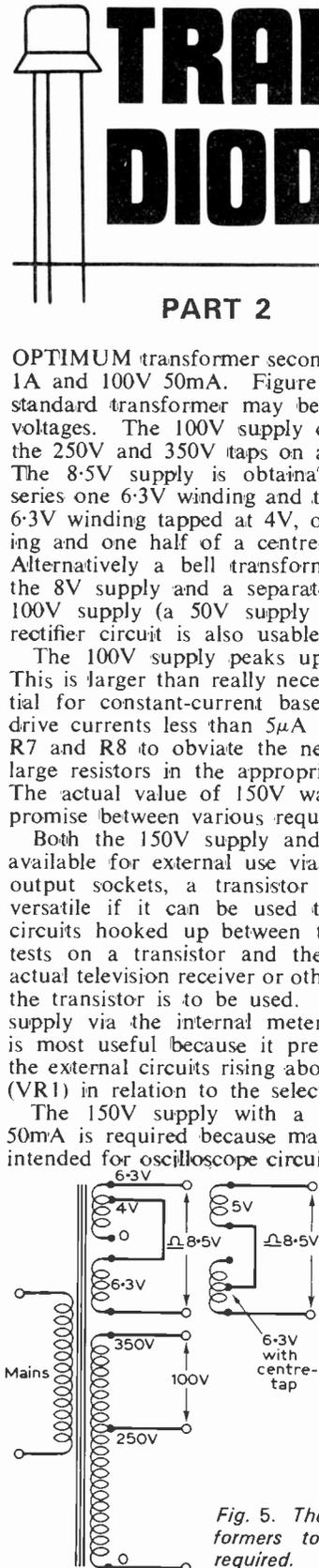


Fig. 5. The use of standard transformers to obtain the supplies required.

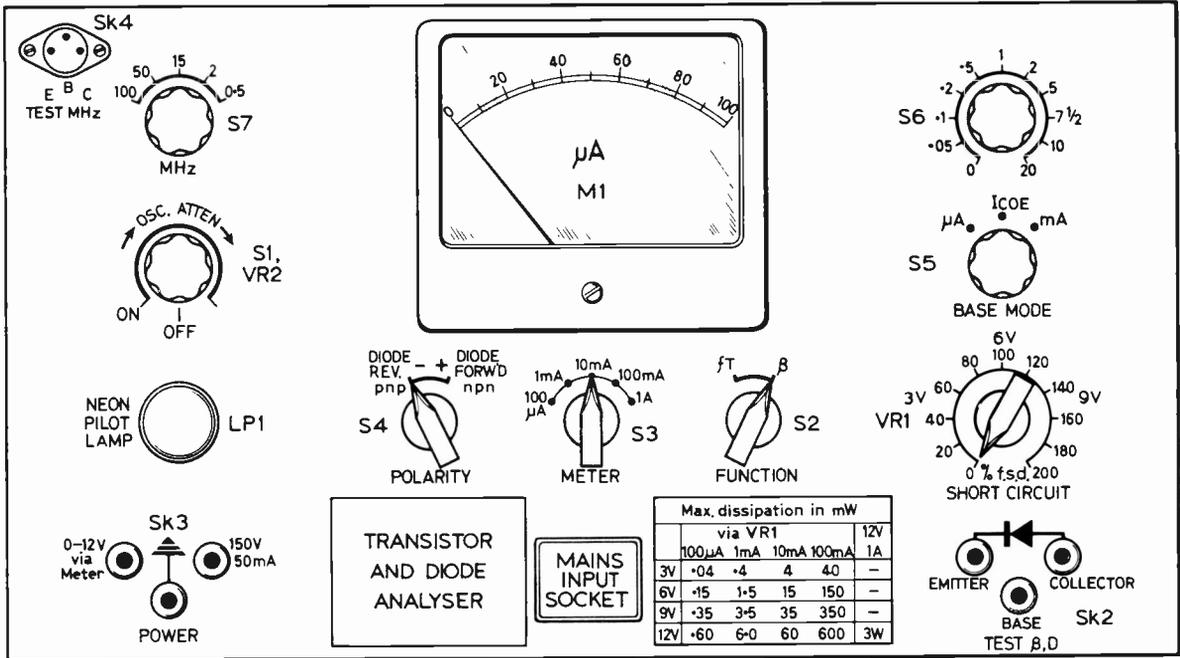


Fig. 6: Front panel layout and lettering.

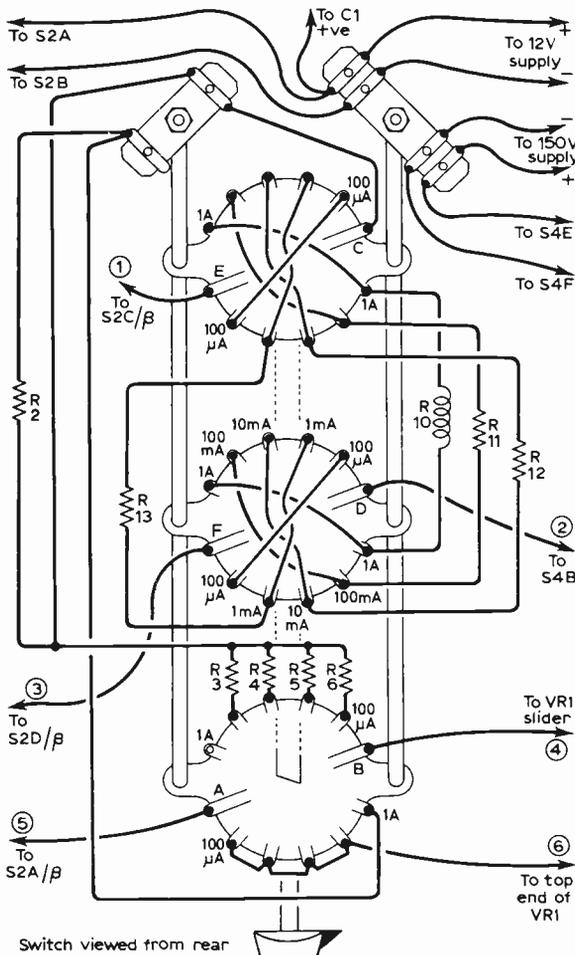


Fig. 7: Meter range switch, S3, wiring.

poor-contact test described later in the systematic instructions.

Shunts R11 to R13 are conveniently obtained by selecting preferred-value resistors with a multimeter connected to the output Sk3 for comparison. Shunt R10 for the 1A range can be selected similarly using several 1Ω resistors in parallel or whatever other suitable values are to hand. Alternatively a length of (preferably solderable) resistance wire may be selected.

The final values for the shunt resistors will depend upon the actual meter resistance. The sensitivity of the movement *must* be 100µA f.s.d. but the meter resistance may be any value up to about 2500Ω. If it is significantly less, add a series resistor between one meter terminal and S2 to adjust the total resistance to 2300-2500Ω and then select shunts with values in the vicinity of the specified ones, but using current comparison with a multimeter as final criterion in the manner described above.

POLARITY SWITCH S4

Eight poles are here changed over. The 150V and the 12V supplies are both floating with respect to ground, two poles of S4 for each supply selecting which side is grounded and which side is fed through to the transistor operating circuits. Both supplies are always switched to the same polarity. Thus the polarity switch carries three pairs of markings on the front panel legend, (a) pnp/npn for transistors, (b) forward/reverse for diodes connected according to the symbol by the sockets, and (c) +/- stating the polarity with which the voltages appear at the power output socket Sk3.

Two further poles are used to reverse the emitter and collector power supply polarities in the oscillator module, the final two poles C and D reversing the safety diodes D7 and D8. Two low-leakage silicon diodes are used here to improve the per-

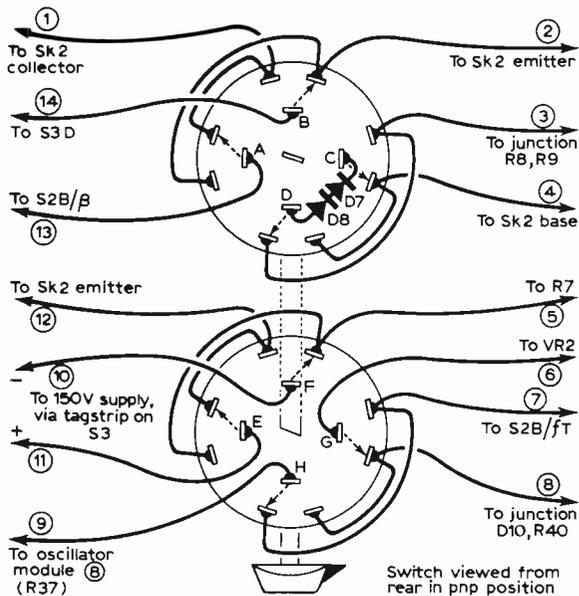


Fig. 8: Polarity switch, S4, wiring.

formance at very low base drive currents. The polarity switch is common to all functions of the instrument.

BASE MODE SWITCH S5

This is a single-pole three-way switch which shorts the base to the emitter in the centre setting and selects the μA or mA banks of the base-drive current selector switch S6 in the other two settings. The collector leakage current without base drive but with base shorted to emitter, called I_{coe} , is measured with S5 in the centre setting irrespective of the setting of S6. To measure the collector leakage current with open-circuit base, called I_{co} , set S5 either to the μA or to the mA positions (normally the μA position for safety) and S6 to the zero setting (open-circuit) at one end beyond the lowest value current setting. Always start from this zero base-drive setting and increase base current step by step as required when testing transistors.

BASE CURRENT SELECTOR SWITCH S6

This is a two-pole eleven-way switch on two wafers, one wafer (pole) serving for graded base currents in the μA range and the other for currents in the mA range. The currents are approximately doubled in successive steps and the numerical values range through a total factor of 20 below and above $1\mu\text{A}$ or 1mA . This gives satisfactory variation through the very large overall range of nearly a million to one, with adequate accuracy of the unambiguous injected base current in each setting. The complete assembly represents VRb in Fig. 1(a).

Base-drive currents under $5\mu\text{A}$ are drawn from a source voltage of about 10V on the divider R7, R8, R9, whereas all larger drive currents are drawn directly from the 150V source. This obviates unmanageably large resistors for the very low currents on the one hand, yet preserves very large source/base voltage ratios at higher currents so that the simple resistors here too function as accurate fixed-current sources.

Diodes D3 to D6 represent Db in Fig. 1(a). Two diodes in series are used in each branch to obtain the required 1V threshold and the two branches in anti-parallel ensure operation on either polarity without additional switching. The p.i.v. rating should be 250V not 25V as specified last month.

BASE-DRIVE RESISTORS

The resistors R14 to R33 on S6 must be selected or trimmed by judicious series/parallel connections. Preferred-value resistors are normally not produced in values greater than $22\text{M}\Omega$ and special resistors of greater value tend to be expensive. Thus the parts list specifies special single resistors and suitable combinations of preferred-value resistors.

To select and trim the resistors disconnect the leads of the finished meter and range switch assembly at S3C and D sliders and temporarily strap connections from these switch sliders to the base and emitter sockets of Sk2. Set the polarity switch to make the meter read forwards and adjust each resistor in turn to make the meter read the intended currents in suitable range settings.

The meter sensitivity is adequate only for selecting R20 to R33 in this manner. To select R14 to R19 measure the actual voltage at the junction of R7, R8 and calculate the required resistor values for R14 to R19 to give the nominal currents. Then select corresponding resistor combinations with an ohmmeter or relying on the accuracy of preferred-value resistor combinations.

It is not worthwhile purchasing expensive special or close-tolerance resistors for the banks on S6 because the actual required values will depend on the actual source voltages which in turn depend on the particular transformer and rectifier circuit used. Thus first finalise these latter items.

INSULATION

It is very important to ensure optimum insulation throughout this instrument. Good-quality paxolin or ceramic switches should be used, wiring and soldering must be tidy and properly insulated. All parts of the base circuit require particularly good insulation since the working current may be as low as 50nA and the circuit resistance as high as $200\text{M}\Omega$ so that even small insulation leakage can present an appreciable shunt path leading to erratic readings.

Components requiring particular attention are S6, S5, S4C and S4D, the three sockets of Sk2, C5 and C4. The latter two are the most likely points which could develop an early insulation fault so make sure to use modern microfoil capacitors with superior insulation for C4 and C5 to avoid this trouble. Such capacitors are not expensive because the required values are very small. Do not use appreciably larger values since the transistors could otherwise be subjected to unnecessary surge current stress.

For those not accustomed to high-resistance circuits it may be pointed out that $200\text{M}\Omega$ is in fact still quite a low value even for paxolin wafer switches, and readers will not find difficulty provided they use clean new switches not old ones which have been kicking around in the junk box and have taken on a very greasy, soiled appearance. It is hardly possible to clean-up such switches again for reliable performance in high-resistance circuits so keep them for other less critical purposes. New

paxolin switches tend to become critical only above a thousand Megohms and the author has satisfactorily used them in special electrometer circuits operating at nearly a million Megohms.

OSCILLATOR MODULE

The principle of this module has already been explained and its construction is clearly shown in Fig. 10 with reference to Fig. 4 and Table 1. It is most important to keep all leads short. The switch should preferably be a ceramic type to ensure low r.f. loss but since the Colpitts circuit employed is not very sensitive to loading any other reasonably good, above all clean, switch will be satisfactory. Capacitors C6, C7 and C8 must be non-inductive types suitable for bypassing frequencies up to 100MHz and diode D9 must be suitable for rectifying frequencies up to at least 100MHz.

FRONT PANEL SOCKETS

Use three substantially insulated wanderplug sockets each for Sk2 and Sk3, spacing them in a small equilateral triangle such that the two pins of large power transistors fit any two sockets snugly whilst a banana plug inserted into the third socket presses securely against the edge of the case. To connect smaller transistors with wire leads, insert a split-pin banana plug into each socket, push one transistor lead laterally through each split pin and then push the banana plugs sufficiently home to grip the transistor leads securely.

A standard three-pin audio input socket as used on tape recorders or a ceramic B7G valveholder is suitable for the oscillator test socket Sk4. Transistors with wire leads can be inserted directly (bend a small loop at the end of each wire). Small adaptors can be made for power transistors.

These arrangements only rarely make it necessary

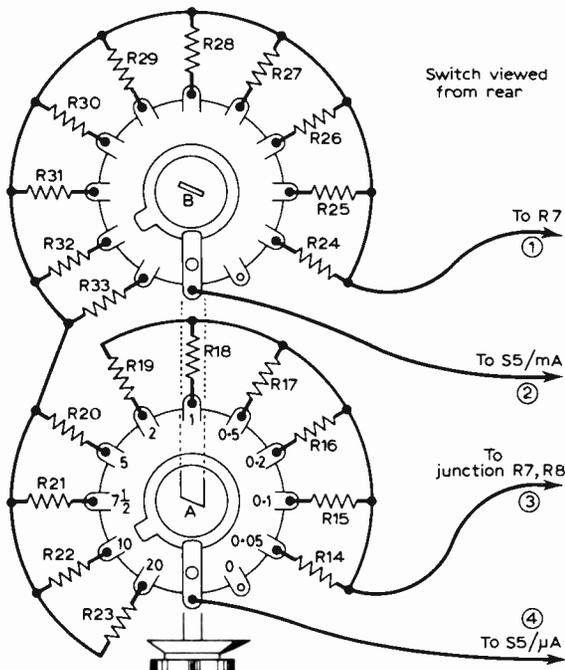


Fig. 9: Base current switch S6.

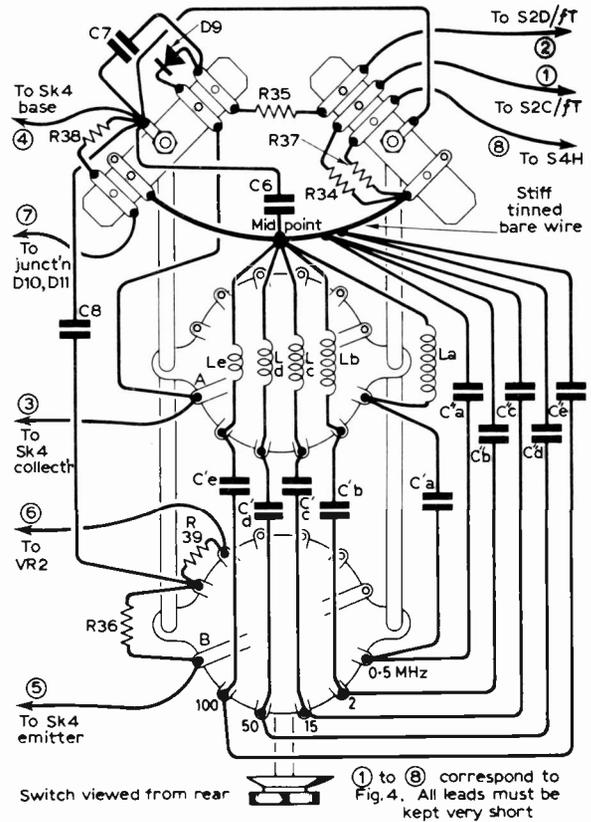


Fig. 10: Oscillator turret (S7) wiring.

to use external test leads. In the great majority of cases the transistors can be inserted directly as described. Note that C4 and C5 positively prevent parasitic oscillation only when the transistor is inserted directly into Sk2. If lengthy external test leads and clips are used C4 and C5 may even provoke instability by the test leads, but trouble on this score may be expected only for transistors with very high values of β at high operating frequencies.

CONSTRUCTION

Figures 7 to 12 give full constructional details. The meter range switch S3 and the oscillator turret should be built up first as separate modules according to Fig. 7 and Fig. 10 respectively. Then mount these modules together with other major controls and components on the front panel according to Fig. 11 and wire up S4 (Fig. 8), S6 (Fig. 9) and S2 etc. in situ.

The power pack should also be built up as a separate module on its piece of sheet aluminium. This power pack, the range switch module S3, the meter and a reference multimeter may be connected up provisionally to finalise the shunts, but the positions of the shunts are well accessible after complete assembly, so their selection may alternatively be left until construction has progressed to the appropriate stage. Note that all selections of resistors on S6 and S3B must be made using the finalised power pack. There is considerable latitude of choice for the mains transformer, rectifiers and smoothing components but these must be finally chosen before trimming the

—continued on page 71

REPORTS FROM THE

TRADE SHOWS

THIS year's television and radio shows took place during the now traditional period of the last week in August. Once again the shows were for the trade only and were held at some of London's best hotels (and at manufacturers' premises). Altogether some fifty firms exhibited at about twenty venues.

Missed Opportunity

The lack of a national television and radio show this year means that manufacturers again lost an opportunity of displaying their goods to the public, just as they did last year. However, while it could be argued that last year was not the best time for a national show this surely could not be said of 1969.

Shortly 625-line BBC-1 and ITV transmissions will be available on u.h.f. to large numbers of the population (transmissions start in the London area on 15th November). This duplication of BBC-1 and ITV on u.h.f. has meant that setmakers have this year been able to introduce single-standard receivers for use on u.h.f. 625-line transmissions only. The simplification of circuitry has resulted in lower prices, or stabilisation of prices, and the elimination of standard-change switching should improve reliability. Sets may now be made to obtain the best possible performance on 625-line transmissions and designers no longer have to compromise between the sometimes conflicting requirements of the 625- and 405-line standards.

TV manufacturers are currently complaining about the poor sales of new receivers, especially colour sets—but who can they blame but themselves? A national radio and television show (like those which used to be held at Earls Court) this year would have informed a great many about the potentialities of colour TV and it would thus have been brought home that colour TV is infinitely better than black-and-white TV no matter what the subject. At such an exhibition, manufacturers would have aimed to make the public want colour TV in their homes; a positive attitude would have been encouraged so that visitors left with the idea of buying or renting a colour set just as soon as funds permitted.

Much could have been made of the imminent availability of ITV on u.h.f. Demonstrations could have illustrated how much better 625-line pictures are and showing programmes like *Coronation Street* in colour would have encouraged viewers to look forward to the time when they would be able to have colour TV.

Unless manufacturers take more interest in selling

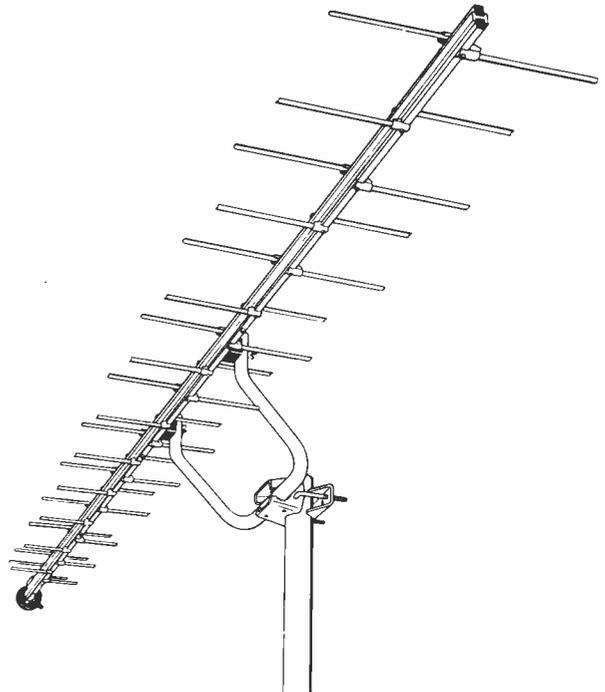
their TV receivers we cannot see that they are going to increase their business in the near future. All in all our report on this year's work by the average set-maker must read "Sometimes tries hard, but most of the time is not prepared to make any effort to help himself: prefers to blame others for his own shortcomings".

Aerials

Another point which could have been brought out at a national exhibition, and which has so far received very little attention in the lay press, is the effect that single-standard reception could have on the unsightly Band I and Band III aerial arrays at present in use. In future when new sets are installed a single u.h.f. aerial will give reception of BBC-1, BBC-2 and ITV and one neat aerial will do the job of the present two or three. (Many areas of the country will not have full u.h.f. coverage for some considerable time but programmes should be available to the majority of the population quite soon.)

Many of the Band I and Band III aerials installed in the early fifties are now in need of repair or replacement and this year would have been an ideal time to urge viewers to take down such aerials as soon as the u.h.f. transmissions become available in their area. This is perhaps wishful thinking however since it seems likely that most viewers with dual-standard sets will continue to watch BBC-1 and ITV on 405-lines even when these programmes are available on u.h.f. This is particularly likely when an early dual-standard set (with continuous tuning on u.h.f.) is in use. Most members of the public will find it much easier to continue to switch the v.h.f. turret tuner rather than to retune the u.h.f. tuner each time they wish to receive a different programme.

Even where push-button tuning is fitted few will



The Antiference "Troubleshooter" wideband u.h.f. log periodic aerial. Note feed to front end (bottom left).

realise that their dealer could soon make all u.h.f. programmes available on the push-buttons.

Trends

So far as television is concerned interest centres on colour and u.h.f. The majority of manufacturers are now producing single-standard sets which receive only 625-line u.h.f. transmissions. The other main item is that although colour sets use the same size tubes as before—19in., 22in. and 25in.—the cabinets are now becoming smaller as the internal chassis diminish in size. In fact it is now becoming quite difficult to pick out colour sets when they are displayed among black-and-white ones (at one time colour sets could easily be distinguished by their deep cabinets and larger size).

Transistorised chassis are being used more and more and this has at least two good effects: the size of sets is reduced and reliability is increased by the cooler running.

New Products—A Selection

Antiference were showing a prototype of a new u.h.f. aerial they will shortly be marketing under the name "Troubleshooter". Like the Trulog aerial the Troubleshooter is of the log periodic type. It is for use on Bands IV and V and a single aerial will be suitable for reception of any channel in the u.h.f. Bands. The polar diagram of a log periodic aerial is almost completely free from side lobes in every plane and this factor can be exploited in areas where ghosting is troublesome. The prices of the new aerials have yet to be announced.

The new colour sets from Bush use a single-standard chassis of new design and are about one-third lighter than previous models. The sets are fully transistorised and use two integrated circuits, one in the colour circuits and one in the sound channel. The two i.c.s replace nearly one hundred conventional components. The new chassis features plug-in printed circuits to facilitate servicing. The Bush CTV184S is a 22in. table model single-standard colour TV and is finished in tropical olive veneer. The price is 263gns. The 25in. colour console also has the same chassis and is fitted with folding doors. The suggested retail price is 299gns.

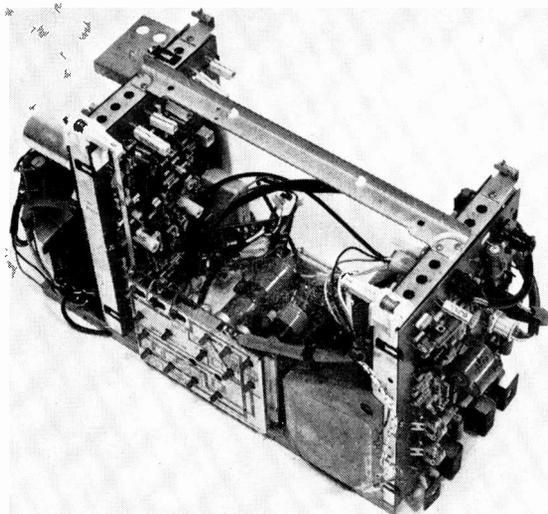
Decca showed two new single-standard monochrome sets with push-button tuning. The MS2000 is a 20in. model and the MS2400 a 24in. version. The two sets sell at £72 19s. 0d. and £79 10s. 0d. respectively.

Also at the Decca show was a convergence generator, the Körting Convergator 82556. The unit provides a crosshatch pattern of eleven horizontal bars and sixteen vertical bars and the output is tunable over ten channels in Band IV.

There were several new monochrome models from Ekco. The 20in. T530 is a single-standard model at £72 and is finished in tropical olive veneer. A new dual-standard 20in. model is the T532 which uses the 368 series chassis and retails at £79 18s. 0d.

The Ferranti dual-standard 20in. Model T1185 sells at £79 10s. 0d. and the 24in. Model T1186, also dual-standard, sells at £86 10s. 0d. Both models are finished in dark veneers.

The 3703 from Ferguson is a new single-standard colour set with 19in. tube. It is a table model and



The new Rank-Bush-Murphy all-transistor single-standard colour television chassis.

has a recommended retail price of £235 10s. 0d. This set typifies the new trend in colour TV, with table models being difficult to distinguish from monochrome models (until they are switched on!). The 3705 25in. single-standard Ferguson colour set retails at £296 10s. 0d.

GEC unveiled two new single-standard colour sets with 19in. and 22in. tubes and also several monochrome receivers including the 2044, a 24in. model retailing at £87 3s. 0d.

The CK402 single-standard colour set from ITT KB has a 22in. c.r.t. and push-button operation. The recommended list price is £304 15s. 0d. The CK402 has a tambour door and integral stand and a similar set, the CK401 without the door and stand, retails at £287 12s. 0d. Both sets use the KB hand-wired chassis. The single-standard monochrome SV041 from ITT KB is finished in teak veneers and has a 20in. c.r.t. The recommended list price is £71 15s. 0d.

Added to the successful Multibeam range of J-Beam Aerials is the MBK30 (with 7 × 4 director units). The aerial is packed fully preassembled and comes complete with cranked mast and chimney bracket type ML6. The suggested list price is £5 12s. 0d.

Murphy showed a new single-standard colour set, Model CV2211S, a 22in. table model available in teak and in white, red, blue, grey, orange and green. The price is 263gns.

The 511 single-standard table model colour receiver from Philips is finished in American walnut veneers. On the monochrome side Philips included the 0300/51 20in. single-standard model. Tuning is by four push-buttons and the price is £73 9s. 0d.

Sony had a very interesting exhibit, a 13in. colour set using the Trinitron single-gun c.r.t. This fully solid-state receiver (apart from the tube) receives u.h.f. 625-line programmes only and is expected to sell at about £200 when it is released in this country next year.

Toshiba featured an 11in. mains/battery monochrome set for 625-line reception only. This model will be priced at about 75gns. and should be marketed early next year. ■

waveforms in **COLOUR** receivers

PART 5

GORDON J. KING

IT IS common monochrome practice to extract the 625-line intercarrier sound signal from either the vision detector or video amplifier as shown in Fig. 1. When this technique is adopted in colour sets the additional chroma signal appearing at the detector is passed to the chroma amplifier channel through a high-pass filter which separates the chroma signal

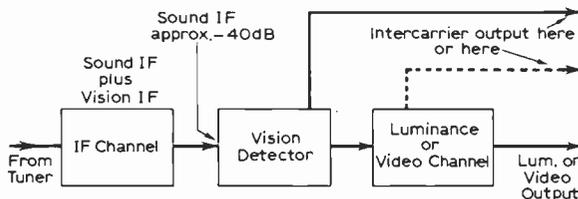


Fig. 1: In monochrome receivers the intercarrier sound signal is taken either from the vision detector or the following stage and is about 40dB down on the vision signal.

from the luminance signal. The idea is shown in block diagram form in Fig. 2. The chroma amplifier channel not uncommonly has bandpass characteristics to yield a response of about 1MHz either side of the subcarrier frequency. Sometimes however for reasons which will be discussed later the response is arranged to fall off on one side of the subcarrier frequency.

The response of the luminance channel is similar to that of a monochrome set but it is necessary to "notch out" the subcarrier to avoid the chroma signal causing unnecessary interference. A high- Q rejector tuned to the subcarrier frequency is included in the luminance channel for this purpose.

It is essential that the chroma and the luminance signals arrive at the picture tube at exactly the same time. If there is any time difference between the two signals the colours of the picture are displaced horizontally from the luminance parts. In order to achieve perfect registration the signals in the luminance channel have to be delayed slightly so that

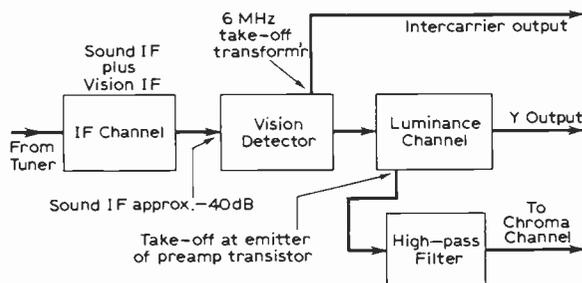


Fig. 2: Colour sets using a single vision detector tap off the chroma signal from the stage following the detector.

they arrive at the picture tube the same instant as the chroma signals dealing with the same piece of picture information. It is often wondered why there is a time difference between the signals in the luminance and chroma channels. The difference arises from the different bandwidths. It will be recalled that the luminance channel passes signals towards 5MHz from almost d.c., which means that the channel must possess a bandwidth of this order, while, as we have seen, the chroma bandwidth is merely ± 1 MHz based on the subcarrier frequency. It is a basic fact in electronics that signals travel faster through wideband circuits than narrowband ones. The speed is in fact proportional to the reciprocal of the bandwidth. Thus it is necessary to introduce a suitable delay into the luminance channel to get the times to match. The precise delay depends on the design of the chroma and luminance channels but is commonly about 600nS.

Separate Detectors

Whilst a few chassis (the Baird 700 and 710 series and the KB CK400) use a single detector for the luminance, chroma and intercarrier sound signals, most receivers use two detectors and three approaches are possible here. These are: (1) To use one detector for the luminance signal only and a second one for the chroma and intercarrier sound signals. This method is used in the BRC 2000 and 3000 chassis, the Bang and Olufsen 3000 series and is also used in the Mullard single-standard prototype design which may well influence a number of manufacturers when they develop single-standard chassis. (2) To use one detector for the chroma signal only and a second one for the luminance and intercarrier sound signals, the method used in the Philips G6 chassis. (3) To use a separate intercarrier sound detector and a luminance/chroma detector, the method used by Pye, GEC, Decca and Bush-Murphy. With this type of circuit a high-pass filter is used to separate the chroma signal from the luminance signal. These arrangements are shown in Fig. 3 (a), (b) and (c) respectively.

Chroma/Sound Beat Signal

A separate intercarrier detector (method 3) makes it possible virtually to eliminate the beat between the sound i.f. and the chroma subcarrier i.f. Such a beat yields a signal at 1.57MHz, the difference between the 33.5MHz sound i.f. and the 35.07MHz subcarrier i.f., and although this beat is unwanted and is an embarrassment it is nevertheless a colour-set signal and so must be considered in a series dealing with colour-set signals.

In spite of the subcarrier proper being suppressed at the transmitter residual subcarrier components appear in the chroma signal as explained last month. The 1.57MHz beat due to these and the sound i.f. results from the normal detector non-linearity, in the same way as the 6MHz intercarrier beat is produced. Under certain conditions, especially if the beat amplitude is large, pattern interference can result, but the symptom is usually very small even in relatively simple circuits.

A separate intercarrier sound detector can be fed with the vision and sound i.f.s in the amplitude ratio for optimum intercarrier detection consistent with least intercarrier buzz—an effect that often plagues some of the early dual-standard monochrome sets when working on the 625-line standard. And a 33.5MHz rejector can be included to attenuate significantly the sound i.f. at the input to the vision detector. This frees the vision detector of intercarrier output, a trick that neatly deletes the unwanted 1.57MHz signal.

When a separate chroma detector is employed and the intercarrier sound is taken from the luminance detector or preamplifier or phase-splitter stage that follows (method 2) the intercarrier tuned takeoff circuit is often arranged to act as a 6MHz rejector in series with the luminance channel. The problem of chroma signal rejection in the luminance channel is also eased by this approach as we shall see in a minute.

When the intercarrier sound is taken from the chroma detector (method 1), the luminance detector input can incorporate a 33.5MHz series rejector (Fig. 3(a)) to eliminate possible chroma/sound beats. The idea here is similar to that described in relation to a separate intercarrier detector.

Chroma Notch Filter

It is necessary to include a 4.43MHz notch filter to remove the chroma subcarrier component in the luminance channel and to avoid this trap impairing the definition of black-and-white pictures the circuit is sometimes arranged (BRC 2000 and Decca chassis) so that the trap is automatically disabled (along with the chroma channel as a result of the action of the colour killer) during monochrome

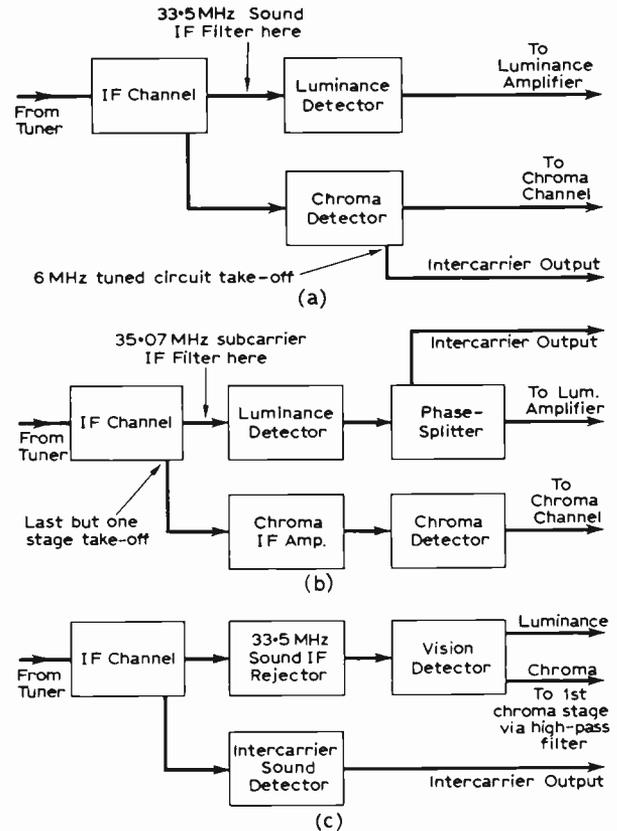


Fig. 3: Three approaches to the use of two separate detectors, (a) luminance detector and separate chroma/intercarrier sound detector, (b) luminance/intercarrier detector and separate chroma detector, (c) luminance/intercarrier detector and separate intercarrier sound detector. In systems (a) and (c) a sound i.f. filter can be incorporated in the feed to the vision/luminance detector to avoid sound/chroma beat interference in the luminance channel. In system (b) the same result is achieved by incorporating a 35.07MHz chroma subcarrier rejector in the feed to the luminance/intercarrier detector. System (b) makes it unnecessary to incorporate a 4.43MHz chroma notch filter in the luminance channel.

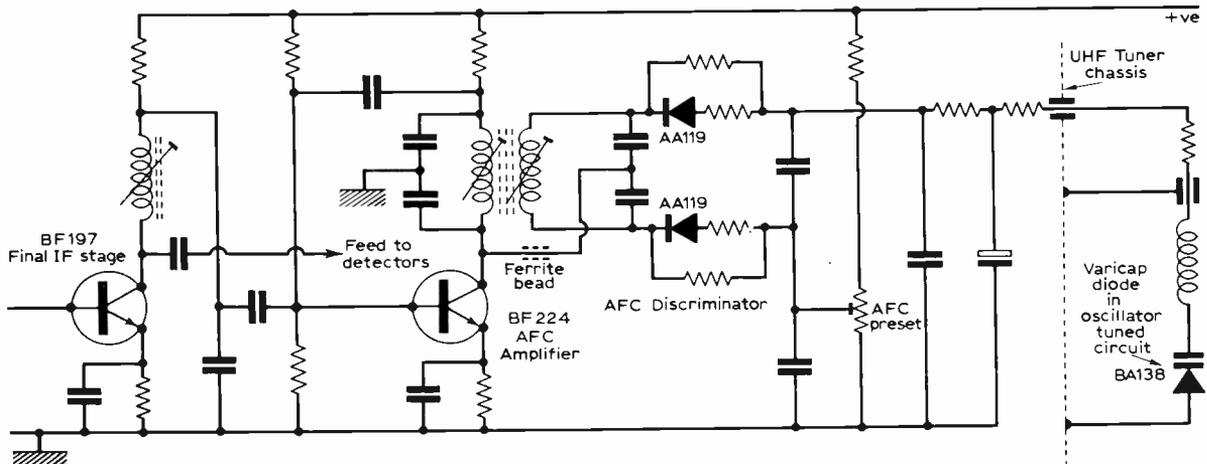


Fig. 4: The a.f.c. circuitry used in the Thorn/BRC 3000 single-standard colour chassis.

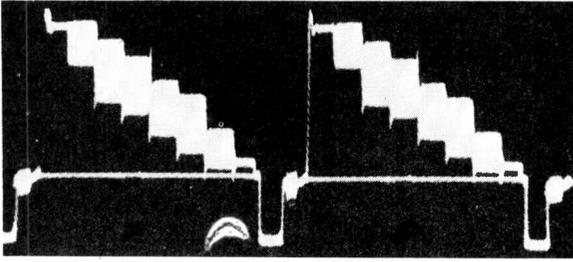


Fig. 5: Luminance signal after the first coupling.

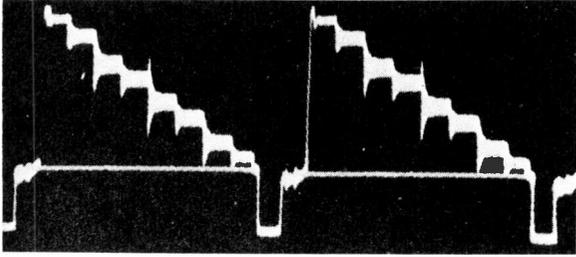


Fig. 6: Luminance signal after passing through the delay line and notch filter and after preamplification.

reception. However instead of the subcarrier notch filter being located in the luminance channel proper (after the detector) it can be located in the vision i.f. channel feeding the luminance detector when the design incorporates a separate chroma detector (method 2). The filter in this case would be tuned to the subcarrier i.f. which is 35.07MHz.

Summary

To summarise, a rejector tuned to the sound i.f. can be included in the i.f. feed to the luminance detector when there is either a separate intercarrier sound detector (Fig. 3(c)) or when there are separate chroma and luminance detectors and the intercarrier signal is taken from the chroma detector (Fig. 3(a)). Such rejection removes the 1.57MHz chroma/sound beat. On the other hand, the chroma rejector can be placed in the i.f. feed to the luminance detector (instead of in the luminance channel proper) when there are separate chroma and luminance detectors and when the intercarrier signal is taken from the luminance detector or a preamplifier/splitter stage following (Fig. 3(b)). Such a rejector removes the 4.43MHz subcarrier components from the luminance channel and at the same time removes the possibility of 1.57MHz beat signals being generated.

To conclude this section it is noteworthy that models using a solitary vision detector to handle the chroma and luminance signals as well as the intercarrier signal often have a chroma signal take-off

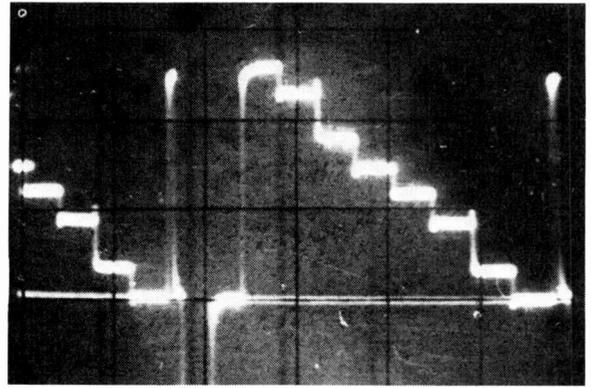


Fig. 7: Luminance signal at the output stage.

sharply tuned to the subcarrier frequency, and since this appears in series with the luminance channel it serves the function of chroma subcarrier notching as well.

A 33.5MHz rejector is incorporated somewhere in the i.f. channel to hold the sound carrier at about 40dB below the vision carrier to produce good intercarrier sound (devoid of intercarrier buzz) and to ensure the least disturbance from chroma/sound beats.

Tuning the Signals

All these filtering actions however only occur when the set is very accurately tuned so that the various signals fit into the passband and rejector points provided by the i.f. tuning. If the tuning (at the u.h.f. tuner) is inaccurate not only will the subcarrier placement be wrong for the best colour reception but the sound i.f. signal will not fall in the trough on the i.f. response curve provided for it. This would cause the sound i.f. signal to pass through the amplifier channel and arrive at the detector at a level higher than it should, resulting in severe chroma/sound beat patterns. When the tuning is correct the sound i.f. signal will fall in the 33.5MHz trough and the sound i.f. signal at the detector will fall almost to zero so that the beat patterns will disappear. This is why accurate u.h.f. tuning is essential in colour sets and why some of them employ automatic frequency correction (a.f.c.). A recent example of this type of circuit, from the Thorn 3000 single-standard colour chassis, is shown in Fig. 4.

It is also noteworthy that when a separate chroma detector is employed (it may also provide intercarrier sound detection as we have seen) allowance can be made for the fact that the colour modulation percentage can rise beyond the 100 per cent mark. Ordinary detectors can distort the signal at this

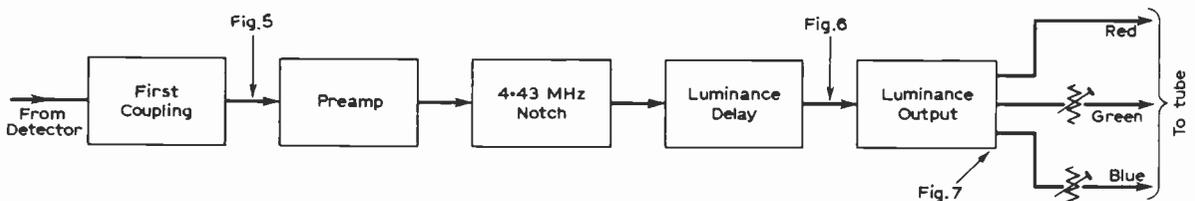


Fig. 8: Block diagram of the luminance channel in a colour receiver, showing signal monitoring points.

sort of modulation level so that certain design compromises are necessary when there is just one detector.

Additional Traps

Because of the multiplicity of channels that will be in use in Bands IV and V and the fact that distant u.h.f. transmissions can be received under certain weather conditions traps are included in the i.f. channel to delete unwanted signals from these sources which would otherwise cause serious pattern interference. These traps are tuned to 31.5MHz for adjacent channel vision and 41.5MHz for adjacent channel sound and channel 1 sound on v.h.f. Also as we have seen there is one or more trap tuned to the sound i.f. at 33.5MHz to act as an attenuator to give the correct level of sound i.f. relative to the vision i.f. at the detector from which the intercarrier sound is taken.

Some of the traps are switched in dual-standard sets. For example while the 33.5MHz and 41.5MHz traps might be permanently in circuit the 31.5MHz trap is sometimes switched in on the 625-line standard only and an extra trap tuned to 39.65MHz corresponding to the adjacent channel vision on the 405-line standard switched in only on that standard.

Luminance Oscillograms

The composite signal resulting from the colour bars was shown in Fig. 5 in Part 4 last month. This is the kind of signal that would appear across the load of the detector handling both the luminance and chroma signals. To conclude this instalment let us trace such a colour bar signal through the luminance channel.

The waveform in Fig. 5 shows how the signal may appear after the first coupling from the detector to the luminance channel. Chroma signal including the bursts is still present but there is a marked attenuation of the chroma components. The waveform in Fig. 6 shows the signal after the luminance delay line and after the chroma notch filter. Here it can be seen that virtually all the chroma has been deleted. There are still traces of the bursts but by the time the signal appears at the output of the luminance channel it is pure luminance, as shown in Fig. 7. This is the sort of signal that in sets employing colour-difference drive appears at the three cathodes (sometimes at the three grids—in the Grundig 902 series) of the tube. The luminance or Y signal as it is now called is adjusted in amplitude at the cathodes for correct grey-scale tracking. It is common practice to couple the Y signal direct to the red cathode (since the red phosphors are the least sensitive) and feed the green and blue cathodes via preset potentiometers.

Peak-to-peak signal amplitudes relative to the colour-bar signal are approximately 1.8V in Fig. 5, 9V in Fig. 6 and 65V (about normal contrast) in Fig. 7 where the signal is monitored at the anode of the luminance output valve—the relative signal amplitudes at the separate cathodes will of course depend on the grey-scale tracking adjustments.

The block diagram in Fig. 8 shows the essential aspects of the luminance channel and the oscillogram test points.

TO BE CONTINUED

TRANSISTOR AND DIODE ANALYSER

—continued from page 65

various resistors to suit the actual voltages provided by the particular power pack. Finally mount the power pack as shown in Fig. 12, using four stand-off bolts to produce a top deck, and then establish the few connections down to the panel wiring.

The arrangement of chassis soldering tags and their interconnections as shown in Figs. 11 and 12 is important to avoid instability. Do not depart from the arrangement shown, which also ensures the necessary good multiple contacts to keep the readings steady enough for the faulty electrode test described in the systematic test instructions.

OPERATING PROCEDURE

The basic operating procedure for this instrument is largely self-evident from the circuit description. Next month we will conclude with a systematic operating procedure giving precise step-by-step instructions and tabulating as well as discussing the results and diagnoses based on them, culminating in a general appraisal of the practical uses to which the tested transistors may be put.

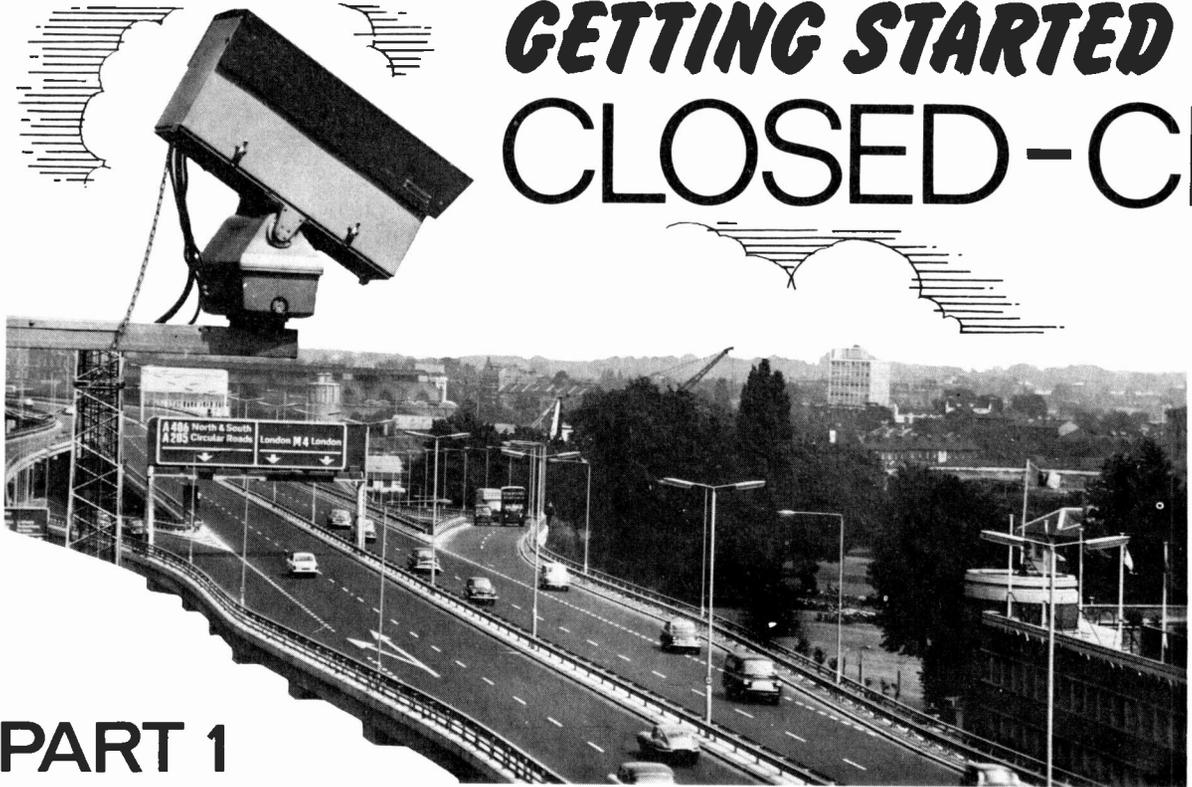
One general point requires mention at this juncture. This concerns the basic function of VR1. At the start of any β -measurement VR1 should be set to zero. After selecting the desired base-drive current and an appropriate meter range for reading the collector current, slowly advance VR1 in steps of about 20% f.s.d. on its scale reading from 0 to 200% f.s.d. Observe the meter, which at first exactly follows the setting of VR1, indicating that the transistor is still bottomed. At some stage the meter reading will start to lag behind the reading on the scale of VR1. Stop when the meter reading, expressed as a percentage of full scale, is some 20 to 30% less than the setting of VR1. The prevailing collector to emitter voltage is then always approximately 1V so that the power dissipation in the transistor (in mW) is numerically equal to the meter reading in mA. This procedure gives control over the power dissipation and imposes minimum strain on the transistor being tested.

VR1 also runs from zero to above 8-12V maximum and this has been roughly indicated in addition to the %f.s.d. scale by marking the nominal 3V, 6V and 9V points at quarter-, half- and three-quarters track. If it is desired to apply voltages greater than 1V between the collector and emitter of the transistor being tested simply turn up VR1 still further beyond the point at which the meter starts to drop behind. Then note the *voltage* setting of VR1 and the voltage setting corresponding to the actual meter reading in %f.s.d. The difference is the actual voltage between the collector and emitter at the resulting operating point and multiplying this by the meter reading in mA gives the power dissipation.

The full significance of the maximum power dissipation table on the front panel will be described next month. It states the *maximum possible* power dissipations which can result in the respective meter range and VR1 settings so that it serves as a guide as to how far it is permissible to turn up VR1 in each meter range for each transistor type group.

Figures 11 and 12 will appear along with the systematic test instructions next month.

GETTING STARTED WITH CLOSED-CIRCUIT



PART 1

CLOSED-CIRCUIT television is concerned with televising without broadcasting; that is the transmission over cables of signals which may be at video frequency or modulated on to an r.f. carrier from camera(s) direct to receiver(s) without the use of aerials. In this series we shall be looking mainly at the circuits and apparatus available to amateurs, but with an occasional envious glance at the equipment available to the professional.

Simple Systems

The simplest possible CCTV system consists of a picture generator, which may be a CCTV camera or a flying-spot pickup depending on the type of material to be televised, and a receiver for the display of the picture. Amateur enthusiasts have strangely neglected the flying-spot scanner (though S. M. Lindsay's articles in *PRACTICAL TELEVISION* February and March 1969 should help to reverse this state of affairs) which is in many ways as useful for entertainment purposes as the camera. Using a scanner, both slides and (with modifications) movies can be shown on a TV receiver without the inconvenience of setting up a projector and screen. Both negatives and positives can be transmitted in positive form, so that 35mm. negatives can be used both to obtain prints in the normal way and also mounted in cardboard frames for use with the scanner.

A simple system consisting of a camera and monitor can be capable of a wide variety of uses, but the design of camera and monitor must be suited to these uses. For example the use of CCTV in amateur dramatics so that stage work can be viewed remotely by the producer requires a camera operator who can use all the camera controls to best advantage.

In such an application the camera controls are being constantly manipulated and stability of setting is not of great importance. On the other hand if the same camera were to be used hidden to view audience reaction at a live performance the required virtues would be high sensitivity (no stage lights here) and automatic action, because it is unlikely that an operator would or could be used. The use of CCTV is generally a group effort and the type of performance required from the camera is set by the purposes for which the camera is required.

Connections

The connection between camera and monitor is by cable, almost inevitably coaxial to avoid radiation or pickup of other signals. Since coaxial cable has a loss of the order of 6dB per hundred feet (for the cheaper types), the length of cable which can be used between camera and monitor is limited unless repeater amplifiers can be inserted at intervals. In general 1,000ft. is the limit of length for a single cable when every circuit dodge has been used in the camera to compensate for the loss and signal distortion of video waveforms, though longer cables can be used when r.f. carriers are used. In amateur work however 100ft. is a better working maximum for cameras and monitors which are not of studio quality.

Connections become more of a problem when more complex systems, using more than one camera or more than one monitor or both, are to be used. When several monitors are to be operated at the same time from one camera cable the connections must be made in such a way that switching one monitor on and off does not disturb conditions in

WITH CIRCUIT

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the line so as to require resetting all the other monitors. For a few monitors matching pads consisting of a network of resistors so arranged that an impedance of 75Ω is presented to both sides of the line and to the monitor (assuming the use of 75Ω coax) are usually sufficient. For four or more monitors the use of isolating amplifiers is preferable, each amplifier presenting a constant load to the line and also amplifying the signal to the monitor so that the losses due to matching are compensated. Such amplifiers must be *unilateral* so that no disturbance in the monitor is transmitted back along to the camera. This requirement is particularly important with transistorised cameras, as a large pulse fed back to the video output transistor may result in a burnout. The common-collector stage shown in Fig. 1 forms an excellent isolator. Note that current is amplified, not voltage, and that diodes are used to provide both d.c. restoration and reverse pulse protection.

Multiple Cameras

The use of several cameras introduces new problems. The less expensive types of cameras generate their own synchronising signals (syncs will be dealt with in detail in Part 3) so that when cameras are switched the monitor(s) must adjust to a completely

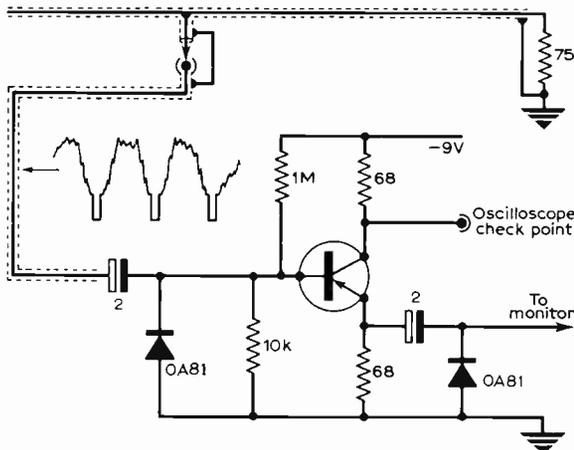


Fig. 1: Isolation stage. Note use of diodes for d.c. restoration—video signal must be positive-going as shown. Use of oscilloscope check point avoids disturbing video signal and enables standing current to be checked (using a sensitive meter). Suitable transistors: AF117, AF114, OC170.

new set of sync signals, usually at a different frequency as far as line sync is concerned, and probably at a different phase though at the same frequency as far as the field sync is concerned. In general monitors will not cope with this, and where TV sets are adapted for monitor use, as is general with amateur equipment, and the sets are fitted with flywheel sync, then the monitor may have to be adjusted manually on each camera change.

This problem can be solved readily by a club, whose cameras can be adapted by agreement to take sync from an external sync generator so that the same sync reaches the monitor(s) from each camera. An improvement on this is to feed sync signals permanently to the monitor and to each camera so that only the video signals are switched. This has the advantage of allowing video to be faded and mixed as well as being switched. The disadvantage is that additional cabling is required, since the video and sync signals have to be transmitted on separate cables, unless cunning circuitry is used at the video switching panel, involving sync separation, video switching and subsequent sync recombination.

Where odd cameras belonging to different people have to be combined for a group effort the best method of use is to modify each camera so that its own sync generators can be synchronised from an external generator or from one of the cameras. If one camera is chosen as "master" its sync signals can be tapped off, amplified and used to keep the sync generators of the others in step. Since the sync generating stages of simple cameras are similar to the timebase stages of TV sets there is little difficulty in making this scheme work. Note however that this also requires extra cables.

The use of extra cameras usually calls for some intercommunication between the camera operator (if used) and whoever is operating the video switching panel. When we get to this stage we are almost at the professional studio degree of complexity, but club efforts may well aspire to this.

Basic Camera Requirements

Every CCTV camera requires a pickup tube, which almost inevitably will be a vidicon, and the necessary clamps and other mechanical arrangements for holding the tube in place. A lens is required to image the viewed scene on to the frontplate of the vidicon, and a source of current is needed for the focusing and the alignment coils.

The more electronic part of the circuitry comprises the scanning generator and coils, and the video amplifier which takes the $0.2\mu\text{A}$ signal at the target of the vidicon, amplifies it and corrects the frequency distortion and delivers it as a 1.0V peak-to-peak (1.4V if syncs are added) signal at the output of the camera. In addition this same signal may be available modulated on to an r.f. carrier for direct feeding into a domestic TV receiver.

The video amplifier is probably the most complex part of the circuitry since the small current signal must be taken from a large load resistor to ensure that the voltage signal will be above the noise level of the first stage of the amplifier. This causes a severe drop in high-frequency response due to the capacitance of the vidicon target across the load resistor, and the video amplifier must include correction for this. In addition the fact that the spot

of the electron beam is not like a well-focused light spot with sharp edges but is "fuzzy"—due to the fact that electrons travelling at different speeds focus at different places—makes further correction, called aperture correction, necessary to the highest frequency components of the video signal. In addition the black-level voltage has to be inserted as the televised scene may not contain a true black: the sync pulses can then be added if mixed sync and video is to be used, starting from black level. A further refinement may be the automatic control of contrast by rectifying the video voltage and using the d.c. obtained to control the vidicon target (see K. T. Wilson, *PRACTICAL TELEVISION*, JULY 1969).

The scanning portion of the camera generates saw-tooth waveforms which are then applied to the scanning coils. Since the power requirements for scanning a vidicon are small the scanning system may be completely transistorised, as on all commercial CCTV cameras, with consequent saving in weight and heat dissipation. The scanning section may carry the master generators for sync pulses, the field generator syncs almost always being derived from the mains frequency while the line waveform is free-running or crystal-controlled. As suggested earlier this may cause difficulties when cameras are run in groups, but it is possible to apply synchronising techniques to the oscillators to bring them into sync with an external oscillator.

The controls of the camera will include the aperture and focus controls for the lens (cheap lenses may have fixed focus though this is rare), the target voltage control and vidicon grid bias control which may be labelled *contrast* and *beam* respectively. There may also be a switch for conversion to automatic target control, and presets to adjust video gain, output voltage level, black level and the ratio of video signal to sync pulse. In general the fewer controls a camera operator has to handle the better and of course for automatic operation all controls are preset.

Viewfinders

A refinement available for all studio cameras but seldom seen on amateur equipment is a viewfinder. This is a miniature monitor mounted on the camera and using a small tube, sometimes of the oscilloscope type but more usually a miniature magnetically deflected tube. The viewfinder provides the camera operator with an exact view of what is being televised since it uses the same video signal. Photographers will know what I mean when I say that using a viewfinder is like using a single-lens-reflex camera after one of the squint-and-hope variety. Viewfinders are not particularly complex to build and their use greatly simplifies the task of the camera operator who otherwise has to look away from the camera to a monitor to see what he is televising.

Basic Monitor Requirements

Monitors are essentially TV receivers without an r.f. section and made to give the best possible reproduction from a CCTV signal. Commercially-made monitors use tubes with fairly narrow deflection angles and provide a standard of linearity unapproachable by any domestic TV receiver. On

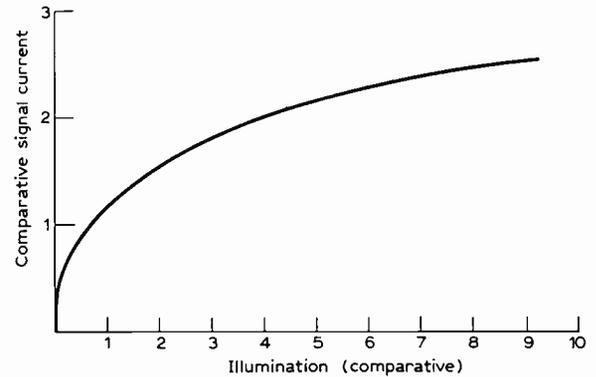


Fig. 2: Graph of signal against light for a vidicon tube. Figure 1 on the signal scale corresponds to about $0.05\mu\text{A}$ signal while that on the illumination scale corresponds to about 1 candela per square metre.

the other hand it can be argued that for CCTV use quality greatly exceeding that normally seen in broadcast TV work is seldom necessary and may be impossible to obtain from the camera, especially under poor lighting conditions. For the amateur, conversion of a TV set is the usual answer since a monitor tube alone costs more than a second-hand TV set.

A monitor should display a picture whose resolution, grey-scale and signal-to-noise ratio is acceptable. Resolution means the ability to reproduce fine detail and is usually measured as the maximum number of black-and-white bars which can be seen in a length equal to the visible height of the picture. The vertical resolution of any CCTV system is set by the line standard (405, 525, 625, etc.) in use, but the horizontal resolution is set by the bandwidth of the video amplifiers, both in the camera and in the monitor, and by the sharpness of focus of the electron beams in the vidicon and in the monitor tube.

Grey-scale means the number of shades of tone which can be distinguished between black and white. A scale of five shades of grey is usually taken as the minimum acceptable, but many CCTV pictures are worse than this and it is in this respect that amateur pictures are most defective. Good grey-scale depends on the "linear" operation of vidicon and monitor and every stage of amplification in between. One snag here is that the vidicon and the monitor tube are *not* linear: the current output of the vidicon

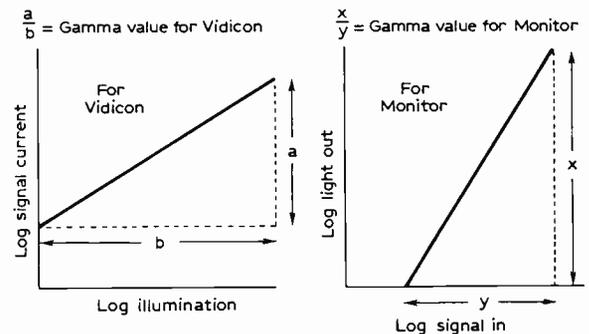


Fig. 3: Vidicon and monitor gamma characteristics. For good reproduction vidicon gamma = 1/monitor gamma.

when plotted on a graph against light input (Fig. 2) is not a straight line nor is the graph of monitor tube light output plotted against voltage drive.

This lack of linearity is usually expressed as the *gamma* of the device, obtained by plotting the logarithm of the current or voltage signal against the logarithm of light in or out (Fig. 3). The slope of the graph (change in height over change in distance) over the working range of conditions is the *gamma*. For vidicons this *gamma* is about 0.5 and for c.r.t.s the *gamma* is about 2. For a good grey-scale the *gamma* of the picture tube should be the *inverse* of the *gamma* of the camera tube (if both were linear the *gamma* would be 1 in each case), and this condition is normally fulfilled for the combination of vidicon and c.r.t. though not when an image orthicon is used as the camera tube. No correction should therefore be required for a vidicon, but this is not true at low light levels where the *gamma* value changes.

When a TV set is used as a monitor it is preferable to use a set capable of Band IV reception (BBC-2) so that 625-line operation is possible. In this way a wider video bandwidth is obtained and as we shall see later every possible way of increasing bandwidth is useful as we cannot as a rule use interlaced signals in CCTV. If the camera output is in the form of r.f. the signal can be fed in at the aerial socket, with suitable attenuation if necessary, and little or no modification need be made to the receiver. If the camera output is at video frequency then some arrangement must be made to feed into the video stage of the receiver.

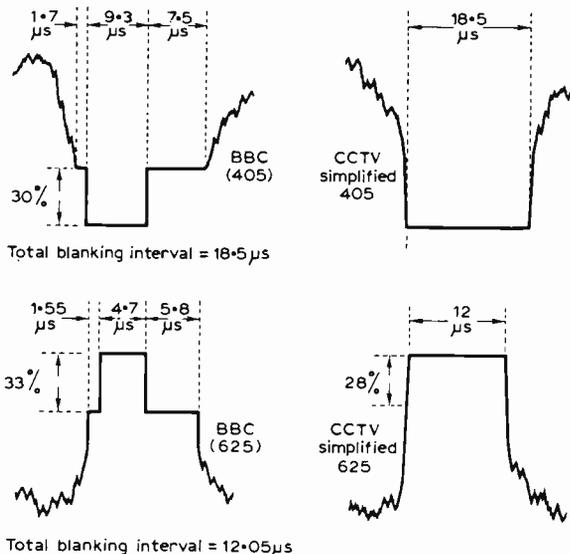


Fig. 4: Broadcast and closed-circuit sync pulses. Line sync pulses shown above. On 405 the BBC field sync period has 8 negative-going pulses of 40μsec width with a separation of 8.2μsec. For CCTV use the line sync pulses superimposed on a field pulse of 40μsec. The BBC field sync period on 625 has 5 negative pulses of line sync width, then 5 27.3μsec pulses then 5 more line sync width pulses. For CCTV use line sync pulses superimposed on a field sync pulse 8 line intervals long.

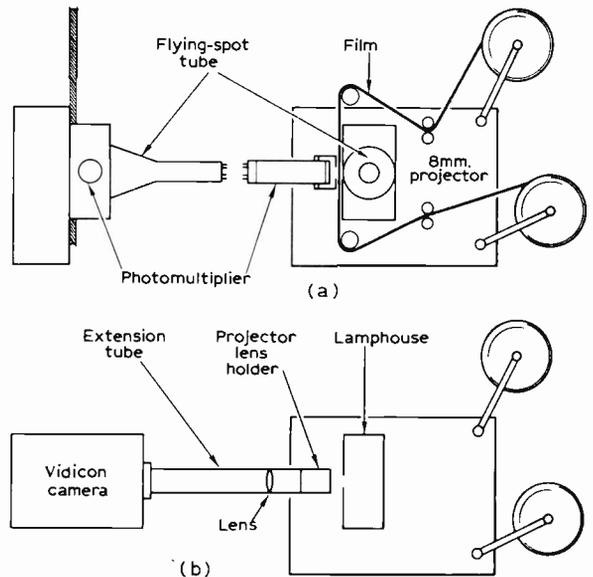


Fig. 5: Movies on CCTV. (a) Lamp is removed and replaced by a mirror tilted at 45° so that a small flying-spot scanner tube can be mounted in the side of the lamphouse and the light from it reflected towards the film gate. The photomultiplier picks up the scanned output. Field sync must be taken from the projector either by taking the long pulse from the photomultiplier as the shutter closes or from a phototransistor and lamp counting the film perforations. (b) The lens in this arrangement will have to be roughly one-third of the way from the projector to the camera. The lamp brightness must usually be considerably reduced by running the lamp from a lower voltage transformer.

and this raises difficulties of earthing. Most TV sets use a chassis which is connected (nominally) to mains neutral and therefore not earthed. Feeding video signals into such a set through an earthed video link can, if the chassis is connected to the neutral line, cause large hum currents to flow, blotting out the video signal. If the chassis is live the risk is of extensive fuse blowing, damage or the electrocution of the operator. The use of TV sets as video frequency monitors is thus not recommended unless a fairly complete rebuild can be undertaken or the set worked from a reliable isolating transformer and the chassis earthed. This will be dealt with in detail in Part 3.

Basic Synchronising Requirements

The purpose of sync pulses is to keep the time-bases of the camera(s) and monitor(s) in step. Ideally this would be done by using the same waveform for both timebases. This can be achieved if camera and monitor are next to each other, the monitor scan waveforms being tapped off through transformers and used to feed the vidicon scan coils directly. Though this is useful for viewfinders, we normally have to operate the monitor at some distance from the camera and we therefore rely on starting the separate scan generators at the same

time by means of synchronising pulses.

In broadcast TV the sync pulses appear as part of the whole waveform (Fig. 4) and are separated from the video portion and from each other by a sync separator stage. This is not necessarily the most convenient scheme for closed-circuit work and it may be better for some purposes to feed the sync pulses quite separately from the video signal. This requires a monitor suitable for this method of operation and a TV set used for this purpose requires modification which is discussed in Part 3. The technique has the advantage of dispensing with some complications in the camera video amplifier circuit since sync pulses no longer have to be mixed with the video signal. Separate sync is most useful when large numbers of cameras and monitors have to be used together and is always used in studio broadcast work.

Film Transmission

CCTV offers advantages in film transmission which are not available to broadcast work. Cine film exposed at 16 frames per second (the standard silent speed) is not easily adapted to TV at 50 fields per second, and much money and ingenuity has been spent in modifying old films by inserting extra frames so that normal 24-frame projectors can be used. The CCTV user however can simply adapt his TV system to the film, taking the field sync from the projector, whether at 16-frame or 24-frame rates, or he can keep his field rate synchronised to the mains and make use of the storage time of the vidicon to avoid any "beat" effect between the different rates.

It is even possible to replace a projector lamp by a flying-spot tube and to use a photomultiplier for pickup as in the scheme outlined in Fig. 5 (a), the field sync being obtained from the pull-down of the projector either mechanically from a contact on the shutter of the projector or optically from a lamp shining through the film perforations on to a photocell. Now that 8mm. projectors are comparatively cheap (single-8) experiments along these lines are of particular interest.

Video Recording

Video recording added to CCTV extends the capabilities of a system enormously. The very high cost and complexity of video recorders (even at £400 a video recorder is not exactly within the price range of those of us who pay taxes) takes them out of the range of most enthusiasts, and the difficulties of obtaining tape heads and drives prevents effective do-it-yourself activities. If very greatly reduced bandwidth can be tolerated something can be done with heads and drive mechanisms from old computers, but in my opinion the achievement of cheap video recording awaits a better method of storage, and this is more likely to be based on photographic techniques than on magnetic-tape techniques. Much is being done but we may have to wait for some time.

In the next part of this series we shall look more closely at the vidicon and at the optics of the CCTV camera.

TO BE CONTINUED

TRANSISTORS IN TIMEBASES

—continued from page 56

impedance path to the transistor this is actually off. This is achieved by biasing the cathodes of the diodes by resistors R7 and R8 which are returned to the collectors of the transistors. To ensure that the switching action is synchronised with the R—Y switching at the transmitter an ident signal derived from the transmitted burst signal is fed to the base circuit of one of the transistors and serves to suppress the trigger pulse in the event of the triggering not being in synchronism so that the triggering of the circuit is held back for a line and then commences in synchronism with the transmitter R—Y alternate line phase reversal.

SINGLE SWITCHED AMPLIFIER

It is not essential to use a bistable circuit to control the R—Y switching in the decoder, and other techniques are in use. In the STC-ITT CVC1 and CVC2 chassis the ident waveform is used direct for this purpose, controlling a ring modulator that performs the actual switching, whilst in the original Baird chassis and the latest Thorn 3000 chassis the ident signal is squared and used to effect the line-by-line switching.

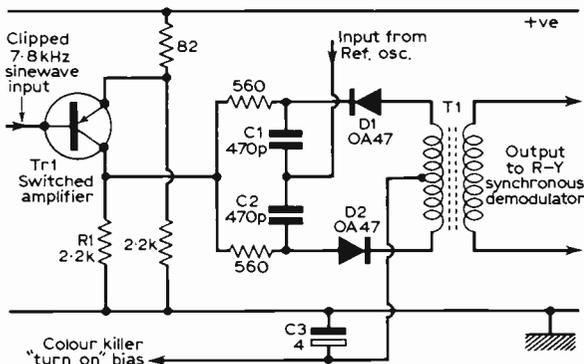
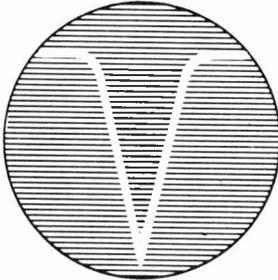


Fig. 5: Alternative R-Y phase reversal circuit used in the BRC 3000 chassis, employing a single switched amplifier stage.

The arrangement used in the 3000 chassis is shown in Fig. 5. The 7.8kHz sinewave produced by the ident amplifier is in effect equivalent to a series of positive- and negative-going pulses at line frequency and after being squared by a pair of clipper diodes is fed as a squarewave input to the switched amplifier stage Tr1. This controls the two diodes D1 and D2 which conduct alternately, D1 being switched on when Tr1 is switched off so that its collector voltage falls to chassis potential while D2 is switched on when Tr2 is on and the voltage across R1 rises. The signal from the reference oscillator is fed via the centre-tapped transformer T1 to the R—Y synchronous demodulator, travelling round the circuit C1, D1, T1, C3 and C2, D2, T1, C3 on alternate lines, inversion occurring due to the centre tapping on T1. The voltage at the centre tap, smoothed by C3, is used as the colour killer turn-on bias for the first chroma amplifier stage.

TO BE CONTINUED

DX FILTER



ROGER BUNNEY

THE ACTIVE DX TV enthusiast has many problems to contend with but possibly the two main ones are weak signals and interference. Weak signals can of course be dealt with by using low-noise preamplifiers, but if the signal is lost beneath interference from a local and very strong Band I signal the amplifier will only tend to exaggerate the problem. In my case, to give an example, the local BBC is on channel B3 from Rowridge and at a distance of 24 miles the sound splatter tends to spread over channel F2, renders IA and E3 useless for all but the strongest signals, while the vision can upset channel R2 with the aerial in certain directions.

Various methods were tried to clear up the affected channels but the main problem was finding a filter with characteristics that could remove the BBC signal but leave the various DX channels clear. All attempts at removing the BBC, which I'll call "the local", seemed doomed to failure. The main problem was the bandwidth of the various filters which when attenuating the local attenuated the required channels as well. For several seasons the only way of resolving E3 and IA signals was by turning the aerial into a direction that gave a null pickup of the local, or as "null" as possible! Unfortunately this often meant that the aerial was off direction for the wanted signal so compromise positions had to be found for the aerial direction.

Towards the end of 1968 there appeared in the September issue of *Wireless World* a notch filter design for channel B2. This was intended for removing interference to channel B2, mainly from channels E2 and R1. However it seemed that this filter could be used in the reverse sense to remove BBC-I interference from the DX channels! After some experimentation the filter was altered to cover all Band I by simple adjustment.

Components required:

- C1 3-30pF concentric capacitor (Radiospares)
- VR1 470 Ω miniature preset (Radiospares)
- L1 11-turn coil with tapings at 5, 6 and 7 turns wound on $\frac{1}{4}$ -in. former with dust core. Use 24 s.w.g. enamelled wire

Coaxial sockets and Eddystone diecast box

Note that polythene coil formers should be avoided as they tend to distort under the heat when the tapping connections are being soldered. $\frac{1}{4}$ in. plastic formers should be used in preference

The coil (L1, Fig. 1) is of 24 gauge enamelled wire wound on a $\frac{1}{4}$ in. coil former and consists of 11 spaced turns over a length of 0.8 in. The coil has tapings at 5, 6 and 7 turns, 5 and 7 being connected to the input and output sockets and the inner tapping to a miniature preset potentiometer (VR1). Across the coil itself is connected a preset concentric capacitor C1 with a maximum capacitance of 30pF. The whole assembly must be mounted within a metal container to avoid external capacitance effects detuning the filter and I found it convenient to use the Eddystone type of diecast box.

Tuning the Filter

In this area the 53.25MHz sound frequency was particularly troublesome and attention was initially directed to the removal of this interference. The tuning of the capacitor is very critical and the notch is so sharp that it can easily be passed. Initially adjust VR1 to give maximum resistance to chassis. Then slowly tune the capacitor until the notch is found. One method is first to tune the set to the offending interference, such as the sound splatter, and then observe the splatter on the screen until it falls to a minimum on adjusting C1.

When the minimum point has been found VR1 should be adjusted until at a point between 150 and 180 Ω a maximum attenuation point will be found. Below this point the interference will increase again.

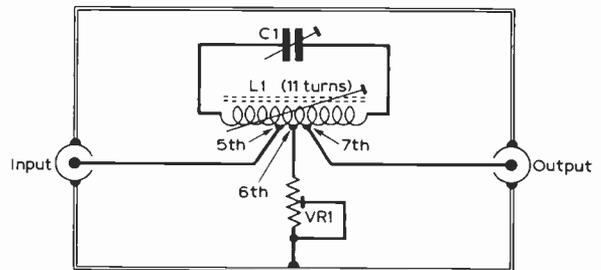


Fig. 1: Circuit of the notch filter.

Recheck the capacitor adjustment to ensure absolute maximum attenuation of the interference from the local and at this point it may be advisable to melt wax over the coil and capacitor to avoid movement and consequent detuning of the filter. When the metal case of the box is screwed on the changes in capacitance may slightly affect the tuning. This can be easily centred by adjusting the dust core through a hole in the lid of the box. This also allows adjustment to adjacent frequencies within 250kHz of the centre point.

Results Obtained

Results from the use of this filter have been most rewarding and with channel IA only 250kHz from the sound carrier of my local it is now extremely easy to resolve weak Italian signals. Channel E3 is also now clear for the first time in many seasons and channel R2 can be tuned throughout instead of the situation before when there was just one point on the tuner with a corresponding dip in the i.f. response. For channel R2 I have found it convenient to use a second filter tuned to the vision frequency of the local.

For the average DX enthusiast who has a local

—continued on page 83

UNDERNEATH THE DIPOLE

NOWHERE else in the world has that particular high-cost item TV studio stage space been so efficiently used as by the BBC Television Centre and the ITV major companies' studios where an output of about 30 minutes per day for a drama with many settings is commonplace. Preliminary and prior off-stage rehearsals are the answer to this problem whether live TV, videotaped or electronic-aided film recording are finally used—but actors and rehearsal space still have to be paid for. All the modes of technical operation mentioned have been used. Some producers and directors have emphatic preferences one way or another and all require the engineering logic and discipline which seems to have been attained only in the UK. But costs are ever rising. The above techniques must be compared with the Continental method of using a stage for one or two weeks—or more—for rehearsals before lighting, shooting, filming or taping a production begins.

These are the facts of life which worry all television managements, particularly those of the ITV companies now faced with the increased levy on advertising revenues. Many other increases in costs (which were not envisaged) have arisen apart from the essential amortization of the costs of new premises and new equipment for colour TV on 625 lines.

SOUTHERN INDEPENDENT TELEVISION

It was pleasant to get away and take a preview peep at the new Southern Independent Television premises at Southampton. These have now been built and are almost ready for turning over to 625 u.h.f. colour transmissions, much of the equipment having already been installed and tested. First however the new stages. These comprise:

Studio 1	6,000 sq. ft.	(4 cameras)
Studio 2	3,000 sq. ft.	(3 cameras)
Studio 3	1,200 sq. ft.	(2 cameras)
Studio 4	350 sq. ft.	(1 camera)

(Presentation)

At the time of my visit colour TV tests were being carried out with Marconi Mark VII colour cameras and superb quality results were seen on the monitors. All the cameras were fitted with Rank Taylor Hobson zoom lenses with Evershed servo-control of focus and zoom conveniently located for the cameraman's use as he manipulates his TV camera mounted on a Vinten pedestal. The ease with which the heavy (but stable) pedestals can be pushed across the superlatively smooth and level studio floor was partly due to the use of a Pegolon plastic material, which

was stuck directly to a carefully floated concrete floor (super-level, not exceeding $\frac{1}{32}$ in. variation in ten feet).

This material and its method of application was noted by Southern TV engineers at several continental studios, mainly in Germany, and is an alternative to the use of thick "battleship" linoleum stuck on asphalt laid on concrete. Several other methods are used in TV studios all over the world, such as parquet or tongued-and-grooved boards carefully laid and sanded for smoothness. However, carpenters erecting sets on wooden floors in film or television studios quickly ruin the smoothness as they just can't resist hammering nails into the floor through sheer habit. Some of them become as knobbly as the Sussex stones which surface Mermaid Street, Rye. Cameras often have to be tracked on rails to effect a smooth passage.

The smoothness of the Southern television stages demonstrates that the tour of European studios by a small working party of engineers was well worthwhile. Most television studios have trouble with their studio floors. This is usually due to the surface material being applied before the concrete has completely matured and dried out. The first symptoms a few months later are the faint shapes of large "bubbles" under the top covering. These tend to give a nautical roll to the tracking of the camera pedestals across the floor which often necessitates greater use of zoom lenses, leaving the camera stationary, but giving the effect of moving the actor magically towards the camera instead of (by tracking) moving the camera towards the actor with a fixed focal length lens.

SOUTHERN EQUIPMENT

The planning of Southern Independent Television premises and equipment was carried out long before the Independent Television Authority was instructed by the Government to obtain an increased levy from their fifteen subcontractors who also share the costs of the very important Independent Television News. All these organisations had put in hand extensive new premises, new equipment and new policies before this command was announced by the ITA. Nevertheless the Chairman of Southern John Davis, his Managing Director C. D. Wilson and the Board decided to carry on in the manner already planned at a cost of £2,500,000 of which more than half was budgeted for 625-line equipment. The main equipment suppliers are the Marconi Company (£500,000), Rank Cintel Telecine equipment (£230,000) and the lighting firms (£225,000 divided between Rank Audio, Berkey, Strand Electric and Thorn). Chief Engineer Basil Bullitude did a great deal of careful shopping in the choice of equipment down to the last film splicer and editing machine.

"IMPACT" FOR WHAT?

Impact seems to be the in word at the moment with "good impact" in television presentation too frequently regarded as being of greater importance than good taste and with basic rules broken for downbeat "smartness" in both radio and TV. Elementary and logical traditions of voice production, enunciation, punctuation and clarity are too often ignored. On TV and sound radio for instance the BBC (breath) seems to encourage (breath) announcers to take (breath) breaths in the wrong (breath) places, ignoring the natural punctuation of the words (deep

breath). How much easier it is for listeners to hear and understand relaxed narrations, commentaries or announcements on radio. On television smoothly spoken presentation, even with dialect overtones, requires a civilised appearance, clean face, brushed hair and (when applicable) a slight smile. Stylised announcing week-by-week can become monotonous. But the friendly greetings of radio and television—and even a few disc jockeys—have become social links in viewers' homes. Some of the late night programmes on both BBC and ITV are sadly lacking in this respect, using kicks, impulses, shocks and impacts instead.

SMALL COMPANY GETS NETWORK TIME

The BBC recently announced that it would show new "silent" films on TV and many of us who hadn't seen non-talkies at the silent pre-1928 cinema must have wondered what was in store. Viewers who saw the Westward Television originated "Loss of the S.S. Schiller" on ITV now know how stylised television-film making can provide an engrossing documentary account in a visually satisfactory manner. The lack of big crowd scenes, visual absence of actors and of dramatic dialogue didn't seem to matter. The German ship Schiller was wrecked off the Scilly Isles in 1875 with the loss of 342 lives. The absorbing voice-off comments, sound effects, music and excellent dubbing counterpointed what must have been about 800 cuts from one visual shot to another with perfect continuity. It was photographed with 16mm. film, models, high-speed cinematography, smooth cutting, sensitive direction and without actors on a shoestring budget and is a model that television directors of the major TV groups and the BBC should see. They will have the opportunity when this and other Westward products are exhibited at the National Film Theatre. More features like this from the smaller companies—Westward, Grampian and Border TV—should appear on the network.

ELECTRONIC EDITING

The readers of this journal are aware of the difficulties of removing unwanted parts of videotaped scenes, close-ups, reaction shots—or for that matter of adding new ones to an existing videotaped production. This is often regarded as being the same artistic make-do-and-mend operation occasionally necessary in film studios, which has many times saved an expensive feature film from being a failure.

All staged television productions have been videotaped for some years and to start with could not be editorially altered. Then a few craftsmen found a special way of using scissors or guillotines to make acceptable cuts. Now by using two high-band colour videotape machines the unwanted scenes can be eliminated or new ones added. Just how sophisticated this operation has now become was demonstrated when in Technicolor's Vidtronics division at Harmondsworth I saw a complicated operation carried out with smooth efficiency.

The problem concerned interviews colour videotaped at *Film 69* in London and totalling about one hour. This had to be edited and reduced to twelve minutes and transferred to film for projecting at the Los Angeles Convention of the Society of Motion Picture and Television Engineers. Some interviews had to be omitted and others shortened considerably. The operation, using the Ampex "Editec" system,

enabled sections to be reassembled, with or without sound, or with extra shots introduced to "cover" cuts. This is an operation which requires a skilled engineer to carry out electronic legerdemain with artistic appreciation and application. Bob Trimmer, a young electronic engineer at the Technicolor Laboratories, did this with precision and confidence and on replaying the shortened and v.t.r transferred videotape recording I didn't detect any of the five cuts that had been made in the first couple of minutes of the replay. Later Ron Egerton, Engineering Head of Vidtronics Division, piloted the complicated process to a streamlined final twelve minutes of 16mm. film for the SMPTE Convention.

Icons

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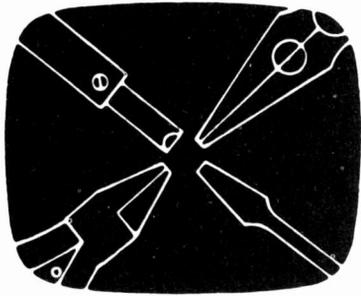
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SERVICING television receivers

L. LAWRY-JOHNS

STC V11 CHASSIS—continued

The HT Supply

A BY100 silicon diode (D12 on later circuit diagrams, D10 on earlier) acts as the h.t. rectifier. The surge resistor R181 (33 Ω , 10W) is on the d.c. side, followed by a resistor-capacitor filter consisting of R180, R179, C158, C157 and C155. An open-circuit in any one resistor will result in no h.t. to any part of the receiver.

Separate filtering is provided for the field timebase the line oscillator and the vision and tuner circuits. It is worthwhile studying this additional smoothing. For example R113 can become open-circuit with the resulting symptom of a white line across the screen. This resistor can be damaged by a short in the PCL85 (V9) or in C94. The valve is most often at fault but confusion can arise when the short in the valve is intermittent. The rule is that if R113 is charred and C94 is not shorted, replace the PCL85 whether it shows a fault or not.

Chain Reaction

Something a little more nasty can occur when R139 (supply to the line oscillator) gets damaged, say by C122 shorting. This results in the PCF802 line oscillator becoming inoperative. Thus there is no line drive to the PL81. This valve overheats passing excessive current through the line output transformer and through the PY81 boost diode. Quite apart from the valves being ruined if this state of affairs is allowed to continue, the transformer may be damaged and the PY81 may develop a heater-cathode short causing R173 to fail before the fuse blows. This is one of the reasons why a set should never be left on "just to hear the sound" when the picture fails.

No EHT

When faced with the problem of no picture and no e.h.t. it is well worthwhile to see what happens when the receiver is worked with the top cap of the PY81 removed. If some degree of line timebase working is restored replace the 0.1 μ F 750V boost reservoir capacitor C145. This capacitor will be found to be shorted. If there is no difference replace the cap on the PY81 and remove the one from the DY86. If this valve is internally shorted the resultant load will stop the timebase working and may cause the PL81 to overheat. If the line whistle is normal but the DY86 is unheated it is reasonable to assume the valve heater to be open-circuit but it is possible for the heater contacts to be corroded or R157 (0.9 Ω) decomposed.

Weak Line Hold

The PCF802 valve is particularly prone to produce the symptoms of no sync, i.e. the picture can be held at a point where it hovers about the correct position but will not lock. Before checking the flywheel sync circuit always check the valve.

Oscillator Transformer Windings

After a period of use the windings of the line oscillator transformer L74, L75 may work their way down the former. In doing so, and with the iron dust core staying in its original position, some drift of the line hold must be experienced. This in itself, and if understood, is not troublesome.

There is however a nasty possible outcome. The coil former is secured by two screws which protrude

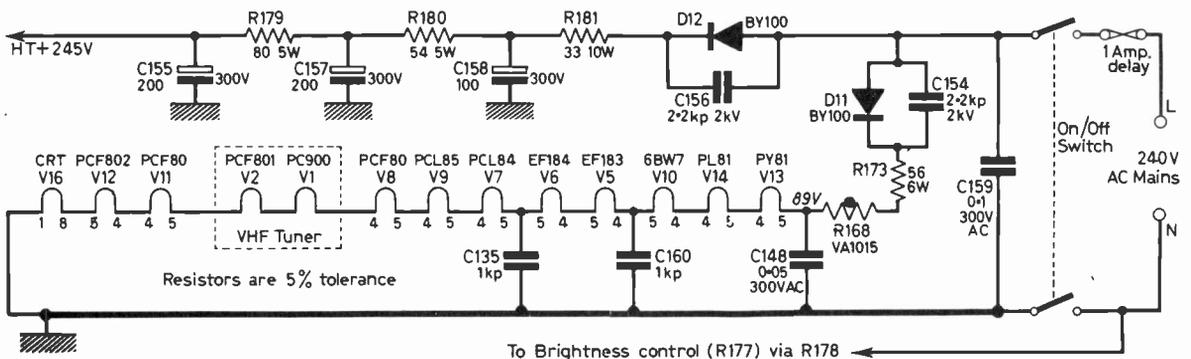


Fig. 4: Circuit of the power supply and heater chain.

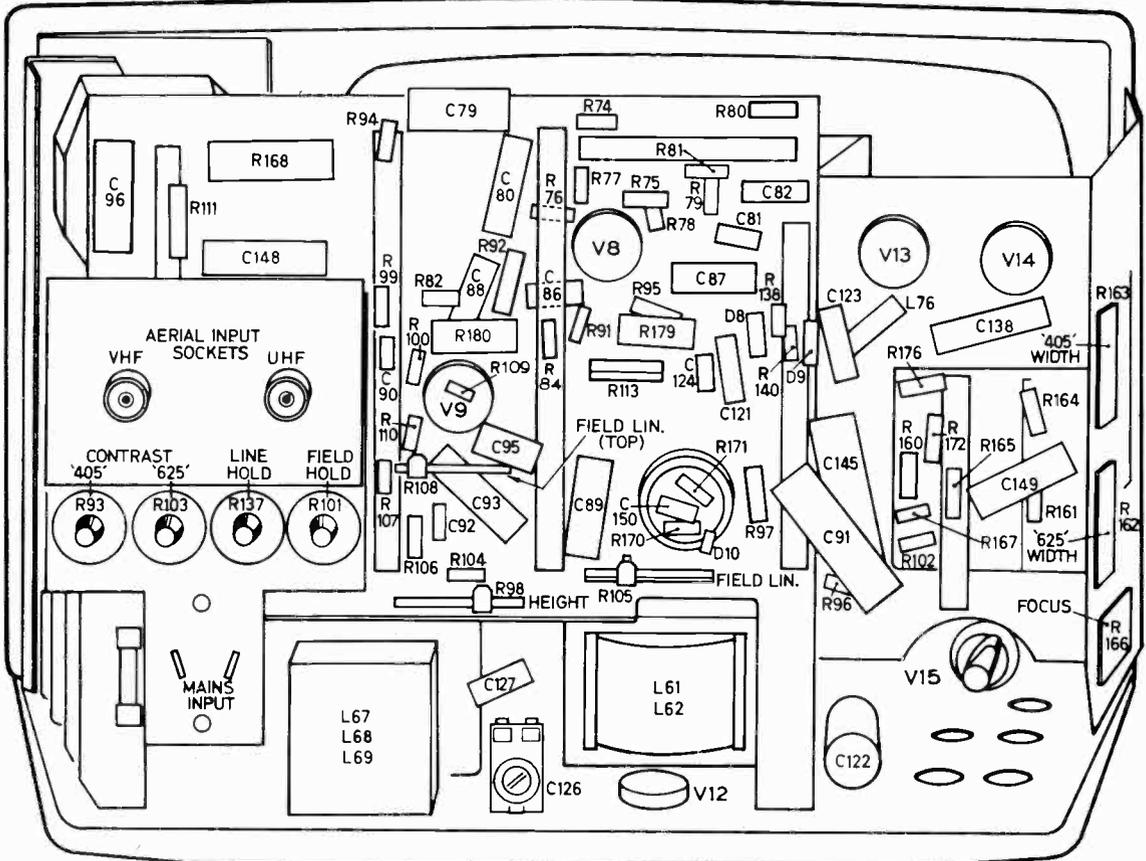


Fig. 5: Rear chassis view.

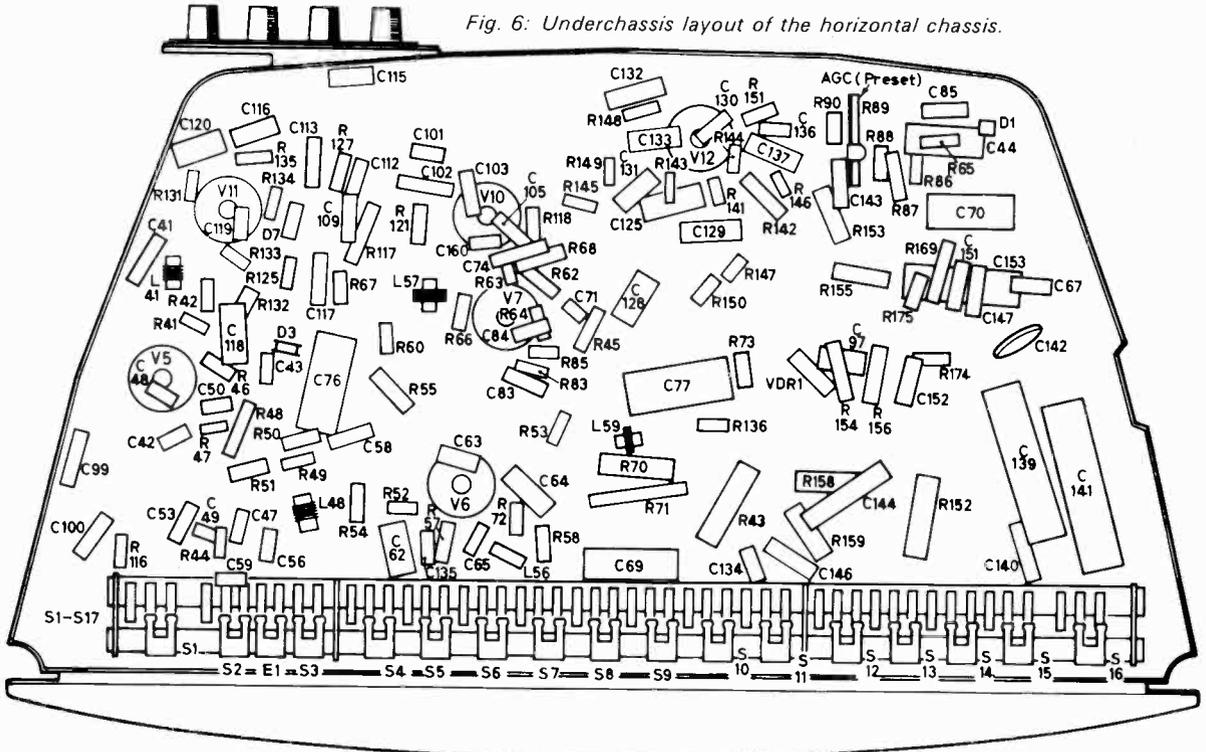


Fig. 6: Underchassis layout of the horizontal chassis.

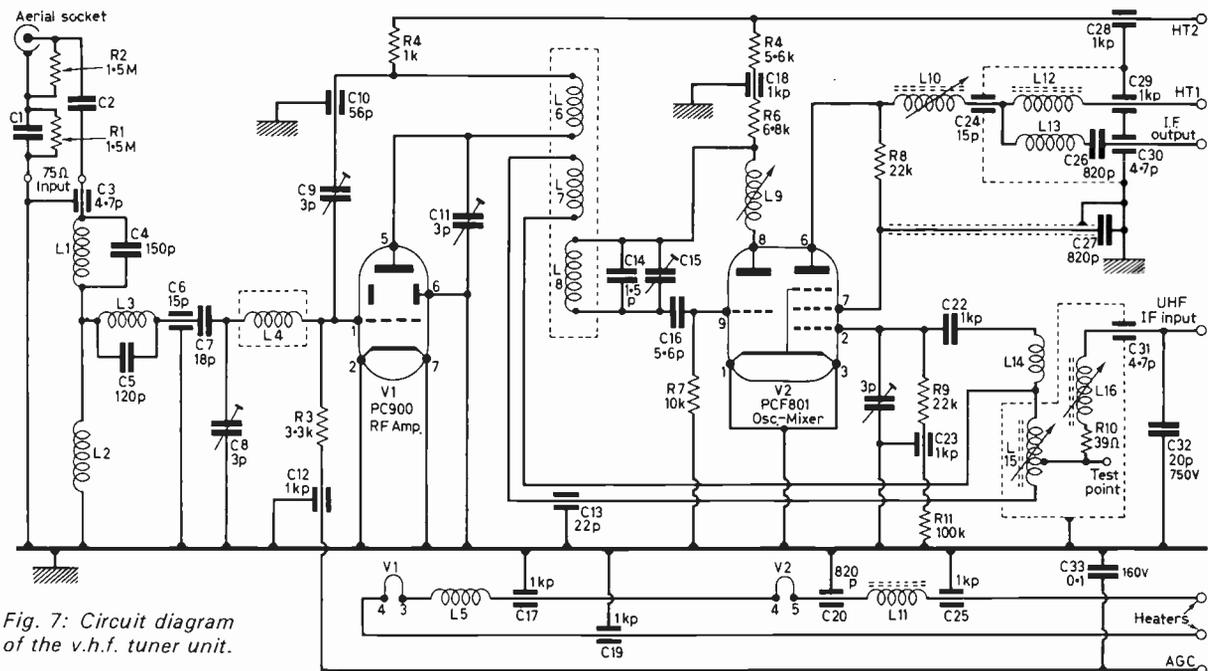


Fig. 7: Circuit diagram of the v.h.f. tuner unit.

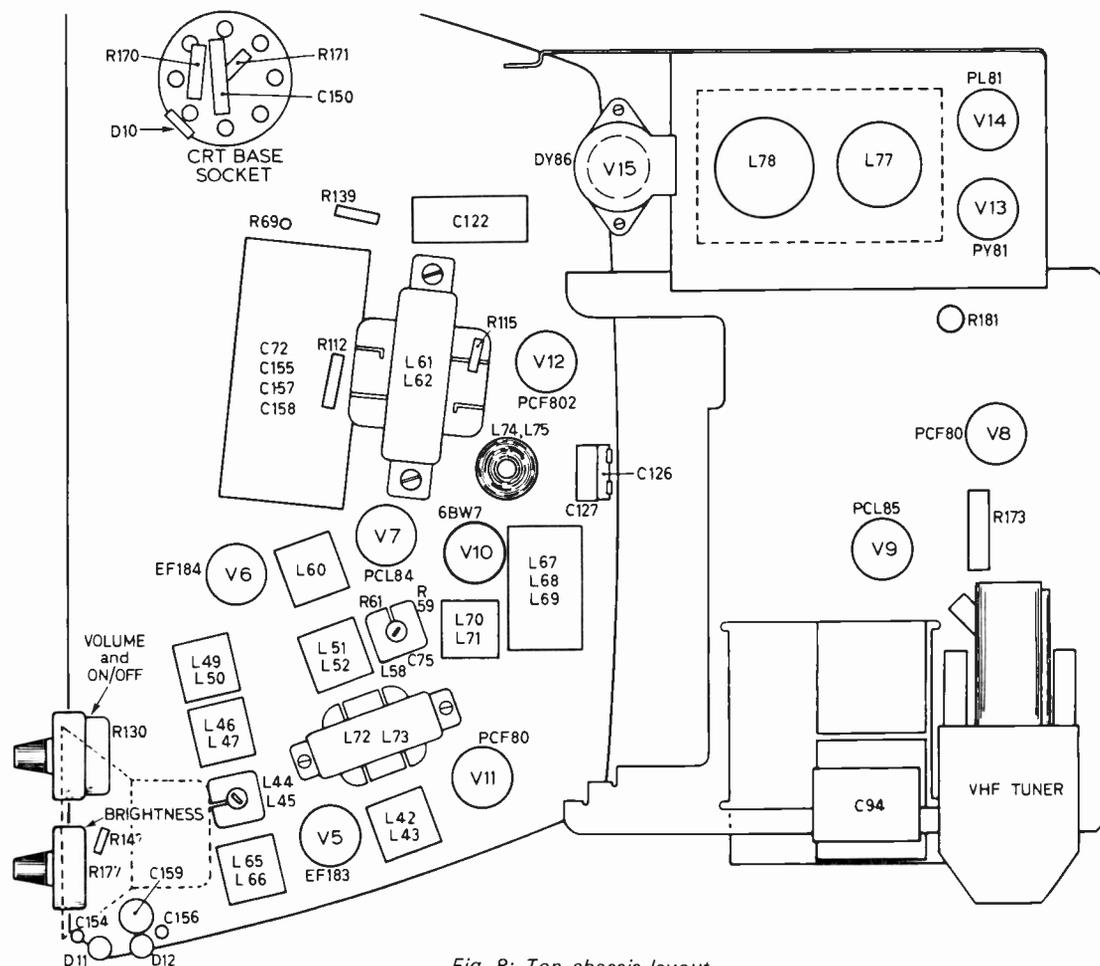


Fig. 8: Top chassis layout.

slightly through the former. When the windings eventually find their way to the bottom the screws, or one of them, can puncture the winding and cause an h.t. short. Usually it is L74 which is shorted causing R145 to burn out or become a dead short. R139 follows suit and if this also becomes zero resistance—and it does you know!—R179, R180 and R181 are in dire trouble until one fails or the fuse blows. Perhaps surprisingly it is R181 (33 Ω) which fails, probably because of its already strained condition (surge limiter).

The windings can be returned to their original position if the former is warmed: then fix with adhesive. To prove the condition described remove the bottom fixing screws of the former; this should clear the short.

Line Oscillator Setting

Switch to 625 lines (625 adjustment must be made first). Connect V12 pin 9 to a low-impedance bias supply of 3V positive with respect to chassis. With a 625 test card pattern applied adjust L74/L75 core for a stationary picture. Switch to 405 lines and adjust C126 to lock the picture. Remove the bias supply. Seal the trimmer screw. Adjust the line hold control to the centre of the pull-in range.

Field Timebase

We have already mentioned V9, PCL85, which can often cause an h.t. short. Other faults which can be laid at the doorway of this valve include loss of height, bottom compression, bottom fold-up (with possible damage to the bias resistor R111, 680 Ω ; always check the value of this resistor) and loss of field hold.

Loss of hold should also attract attention to resistor R100 (390k Ω) and the PCF80 V8.

Video Stage

The only real trouble occurs when the PCL84 shorts. This not only causes damaged resistors but a damaged detector diode (D2 GD12) if the set is operated on the 405 standard. So the rule here is check the PCL84, replace any damaged resistors and check the back to front reading of the diode before trying to reassemble. It is quite in order to check the diode by taking a resistance reading from pin 8 of the PCL84 to chassis; this should be about 7k Ω with the meter leads one way round and very low when they are reversed. A low reading both ways indicates a shorted diode.

IF Stages

Once upon a time we rarely had much to say about the i.f. stages as far as common faults were concerned. Since the widespread use of frame-grid valves however these stages are more liable to give trouble. Both the EF183 and the EF184 can lose emission fairly suddenly resulting in lack of contrast and increased picture noise (the tuner valves then trying to make up for the loss and causing more noise in doing so).

It is also well worth noting the source of the u.h.f. tuner unit h.t. feed. This is the cathode circuit of the EF184. If the h.t. feed to the u.h.f. tuner is less than 12V check the EF184, C64 (which may be shorted) and the bias resistor R57.

Modifications

R69 should be 1W. R147 and R150 replaced by a single 330k Ω resistor. R153 and R154 by a 1.8M Ω resistor, and R155 and R156 by a 1M Ω resistor. R102 and C91 deleted. R96 taken to the junction R160, C145. L59 deleted. An S5AR2 diode is used in place of a BY100 in the D11 position. C115 deleted and C112 transferred to the junction of S4 wiper contact and chassis. R80 changed to 68k Ω . R81 to 68k Ω and C83 to 0.01 μ F. R83 should be 220k Ω in all chassis (not 150k Ω). R79 deleted. R84 deleted and R82 connected to V8 screen pin 3 instead of chassis to provide h.t. for V7 triode section.

Red-faced Writer

During the course of jotting down these notes the writer was called from the desk to the bench by a friend carrying one of these portables. *She* said that it had faded out and now seemed dead altogether.

With the cabinet off and the set plugged in we advanced our trusty neon with little hesitation to the heater resistor R173. It was alive at both ends. Raising one eyebrow very slightly we moved on to the heater pins of the PY81. Pins 4 and 5 were alive as were the same pins on the later valves in the chain. Swallowing slightly we checked pin 8 of the tube base. Our fears were confirmed when the neon again lit on this pin but of course not on pin 1 which is the chassis pin.

Upon conveying the afflicting intelligence to her a rough translation of her comment was that I was a poor friend and her just going on holiday and all. The upshot was that we welded the heater on the third attempt by judicious application of pulses from the PL81 top cap and sent her happily on her way with the warning that it could go open again at any time. The moral of this is of course don't always expect R173 to be open-circuit when the heaters fail to light up! (Anyone got a TSD282?)

NEXT MONTH : BRC 1400 CHASSIS

DX FILTER

—continued from page 77

which gives a large amount of interference this filter will be of great use. It will not of course remove the B2 sound from E2 vision as both are on the same frequency (48.25MHz) but providing there is at least 250kHz separation between the wanted and unwanted frequencies the filter does work effectively. The only solution to the B2/E2 problem that is effective without too much trouble is to mount an aerial in a fixed position that will give minimum pickup of B2, and preferably some distance from the main rotatable array. The reason for the latter is that rotation of the main array may effect the other aerial's minimum B2 pickup properties.

This filter gives an attenuation at the required frequency of over 45dB and although there is an insertion loss over the band—fortunately rather small—this can easily be compensated with a good preamplifier. Finally it should be noted that the filter must be placed in circuit ahead of any preamplifier so that all amplification takes place after the interfering local has been eliminated. ■

DX TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

CHARLES RAFAREL

THE latest period under review was a fairly good one if not a very good one for SpE and on checking back to the same time last year the August log for this year showed some improvement. I suppose all DXers are perhaps a little too anxious to make the best of the all too short SpE season and tend to expect far too much of our fickle friend. One just does not get every country in Europe every month or for that matter every year.

The early part of August was quite good but there was a noticeable reduction in SpE in the second half. The main directions of the openings were to the North East to Scandinavia (easily the best once again) and to the South for Spain and Portugal. There was less activity to the South East—only a little to Yugoslavia—and short skip to Germany was poor as well. The following countries were “missing” here: Rumania, Finland, Italy, Switzerland and Denmark. The first two have been very rare this year. Longer skip to the East was quite good to the USSR and Poland but generally only in the early morning when the USSR was most mornings a regular visitor, often at very good strength. So now to the log for 1/8/69 to 31/8/69:

- 1/8/69 USSR R1, Poland R1.
- 2/8/69 USSR R1, Poland R1, Spain E2 and E4.
- 3/8/69 USSR R1 and R2, Hungary R1, Czechoslovakia R1, Sweden E2, E3 and E4, Yugoslavia E4.
- 4/8/69 USSR R1, Sweden E3, Spain E2, E3 and E4 and 2nd chain E2.
- 5/8/69 USSR R1, Poland R1 and R2, Czechoslovakia R1, Spain E2, E3 and E4.
- 6/8/69 USSR R1 and R2, Poland R1 and R2, Hungary R1.
- 7/8/69 Poland R1, Norway E2, Spain E2, E3 and E4, Portugal E2 and E3.
- 8/8/69 Poland R2, Czechoslovakia R2, Spain E2.
- 9/8/69 USSR R1, Poland R1, Hungary R1, Spain E2, E3 and E4, Sweden E2, E3 and E4, Yugoslavia E3 and E4.
- 11/8/69 Czechoslovakia R1 and R2, Poland R1 and R2, Hungary R1 and Austria E2a.
- 13/8/69 Poland R2, Norway E2 and E3.
- 14/8/69 Czechoslovakia R1, Poland R1.
- 16/8/69 USSR R1, Norway E2 and E3, Sweden E4, Spain E2, E3 and E4.
- 17/8/69 Poland R1, Norway E2.
- 19/8/69 USSR R1, Czechoslovakia R1.
- 21/8/69 Norway E2, Sweden E2, E3 and E4.
- 25/8/69 USSR R1, Czechoslovakia R1.
- 28/8/69 Spain E2 and E4.
- 29/8/69 Sweden E4, West Germany E4.
- 30/8/69 USSR R1.

The Trops have once again been very indifferent with a number of small openings but not much really worth noting. I feel rather ashamed in mentioning it as I am not a “head-hunter” for new local stations in the British Isles but I did in fact log the new low-power BBC-1 relay on B1 at Weymouth at least 30 miles from here! Big deal! Still I suppose that we must be grateful for what we receive under poor conditions!

NEWS

Big news at last about Bulgaria. You will recall that I mentioned test card G as being seen on Ch. R2 and suggested that it might be Bulgaria. We now have some confirmation. Roger Bunney has heard from the Bulgarian Radio with a photo of this card and stating that they are using it, but unfortunately at this stage there is no further information about the transmitters involved.

Roger Bunney received it on 16/6/69 and we have a second claim from Doug Bowers of Saltash who had it on the same day and about the same time, 18.04. He notes that the test card was preceded by small black squares so now we know what to look for. I for one have been concentrating on Ch. R2 but with no joy so far. I suggest that the best time would be during any opening to Rumania, but we seem to have had few of these recently.

Just in case you missed it in the Sunday press earlier in August it was stated via the Icelandic Embassy that TV there was “closing down for five weeks holiday during July and August”, exact dates not given. So if anyone was struggling unsuccessfully for it this may have been the reason and I suggest some caution before anyone jumps to the conclusion that they got it particularly as West Germany uses the same type of card on E3 and E4.

Albania is building a new TV centre in Tirana and they are likely to be spending a considerable amount of money on this. It seems reasonable to suppose that high-power transmitters must be under consideration and as Tirana is already on R2 with very low power it may well be that there will be a high-power one here in Band I in the not too distant future which could mean a “new” country for us.

Our old DX friend Maurice Opie married recently and I am sure that you will all wish to join with me in wishing him and Thelma every happiness. They are living in Ringwood, Hants, not far from here in Bournemouth so the DX should be pretty good there too.

—continued on page 90

Faults of the **DEVIL**

TELEGENIC

NINE out of ten of the faults that develop in electronic equipment—whether it be radio, television, or whatever—are easily solved by the application of straightforward servicing techniques. They are easy because the expected has usually happened; one of the common faults for that model has developed, or the results of a fault are obvious.

The remaining one in ten faults is that which seems to defy solution. The service engineer can spend days searching for the obscure component or device failure and so often when it is found the engineer will undoubtedly have checked the same thing before. If this is so there must be something wrong with the system used for checking.

The most difficult faults are those that are caused by servicing. These vary from the wire left off after checking a component to wiring errors put in by another engineer. When presented with such a mess some people get down to the matter in an orderly way and given time and sometimes a great deal of patience can cure the fault. Others seem to develop an illness that I would like to call "Faultissima" which in its advanced state has symptoms not unlike those of a mad cat. Those afflicted chase their tails, grit their teeth, become very bad tempered and do themselves and objects around them some damage. When the object damaged is the subject of the repair the process becomes increasingly more difficult.

Tracking down the obscure fault needs a particular type of man and has led to many smaller radio and TV dealers passing difficult faults to specialised repairers. This system is expensive to the dealer but often cheaper than employing a more skilled serviceman for the odd "devil" receiver.

However, the servicing of any piece of equipment remains the same whether the fault is simple or not. A process of isolation must first take place. Much has been written on this and it is not proposed to repeat it here. Then when the particular stage where the fault is occurring is located it may be necessary to check every component in that stage. It's the limitations of normal checking procedures however that are usually the cause of difficulties and frustration so it may be useful to deal with some of these.

Resistor Checks

The value of a resistor is not of course correct merely if the colour coding is right. A simple ohmmeter will show the value accurately enough for most servicing although very large and very small resistors may require more expensive equipment. Even when replacing resistors in a difficult job it is advisable to take the few seconds necessary to check the values. It is not unknown for new resistors to be open-circuit or to be incorrectly colour coded.

Never replace a resistor that has shown signs of overheating without finding the cause. This is often due to voltage errors or an associated capacitor failure.

The tolerance of any replaced resistors should be equal to or higher than the original.

Many heat or intermittent faults are due to resistance value changes. The only way to overcome such a fault is to replace where thought necessary.

Capacitor Checks

Capacitors may show open-circuit or short-circuit on an ohmmeter if faulty. If they check OK however it may only be that the voltage source in the meter is insufficient and that they are faulty at the normal operating voltage. Checks may be made by the use of a Megger or by replacement.

Capacitor leakage is a relative term and its importance depends on the circuit position in which the capacitor is used. In some locations a large leakage may have little effect while in others only a small leakage may upset circuit conditions. Again substitution is often the only fair test.

Capacitor values can only be exactly checked on a bridge and substitution is usually far quicker than measurement.

The well-equipped workshop should have a good range of capacitors available especially for substitution checks.

Coils and Transformers

A d.c. resistance check does not confirm that a coil or transformer is OK. A single short-circuited turn which would be undetectable on a resistance check may often prevent correct operation. The only reliable way of checking is by substitution but as this is sometimes expensive it is often better to check the rest of the circuit completely before coming to the decision that it must be the transformer.

Valve Tests

A valve tester check is usually sufficient to pass or fail a valve although in some sensitive r.f. positions interelectrode capacitances may be critical and these are not indicated by such a check. Also some valves cannot be tested on a tester.

In most cases it is quicker and easier to replace a valve with a *known* good one. If a valve is found to be faulty it should be disposed of: it is pointless having a cupboard full of unusable valves. Occasionally it is found that a valve will operate correctly in one position but not in another. If it is kept for the former purpose it should be clearly marked so that frustration at a later date is avoided.

Transistors

D.C. checks with an ohmmeter are usually but not always sufficient to check a transistor. In some cases substitution is the only sure method—again with a *known* good device.

General Advice

We have seen then that there are a number of limitations in testing components. It should always

—continued on page 90

fault finding FOCUS

S. GEORGE

WAVETRAPS

WAVETRAPS are vital in television receivers, particularly in the early i.f. circuitry, to ensure freedom from adjacent channel signals and to tailor the overall frequency response. Without their inclusion amongst the tuned coupling circuits it would be virtually impossible to provide the required vision bandwidth within the channel spacing.

On v.h.f. the video frequencies extend to 3MHz with the cosound carrier transmitted 3.5MHz below the vision carrier: these signals must be contained within a 5MHz channel width. On u.h.f. the video frequencies extend to 5.5MHz with the f.m. cosound carrier transmitted 6MHz above the vision carrier, all within an 8MHz channel width. Wavetraps are therefore essential to prevent sound and vision signals from adjacent channels filtering through with the wanted signals.

Wavetraps, which are a selective form of filter, can remove an unwanted frequency in one of two ways, either by acting as a high impedance to it in series with the signal feed or by acting as a low-impedance shunt across the circuit.

Filters generally can either remove or pass a particular band of frequencies and vary widely in design according to their application. If the rejection or passband is centrally placed, filtering will be by an LC wavetrapp circuit: if on the other hand attenuation at only one extreme is needed simple RC combinations often suffice.

As examples, to remove the intercarrier sound from a video stage requires a 6MHz trap sufficiently

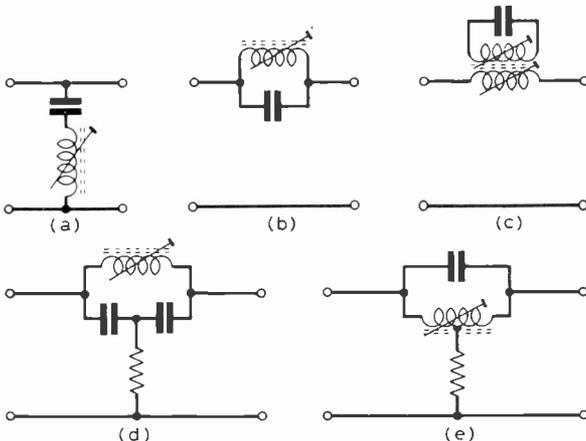


Fig. 1. Five types of wavetrapp widely used in television receivers: (a) Acceptor, (b) rejector, (c) absorption, (d) and (e) bridged-T types.

selective not to attenuate the higher video frequencies and an LC wavetrapp circuit is used for this purpose. To remove all video content from the potential tapped from a sync separator grid and leave only the mean d.c. voltage for a.g.c. bias requires a simple RC low-pass filter. A high-pass filter however is required at the input to a colour receiver chrominance amplifier to attenuate the video signal up to the lower 4.43MHz subcarrier sidebands: both RC and LC circuits are used for this purpose. High-pass and low-pass are thus relative terms—what may be the high frequencies in one filter may be the relatively low frequencies in another.

Wavetraps can broadly be divided into four categories: acceptors, rejectors, absorption and bridged-T types. These are illustrated in Fig. 1.

Acceptors consist of a series LC combination which offers minimum impedance at its resonant frequency and is therefore simply shunted across the signal circuit to short out the unwanted signal to which it is tuned. The impedance of a series LC circuit equals the difference between the reactance of its capacitor X_C and the inductive reactance of its coil X_L , since they are in opposition. At resonance X_C equals X_L so that the total impedance of the combination equals only the coil's d.c. resistance of a few ohms.

Rejectors consist of a parallel combination offering maximum impedance at its resonant frequency and therefore generally placed in series with the signal feed. Again at resonance X_C equals X_L but as the capacitor takes a current leading the applied voltage by 90° while the coil passes a current lagging it by 90° a mutual current interchange—a circulating current—develops between them requiring only a small "make-up" current from the supply to compensate for I^2R losses. The circuit therefore appears as a high impedance of value QX_L or L/Cr (r is the d.c. resistance) which is generally referred to as its dynamic impedance and can be many thousands of ohms. Although rejectors are usually placed in series with the signal feed they may be placed partially in shunt with a circuit if their high impedance results in negligible potential being developed across the low input impedance of a valve or transistor.

Absorption wavetraps consist of a series LC combination inductively coupled to a coil carrying other frequencies. The trap attenuates or absorbs the energy induced in it by functioning as a load at its resonant frequency only.

The bridged-T type of attenuator consists of an LC arrangement using a centre-tapped inductive or capacitive arm connected by a resistor to chassis. They have sharper selectivity and thus greater rejection at the unwanted frequency than simple acceptors or rejectors.

An extra contact on S1, S2 earths either S1b or S2a depending on which system is in use.

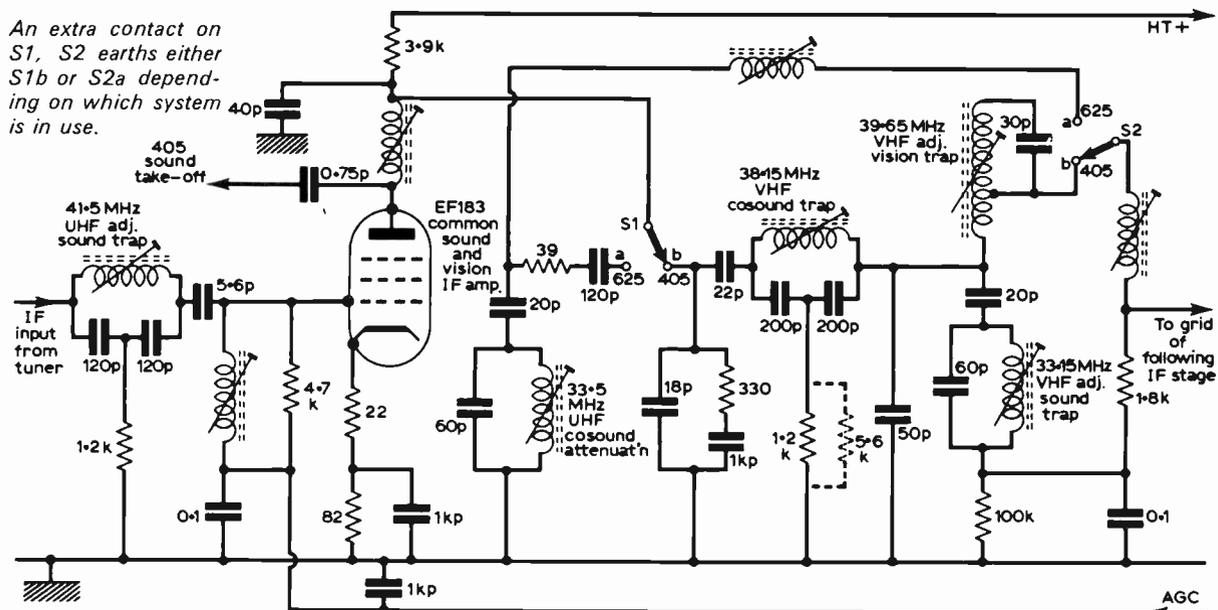


Fig. 2. I.F. wavetraps circuitry of a typical dual-standard valve receiver (STC VC3 chassis).

With all types of wavetraps the resonant frequency is given by the formula f (MHz) = $159.2/\sqrt{LC}$ where L is in μH and C is in pF. With any combination doubling the inductance and halving the capacitance retains the original resonant frequency since the LC product is the same, but greatly improves the Q and therefore the selectivity by improving the L/C ratio.

Practical Circuits

In practical television circuits a simple acceptor may be combined with a bridged-T type to form one complete unit, or individual traps may provide rejection of one frequency on v.h.f. and another on u.h.f. by having an additional capacitor brought into circuit by the system switching. Additionally acceptor coils may be shunted with capacitors to broaden their response and/or to function as a rejector at another frequency. It is thus often necessary to refer to the service manual to identify positively their function.

Dual-standard models may incorporate up to seven wavetraps as follows. On v.h.f. one at 33.15MHz to reject adjacent channel sound from the next lower channel, one at 39.65MHz to reject adjacent channel vision from the next higher channel, one tuned to the cosound i.f. of 38.15MHz and placed in the vision circuit to prevent sound-on-vision, and one tuned to the sound-vision i.f. difference frequency of 3.5MHz and placed in the video circuit—usually the video pentode's cathode lead—to reject possible "dot" interference. On u.h.f. the wavetraps consist of one at 31.5MHz to reject adjacent channel vision from the next lower channel, one at 41.5MHz to reject adjacent channel sound from the next higher channel, and one at 33.5MHz—the u.h.f. cosound frequency—to attenuate the sound signal strength to the required level to ensure freedom from vision buzz. This last tuned circuit is an attenuator rather than a "stopper" designed for maximum rejection.

The intercarrier sound is produced at the vision

detector diode where the vision and sound i.f. frequencies produce a difference beat of 6MHz, and to ensure that the sound i.f. amplitude does not exceed the minimum vision i.f. amplitude, i.e., peak white, it is necessary to keep the former at about -24dB down with respect to the latter. If this disparity is markedly reduced irradicable vision buzz will develop.

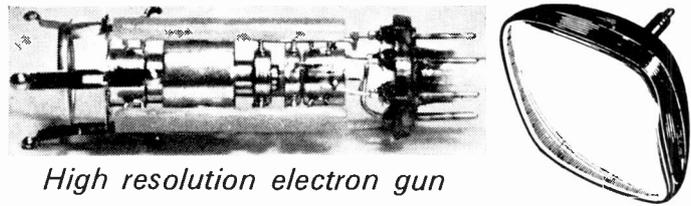
In valved i.f. strips the wavetraps are mostly incorporated between the first common i.f. amplifier and the vision-only i.f. stage as shown in the typical example in Fig. 2.

In transistor i.f. strips, however, the wavetraps tend to be placed mainly between the tuner and the first i.f. stage. This is principally due to the fact that transistors are more prone to cross-modulation than valves so that if the signal strength is sufficient to produce this effect no amount of subsequent tuned-circuit rejection will remove the unwanted frequency. Adjacent channel signals are therefore removed at low signal levels, very often immediately after the tuner. A clear example is the wavetraps circuitry between the tuner and i.f. strip in the Decca "Professional 23" model: this was shown in the July issue of PRACTICAL TELEVISION, page 471. The following three-stage vision i.f. amplifier and two-stage sound i.f. amplifier are free of further traps except for 3.5 and 6MHz absorption-type traps coupled to the output of the vision phase-splitter transistor following the detector.

Tapped Rejectors

Many rejector wavetraps are connected into circuit via a tapping on the coil. This is done to maintain rejector Q by reducing the effect of circuit loading and/or high stray capacitance, and is particularly useful when the trap is in the cathode lead of a video output pentode. The comparatively high capacitance existing between the valve cathode and chassis is then applied only across a section of the trap coil.

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Resistive Balancing

Several models employ bridged-T rejectors with a variable resistor as the top signal link, maximum rejection being obtained when the circuit is electrically balanced. Figure 3 shows an example.

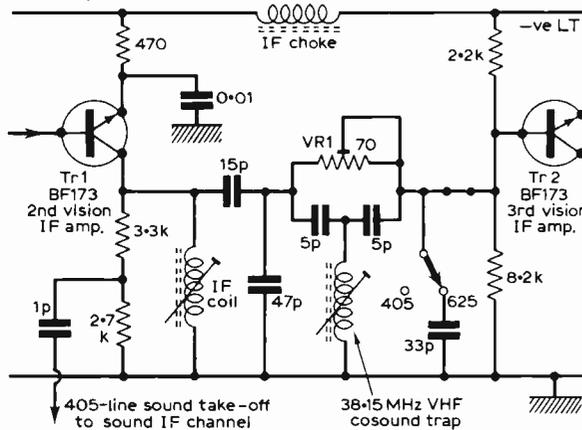


Fig. 3. Bridged-T cosound filter adjustable by VR1 for optimum rejection (Pye 368 chassis).

This is incorporated between the second and third vision i.f. transistors in the Pye 368 series and is tuned to the v.h.f. cosound frequency of 38.15MHz. On u.h.f. a 33pF capacitor is switched in parallel with the coil to tune it to a very low frequency and render it ineffective.

Video Rejectors

Most video circuits today include traps to prevent the 3.5MHz v.h.f. beat and the 6MHz u.h.f. inter-carrier beat reaching the picture tube.

Unless the intercarrier sound signal is routed through the video pentode for further amplification the usual place for such traps is the video output valve's cathode lead. There are two reasons for this. First the potential developed across them results in considerable negative feedback at the resonant frequency to increase the rejection. And

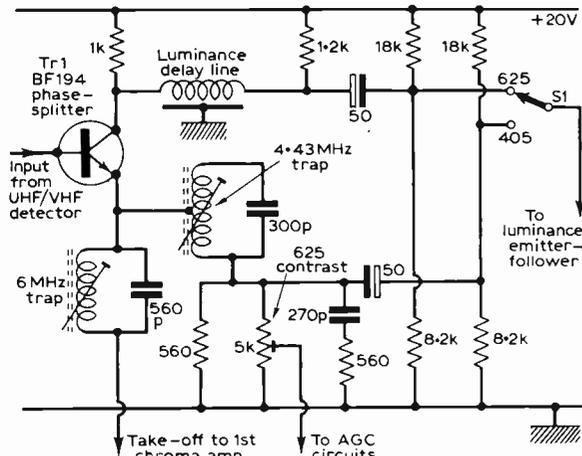


Fig. 4. Video phase-splitter used in GEC colour television receivers. The chroma signal developed across the 4.43 MHz trap causes heavy negative feedback at this frequency preventing the signal developing across the collector video load.

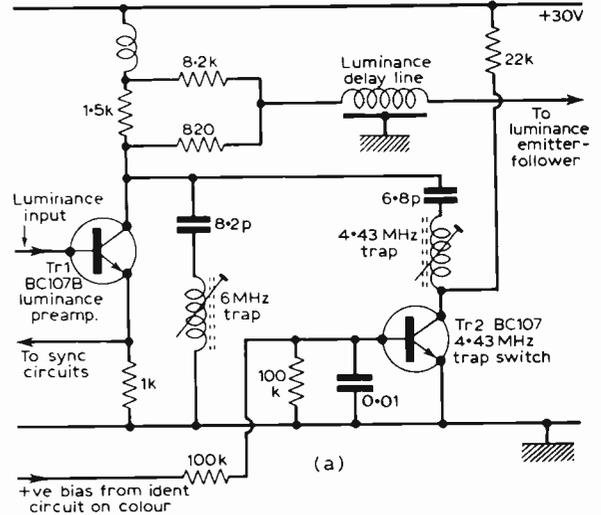


Fig. 5(a): Switched 4.43MHz trap used in the BRC 2000 chassis. On colour forward bias is applied to Tr2 which bottoms so that the trap is brought into circuit.

secondly this position frees the anode circuit from additional capacitive loading.

When the 6MHz signal is extracted after video stage amplification the anode tuned circuit across which it is developed acts as a series rejector to prevent its intrusion into the video load.

Colour TV Rejectors

The luminance stages of colour television models also incorporate 3.5MHz and 6MHz traps but in addition include a 4.43MHz trap to reject the chroma subcarrier and, in many models, another tuned to 1.57MHz, the difference beat between the subcarrier and the f.m. sound signal. The 4.43MHz subcarrier trap is often placed in the emitter lead of a first luminance transistor stage arranged as a phase-splitter. The 625 luminance output is then tapped from the collector and the 405 luminance output from the emitter. As a result on colour the 4.43MHz signal is present at the emitter, the stage acting as an emitter-follower feeding the chroma amplifiers in the decoder, while the 4.43MHz signal is cancelled at the collector to avoid 4.43MHz patterning in the luminance channel.

An example of this arrangement is shown in Fig. 4 as used in GEC colour television models. A single unswitched vision detector diode gives a positive-going output on both systems to the base of Tr1. Output in the correct phase is then taken to the luminance stages from the collector or emitter via the system switch S1. The 4.43MHz trap in the emitter lead develops the chroma component of the composite picture signal which is then fed via a 6MHz trap to the first chrominance amplifier stage in the decoder.

Subcarrier rejection at 4.43MHz will also attenuate the Y (luminance) information at this frequency on monochrome, so some makers incorporate an electronic switching arrangement to render the trap ineffective on black-and-white. Two examples are shown in Fig. 5.

The first, used in the BRC fully-transistorised chassis, employs an acceptor 4.43MHz trap connected between the collector of the luminance ampli-

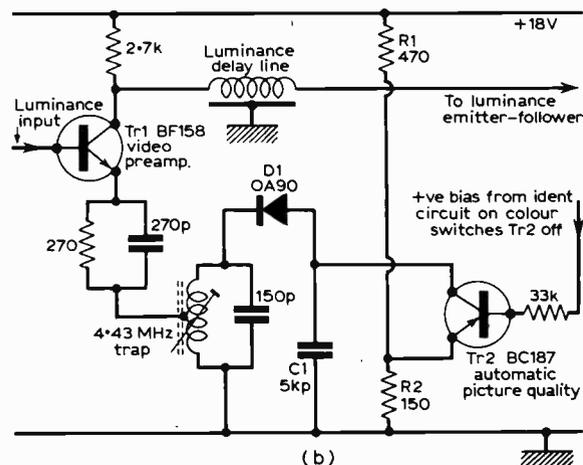


Fig. 5(b): Switched 4.43MHz chroma subcarrier trap used in the Decca CTV25 colour receiver.

fier Tr1 and the collector of the trap switch transistor Tr2. On monochrome Tr2 is nonconductive, receiving no forward bias, so that it constitutes a high resistance and renders the series trap completely ineffectual. On colour reception however a positive bias derived from the ident circuit drives Tr2 into full conduction thereby bringing the trap into circuit by completing the path to chassis via the emitter-collector conductance of Tr2. The 6MHz trap is, of course, left permanently in circuit.

The second example is from a Decca colour model. Here the 4.43MHz rejector trap is connected in the emitter lead of the video amplifier transistor Tr1. Tr2 provides the electronic switching action. On monochrome Tr2 is conducting because of the positive bias applied to its emitter by the potential divider R1, R2, and D1 is then forward biased. In this condition D1 and C1 fully damp the trap. On colour reception however a positive potential obtained by rectification of the ident signal is obtained from the decoder and fed to Tr2 base, cutting it off. D1 is then reverse biased and the trap is thus brought into operation to remove the 4.43MHz signal from the luminance channel.

Servicing

The most common defect with wavetraps is broken or jammed coil cores due to the use of fine screwdrivers instead of hexagonal insert trimmers.

As with the main tuning coils, drift is usually negligible and most apparent instances of maladjustment are due to other causes. Vision-on-sound and sound-on-vision are most commonly caused by excessive signal input, an over advanced sensitivity control or insufficient a.g.c., especially to the tuner.

Till proved otherwise the alignment must always be assumed to be within the makers limits, but if it appears that only one or two slugs have been adjusted first positively identify their function and attempt readjustment on a Test Card only and only if using a good outdoor aerial. Although many indoor types in good signal strength areas can give adequate results, they can introduce ghosting, reflections and incorrect sound/vision response which makes accurate realignment impossible even when confined to one or two stages.

SERIES TO BE CONTINUED

FAULTS OF THE DEVIL

—continued from page 85

be borne in mind that one part of a circuit inevitably loads another and that checks should preferably be made with components isolated. In some cases this can be done simply by removing a valve. More often than not however one end of a component must be unsoldered to isolate it. Whenever this is done it is essential that the connection is remade immediately after the check. It is a nightmare to have a piece of equipment presented to you for repair when half a dozen leads are disconnected.

Cracked printed circuit boards and dry-joints are of course possible and these should be checked first if an intermittent fault occurs. Pieces of solder between tags can also cause many faults and one should always view with suspicion a receiver which has signs of more than normal soldering-iron activity in it.

Alignment

It should also be remembered that a considerable amount of servicing time is wasted because a fault is being looked for that is due to poor receiver alignment. This is especially true when the set has previously had faults in the i.f. strip. With the right equipment set-up it takes only a few minutes to check the alignment. Conversely however with poor or even no equipment the practical approach is to leave the alignment well alone. *Never* tamper with the alignment unless you have the right equipment and know-how. ■

DX-TV

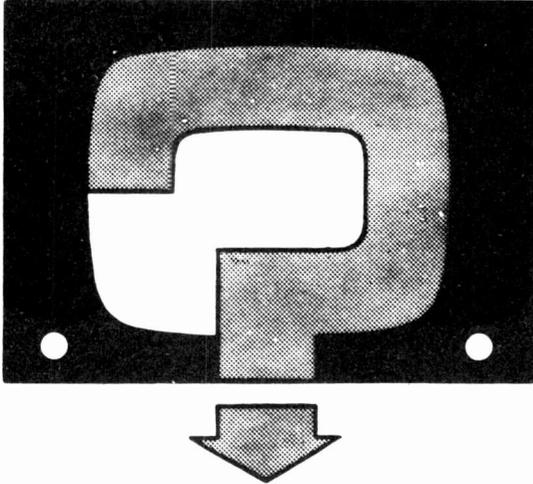
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READERS' REPORTS

A new correspondent, Brenden Rooney of Sligo, Eire, has been DXing for a relatively short time but already his log has Austria, Belgium, Czechoslovakia, Denmark, France, E. Germany, W. Germany, Hungary, Italy, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the USSR and Yugoslavia. He says no Finland and omits Rumania so he is in "the Club": where have these gone to recently? He also reports "rumblings", hum bars and weak 525/625 images in November last and again in May this year. This looks like F2 DX: all very interesting. He has even possibly got Iceland E4, the time 20.32 looks right and so does the test card. Our congratulations.

Another convincing claim for Iceland Skalsfell E4 comes from H. G. Stokes of Salisbury, Wilts. His dates and times of reception tally very closely with my own and he is not far from my location and a little further North. R. L. Yates of Moreton, Cheshire, has certainly got it too; his time of reception and aerial direction are correct—nice work!

My wife and I will be off on holiday on 5/9/69 to ORTF, TVE and RTP land (for the uninitiated France, Spain and Portugal) then all being well to Morocco. I hope to see some of our old favourite stations as "locals" and find out what Moroccan TV is like. It may be a chance at least to see what the test card looks like and I promise not to take photos of it and claim DX from here—even if they only operate in Band III! Still it would be nice to know in case they ever open in Band I.



YOUR PROBLEMS SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 93 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

KB SV30 (IMPERIAL)

The following faults on this set occurred when it was operated in Essex after being used in Yorkshire: Poor focus with the control set at maximum. Weak brilliance which will not turn right down, i.e. completely black, or maximum brilliance. There is poor quality reception with the gain at maximum and there is insufficient line scan on 240-250V and 220-230V. Everything improves when the 200-210V tap is used but line sync is weak. The sound is good on all tappings.—J. Marshall (Yorkshire).

All the symptoms you have given us for your receiver suggest low h.t. voltage. This would not affect the sound output unless it was extremely low.

The h.t. should be measured at the junction of C104 (400 μ F reservoir) and the h.t. smoothing choke (L64). At this point it should be about 230V on the 240/250V position of the mains tap.

If low the components to suggest as suspect would be: the l.f. choke, the smoothing (C103 100 μ F) or reservoir (C104 400 μ F) capacitors, the rectifier (even though it has been replaced) or one of the decoupling capacitors in the receiver across the h.t. line.

It might be a good idea to replace the metal rectifier anyway with a silicon one such as the OA210. These are cheaper than metal rectifiers and much more reliable.

RGD RV215

The picture lost focus and expanded horizontally and vertically when either the brilliance or contrast controls were advanced (all channels). The set was repaired by replacing the DY87 and PL36 valves and a section of the mains dropper which had subsequently burned out. The fault has now reappeared and on checking the voltages on the PL36 I find them to be rather high (-40V on the control grid and 120V on the screen grid). Could these high voltages be due to a faulty PL36 and if so could you suggest a reason for the valve's breaking down so quickly.—R. Page (Essex).

In fact the voltages on the PL36 in your receiver are on the low side rather than too high. Grid one should be at about -60V and grid two at about 200V rather than 120V. The first is understandable because it is in part dependent on the e.h.t. voltage,

but the latter is curious. It could possibly be due to the screen resistor going high-resistance (R141 should be 2.2k Ω) or the screen decoupling capacitor going leaky. It could also be due to the anode current being too low due to a fault here. All these things should be checked.

With such a low screen voltage there would be insufficient anode current and therefore a limit on the amount of current available to the c.r.t. This shows when the brightness or contrast are increased because more beam current is required and to achieve it something must be loaded. Increased raster size, loss of focus, change in pitch of the line whistle and quite often a loss of field hold result from this.

When you have found why the voltage conditions are wrong on the PL36 you may have to replace it again because of the abnormal currents it has been taking.

FERGUSON 306T

The original fault on this receiver was a burnt-out line output transformer. This together with the e.h.t. rectifier (EY86), booster diode (PY81) and line output pentode (PL81) were replaced. This gave good sound and a good raster—except for a shadow on the right-hand side—but the picture was only a vague shadow and impossible to distinguish.—S. Rowley (Birmingham).

It seems unlikely that the fault you now have is tied up with the original line output fault. Your description of the fault suggests a low video level at the c.r.t.—although the c.r.t. itself may be at fault.

As you say the raster is good presumably this means that it is solidly locked both in line and field. If so there must be sufficient video being applied to the sync separator and as this is derived from the video amplifier this too must be OK.

Between this stage and the cathode of the c.r.t. there are very few components. From the anode of the video amplifier (V5 PCF80 pentode section) there is an anti-flutter circuit of C118 (0.1 μ F) and R123 (330k Ω) in parallel and then a bias circuit putting about 125V d.c. on to the cathode. This consists of R128 (150k Ω) between h.t. and the cathode and R129 (330k Ω) between the cathode and chassis. These should all be checked.

On the c.r.t. in your receiver (M/W43-69) the cathode connection is pin 11.

EKCO T164

When a bright picture is on the screen a darker, irregularly-shaped patch about $1\frac{1}{2}$ in. across is seen. On increasing the brightness with such a picture the pitch of the line whistle falls and the size of the picture increases. While trying to trace this fault the U25, U282, 20P1, 20L1 and h.t. boost capacitor have all been either checked or replaced.—J. Morris (Surrey).

Your description of the dark patch on the screen of your receiver suggests a burn mark on the tube face. The only solution to this—if you find it is intolerable—is replacement.

The increase in picture size and change in pitch of the line whistle with an increase of brightness or contrast are all indicative that the e.h.t. is unable to supply sufficient beam current for the c.r.t. This again could be the c.r.t. but there are other, cheaper possibilities.

As you have replaced all the valves in the line output/e.h.t. part of the receiver the things left would be: the voltage-stabilising Metrosil from the final anode cap on the tube to chassis or the $0.001\mu\text{F}$ (13.5kV working) capacitor bypassing it. Both should be checked.

Unfortunately the c.r.t. used in your receiver is obsolete—15 in. Ediswan (Mazda) CRM152A. However one of the advertisers in PRACTICAL TELEVISION may still be able to supply one or suggest a replacement type.

MURPHY V310

There is no e.h.t. and no line whistle. All the valves and the tube light up and the sound has remained normal. There is no spark from the top cap of the U26 and no spark from the anode of the tube.—W. McDonald (Glasgow).

Your fault appears to be in the line output transformer. We regret that there is no simple way of testing this other than substitution since the line timebase in the V310 is a single-valve stage using the line output transformer to provide the feedback for oscillation.

FERRANTI 17K5

The picture is full width across the screen but only about one inch high. What can be seen is very clear and any words shown can be easily read. This narrow picture does answer to contrast and brightness controls but height, horizontal controls and ion trap magnet have no effect at all. A spark about half-an-inch long can be drawn from the top cap of the EY86 and also from the PL81 and PY81, but from the tube anode just a very small spark.

When the fault first appeared this is what happened: The picture split into two halves with a broad black band down the middle and changing over the ECL80s made no difference at all. I put in two new ECL80s but no improvement was noted. I then thought that the components in the field timebase were at fault and changed a few resistors and one capacitor. On switching on after these repairs the above fault appeared.—C. Hoare (London).

We suggest that you check the $500\mu\text{F}$ capacitor which is in series with the field deflector coils. A quick test is to short it out and note the effect on the screen. Also check the $270\text{k}\Omega$ resistor in series with the height control.

PYE VT17

The picture appears to be one-third of the bottom section shown on the top of the screen. The set has been checked as regards valves against a service sheet. Both hold controls are in good condition and the sound is of good quality.—E. Healey (Wiltshire).

The trouble you describe is best found with an oscilloscope. We assume that you have checked the PL83 and ECC82 field timebase valves by substitution in which case we advise you to look for leaky coupling capacitors in those stages, together with faulty mains smoothing. This latter is readily checked by bridging each electrolytic in turn with one known to be good.

MURPHY V250C

I cannot obtain sufficient brightness. The picture is discernible but very dim. Sound is perfect.—H. L. Collins (Huntingdon).

Suspect a weak tube but check the setting of the ion trap magnet, the h.t. voltage, line output drive, etc.

DEFIANT 172

When switched on and at varying intervals the sound becomes severely attenuated but free from distortion. It can be restored by switching from one channel to the other but will reappear with no definite time interval between occurrences. The vision is in no way affected by this fault.—C. Pedit (Suffolk).

You will almost certainly find that the trouble is associated with one of the sound i.f. transformers. Remove the cans and check for dry-soldered joints at the lead-out tags. Also check decoupling of sound i.f. valve pin 8 to chassis.

PHILIPS 23TG175A

The picture on this receiver has three or four vertical shadow bars on the extreme left-hand side.—R. Butcher (Essex).

This is the symptom of ringing in the line output stage or of velocity modulation of the tube electron beam. The former could indicate trouble either in the line output transformer or line scan coils (or both). It can however also be aggravated by low emission of the line output valve and/or booster diode. Low h.t. voltage is another possibility. The latter would mean that the tube control grid circuit is inadequately decoupled, and this would be proved if connection of an $0.1\mu\text{F}$ capacitor between grid and chassis clears or at least modifies the effect.

PYE CTM17T

When this set is first switched on there is a crackling on the sound. If the volume is increased the sound fades completely and when the picture appears the sound is always absent. The picture remains perfect. I have changed the PCL83 and some of the other valves.—J. Edwards (Yorkshire).

Normally the PCL83 will cause the symptoms you have described although its coupling capacitors should be suspected also. Alternatively check for sound i.f. instability, normally due to the last i.f. stage screen grid decoupling capacitor becoming high resistance. This component is a $0.001\mu\text{F}$ capacitor located inside the small detector can.

EKCO TC313

There is very heavy hum on both channels. I have replaced the main smoothing capacitor but no improvement has been noted. This hum varies in pitch when the vertical hold setting is altered.—R. Kirkwood (Scotland).

The capacitor which could be faulty and causing the trouble is the $16\mu\text{F}$ i.f. strip decoupler located just behind the tuner. Alternatively suspect heater-cathode leakage in one of the 6D2 diodes in the sound detector stages.

FERGUSON 518T

The height of the picture is reduced to about three inches and there are four pictures horizontally. Both field and line timebases are affected. I have changed EB91, PCL82, ECC82, PL81 and PY81 but with no results.—G. Johnson (Lancashire).

The scan coils could be causing the reduced field amplitude (height). There would however appear to be a separate fault in the line timebase since the side-by-side picture effect is caused by the generator running at incorrect speed. It is possible that the two symptoms are related but this need not be the case, depending on how the effects developed.

Check first the field timebase valves and associated components, endeavouring to increase the field amplitude. When you have achieved some results in this direction—assuming that the line fault still exists—check the resistors connected to the line hold control and also the line oscillator valve itself.

ALBA T1135

There is a perfect picture on BBC-1 and ITV but when the set is switched to BBC-2 the picture is too bright and narrow. When the brightness is turned back the picture fills up. When the set is switched back to BBC-1 or ITV the brightness has to be turned up to receive a viewable picture.—J. Mulligan (Scotland).

We would advise you to replace the PL83 video amplifier valve, change C255 to $0.15\mu\text{F}$ and R248 to $150\text{k}\Omega$ (approximate value).

RGD PORTABLE (STC VC11 CHASSIS)

The PL81 line output valve overheats and its grid goes red hot. I can measure no voltage at the grid.—D. John (Wales).

We suggest you replace the PCF802 line oscillator valve V12. Check its associated components if necessary.

QUERIES COUPON

This coupon is available until November 21, 1969, and must accompany all Queries sent in accordance with the notice on page 91.

PRACTICAL TELEVISION, NOVEMBER 1969

TEST CASE



84

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 symptom on a Cossor Model 1972A was slight foldover at the top of the picture resulting in the display of the BBC's interfield test pulses. The fault was put down to a slow field retrace and tests were made of the field timebase valve (checked by substitution), the time-constant components in the vertical oscillator circuit, the feed components to the oscillator anode, the electrolytic capacitor at the cathode of the output valve and the components in the negative feedback linearity correcting circuit, but to no avail.

The symptom could be masked by increasing the vertical amplitude—there was a fair scope of adjustment here—and by misadjusting the linearity preset, but these palliatives tended to impair the linearity towards the bottom of the picture—causing the scan

lines progressively to open—and cut off information at the top of the picture.

It was also noticed that the field buzz could be heard more distinctly than hitherto from the speaker as the vertical hold control was adjusted.

What component so far not tested could have been responsible for this symptom. See next month's PRACTICAL TELEVISION for the answer and for a further item in the Test Case series.

SOLUTION TO TEST CASE 83 Page 45 (last month)

As the trouble on the Ferguson set was obviously of video origin the voltage at the cathode of the video amplifier was monitored. With the contrast control set to its normal position the meter read about 4V—increasing with more advanced settings of the contrast control as would be expected. However when the symptom occurred the cathode voltage jumped to around 10V and the screen grid of the pentode section appeared to be running red hot. This effect is not uncommonly caused by the i.f. channel going unstable and oscillating, the oscillation being rectified by the vision detector and pushing the valve hard into anode current. However this time the fault was caused by the small grid inductor going open-circuit and thus cutting off the cathode-derived grid bias. This of course requires the grid circuit to be returned to chassis: the open-circuit choke prevented this, thereby causing a significant rise in cathode current and hence cathode voltage.

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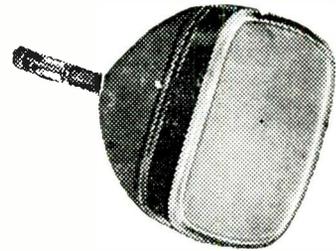
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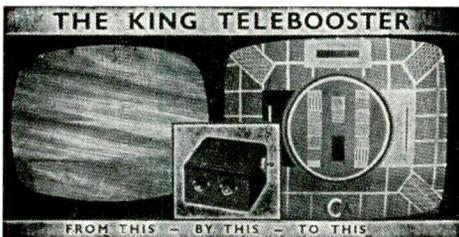


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