PRACTICAL

TELEVISION

3/6

MAY 1970

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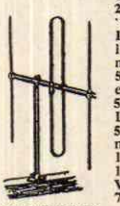

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PRACTICAL
TELEVISION

VOL 20 No 8
ISSUE 236

MAY 1970

CONSTRUCTIONAL PROBLEMS

READERS of Practical Television are a pretty loyal bunch; so are the staff of the magazine. And there are times when in the common effort it behoves both staff and readers to bear with each other. The cause of this heart call is the single-standard TV receiver we launched in the March issue, with three motives in mind: (1) as an academic exercise for readers who like to investigate circuits and their applications, (2) as an ideas source for the experimenter who may wish to develop his own ideas around sections of the P.TV. design, and (3) as a complete constructional project for those wanting to build a first-class modern receiver.

We have quite frankly been overwhelmed by the number of readers falling into the third category! And the suppliers of the i.f. panel have likewise been taken by surprise by the demand. Consequently supplies have run short (large quantities of these i.f. panels have already been shifted). To add to the trouble the suppliers (Manor Supplies) are now in the process of moving premises. Some readers will therefore be subject to delay and for this everyone concerned offers their apologies. New supplies *will* become available, although these may not necessarily be exact replicas of the units used in the prototype. We will keep readers informed of the situation.

The manufacturer and supplier of the special mains transformer was inadvertently given as Olympic Electronics Ltd. This should have read Olympic Transformers Ltd. (at the address given correctly in the March issue). We apologise to readers and to the two companies concerned for any inconvenience this slip has caused.

We have also been asked to mention that the line output transformer is in stock at D. & B. Television (Wimbledon) Ltd., 80 Merton High Street, London, S.W.19. Finally we would like to mention that the complete chassis metalwork is now priced at £6 17s. 6d. including postage and packing (from the supplier mentioned).

Most of the trouble has been due to our aim to make construction of the receiver as easy and inexpensive as possible, which means using surplus units (such as the tuner and i.f. strip). Unfortunately these items not being catalogue pieces are liable to become in short supply. We are doing our best to remedy the situation and hope that readers will understand the difficulties.

W. N. STEVENS, *Editor*

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TELETOPICS

RESULTS FOR 1969

With colour television set deliveries at 25,000 for December the total for 1969 rose to 154,000, an increase of 27 per cent over 1968. Monochrome set deliveries for December were 143,000, bringing the total for 1969 to 1,673,000, a fall of 5 per cent.

On the radio side 1969 was a poor year with radio set deliveries down by 28 per cent, car radio deliveries down 12 per cent and radiogram deliveries down 11 per cent.

PLASMA DISPLAY SYSTEM

Fujitsu Ltd. of Japan in conjunction with the University of Illinois have recently developed a thin, bright and cheap plasma (ionised gas) display system which may be the forerunner of a new generation of display devices for computers, television sets and other electronic applications. The arrangement consists of a combination of three sheets of glass panels with two internal gaps filled with a mixture of 95 per cent argon and 5 per cent nitrogen gas and is about a centimetre thick. Plus and minus electrodes are attached to the outer panels to ionise the gas and a small hole in the middle panel is thus illuminated to produce an image which is claimed to be twice as bright as the average c.r.t. display.

GEC-SOBELL SERVICE PHONE

The GEC-Sobell radio and television service department at East Lane, Wembley, Middx. has been given a new telephone number—01-904 0171.

FRINGE UHF AERIAL FROM AERIALITE

The SP50 Golden Gain Supreme, a fringe u.h.f. array, is the latest addition to the Aerialite range of aerials and features a very distinctive design. A pair of folded dipoles mounted in the same plane and carefully spaced and dimensioned is used for increased gain in combination with a precisely calculated director structure consisting of sixteen directors of S configuration. The aerial can be seen illustrated on page 360. The S form of the directors when incorporated into a scientifically designed director chain not only ensures the correct phasing to increase the gain and capture area but also increases the total bandwidth percentage. The mesh-type reflector is aperiodic—non-resonant—across the bandwidth to improve the bandwidth characteristic, the placing and dimensions of the holes and slots playing an important part in these anti-resonance characteristics. The recommended retail price is £6. Aerialite Ltd. are at West Heath, Congleton, Cheshire.

US SATELLITE TV

Details of domestic satellite television transmission experiments being carried out in the US have been announced by the US Corporation for Public Broadcasting. NASA have agreed to the use of satellite ATS3 for these tests which involve transcontinental programme transmissions. The aim is to investigate the technical problems and costs involved.

BATC 1970 CONVENTION

The two-day British Amateur Television Club convention to celebrate the Club's 21st Anniversary is being held at Churchill College, Cambridge, on July 25th-26th. The convention is primarily intended for BATC members but a warm welcome will be extended to anyone interested in amateur television. Those interested should write to D. S. Reid, 71A Rose Valley, Brentwood, Essex.

SENSITIVE PLUMBICON TUBE

A new, sensitive 1in. Plumbicon tube for industrial CCTV use is announced by Mullard. The type XQ1071 tube gives acceptable pictures under normal lighting conditions, avoiding the need for the floodlighting often required with vidicon tubes. The XQ1071's rapid response greatly reduces smear when the camera is focused on moving objects. Resolution is 600 lines, focusing and deflection magnetic, maximum operating voltage 1,100V, heater supply 6·3V at 95mA and capacitance between target and other electrodes only 4·5pF. The XQ1071 is intended for monochrome cameras but other versions suitable for use with red, green and blue light are available.

STEPS AGAINST PIRATE TV

W. European countries have been preparing plans to curb the intentions of pirate TV broadcasters to transmit from a plane circling over the North Sea. John Stonehouse, Minister of Posts and Telecommunications, has stated that concerted action would include withdrawal of aircraft registration, denial of airport facilities and legal measures against the individuals involved. Assurances of cooperation have been received from every W. European country within practicable flying distance of the North Sea.

TV LINK TO AUSTRALIA

A permanent live TV picture link to Australia has now been opened via satellite to a station at Ceduna, South Australia. The signal path is via the Goonhilly station to the Indian Ocean Intelsat III satellite.

NEW COLOUR SETS

ITT-KB have redesigned their range of two single-standard colour receivers. The new models, the CK403 and CK405, now have an American walnut cabinet and restyled control panel. The receivers are technically identical to their predecessors the CK401 and CK402. The CK403 has a list price of £287 12s and the CK405 £304 15s.

The BRC has introduced its first 22in. colour set, the HMV Colourmaster Model 2704, which is fitted with the Thorn/BRC 3000 single-standard colour chassis. Finished in walnut veneer and incorporating the Mazda A55-14X Rimguard shadowmask tube, the recommended price is £275 3s.

ITV FROM WALTHAM & WENVOE

The full ITV programme service on 625 lines with colour started from the Waltham transmitter in Leicestershire on February 28th, carrying the ATV programmes on channel 61 (group C receiving aerial) with horizontal polarisation. The effective radiated power is 250kW omnidirectional.

The Wenvoe u.h.f. service started on April 4th on channel 41 (group B aerial horizontally polarised) carrying Harlech programmes.

REDIFFUSION DIAL-TV EXPORT ORDER

Rediffusion have received the first export order for their dial-a-programme cable TV distribution system, from the Leghorn Corporation of Boston, Massachusetts. The initial installation will have a 36-channel capacity which can be expanded to meet consumer demand.

NEW LOW-COST SCOPE

Mitre Electronic Products of 22 Powis Terrace, London W.11 have introduced a new oscilloscope type EA0669-2 at only £29 15s. 0d. Features include: 2¾in. diameter tube; d.c. to 100kHz Y-amplifier bandwidth; calibrated Y attenuator giving deflection sensitivities of 100mV/cm., 250mV/cm., 1V/cm., 2·5V/cm., 10V/cm., and 25V/cm.; a.c. or d.c. input coupling; automatically synchronised timebase with four ranges (plus off) from 100mS/cm. to 10μS/cm.; X-input facility and suppressed flyback. The all-metal case measures 6¼ × 6¼ × 10¼in.

VIDEO TRANSISTOR

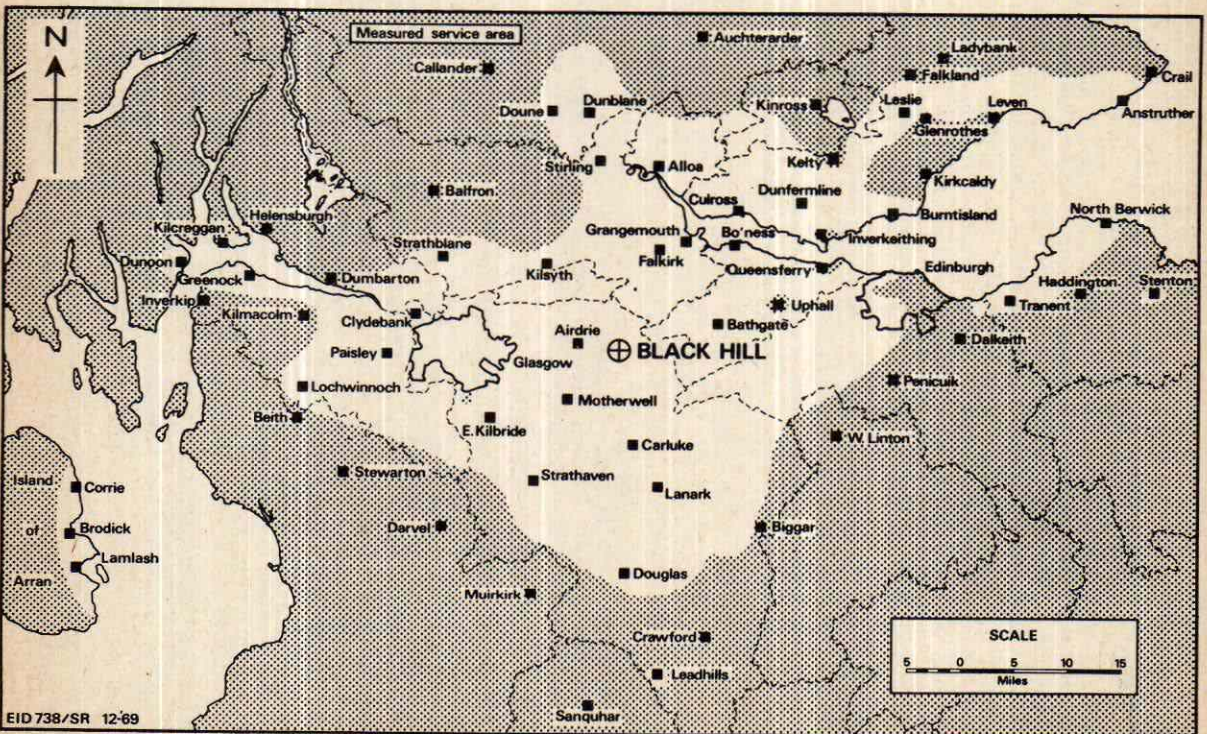
Jermyn Industries, Vestry Estate, Sevenoaks, Kent, announce the availability of the General Electric D40N 300V npn video output transistor. The transistor is suitable for other TV applications and for such uses as video drive for oscilloscopes and high voltage regulation circuits.

THIN-FILM VIDEO AMPLIFIER

ITT Components Group Europe have introduced a thin-film integrated-circuit video amplifier designed by the BBC to meet the need for a miniature video and pulse output amplifier for driving a 75Ω load. The output impedance is less than 100mΩ and the input impedance—which can be increased by applying bootstrap feedback—greater than 15kΩ. Gain is determined by the external feedback connections, direct connection giving 6dB gain and a 220Ω resistive connection 12dB gain.

BLACK HILL UHF TV SERVICES—625 LINES AND COLOUR

Horizontal polarisation
Group B aerial



The above BBC map shows the approximate service area of the Black Hill transmitter. Small pockets of poor reception too small to be shown in this map may be experienced. Channels: BBC-1 40, ITV 43, BBC-2 46.

SURPLUS IF PANEL for the constructor

DAVID ROBINSON

THE receiver described in my article *A Constructor's 625-line Receiver* in the January issue was built about two years ago. Since then the Thorn conversion panel used in the set has become difficult to obtain. However another excellent conversion panel, made by GEC, is now available from Manor Supplies, price 32/6 (plus 4/6d post and packing). The panel was originally used on the Sobell ST282DS/GEC BT452DS series. This article describes how to use this panel and also how to improve it considerably in two respects, namely sound quality and d.c. restoration.

Since the constructor will no doubt already have a 405-line receiver, if this is still required for BBC-1 and ITV in his area it will be assumed that the unit is to be used on 625 only (although its circuits are dual-standard).

TUNERS

The use of a valve u.h.f. tuner is not recommended since not only are they much less reliable than transistor types but as they have a much higher noise level than transistor types the money saved on a valve tuner will have to be spent on the aerial.

There have been at least three types of transistor tuner available. Manor Supplies had two types, an integrated tuner complete with push-button mechanism at £4 10s 0d or the same tuner less the mechanism at £2 10s 0d. The former type is recommended for ease of operation by non-technical families. Radio and TV Components (Acton) Ltd. had a two-transistor u.h.f.-only tuner at £2 10s 0d. This is also continuously tuned but is considerably easier to link to a drive mechanism than the second tuner mentioned. On the other hand unlike the integrated tuners it has no i.f. gain.

You will also need a set of valves for the i.f. strip and an old set to convert. Methods of timebase conversion have been described in previous issues of PRACTICAL TELEVISION.

IF STRIP CONNECTIONS

Figure 1 shows the layout of the various tags on the chassis. These are connected up to the parent receiver as listed under Fig. 2. Also link the chassis to the main receiver by a short, thick cable.

The EH90 heater should be placed near the lower potential end of the heater chain.

The tuner output should be connected to the two-pin socket on the side of the chassis, but be sure to remove the large 5·6kΩ resistor R18 (assuming that a transistor tuner is used). The volume control is connected to the three-pin socket provided—bottom to the braiding and top to the inner of the screened wire and slider to the 47kΩ resistor R96.

TESTING

Having adjusted the main dropper in the receiver to the correct value (easily found by Ohm's Law) the unit may be tested. If the integrated tuner is used

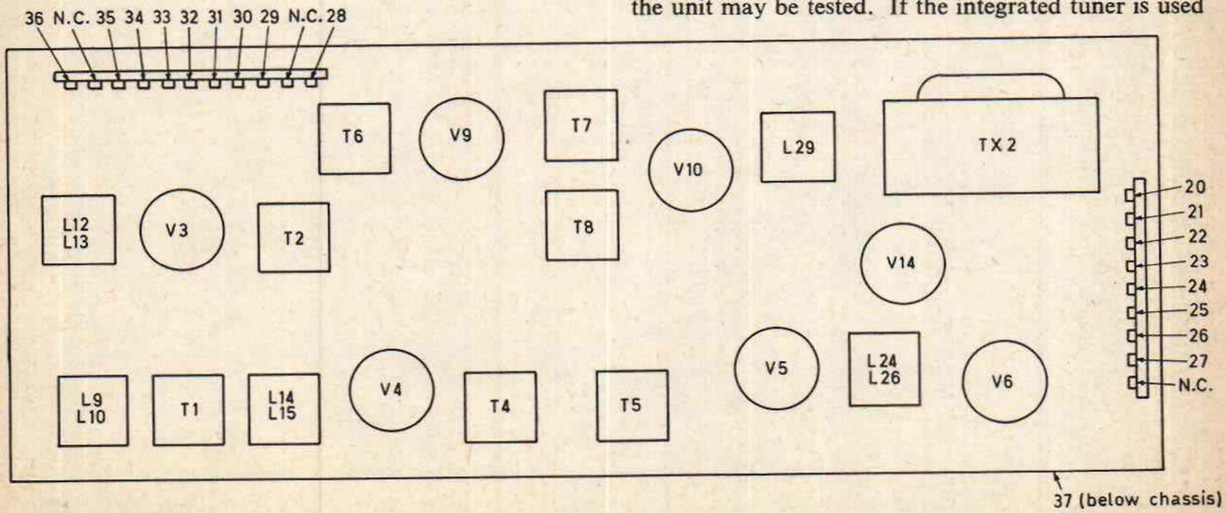


Fig. 1: Top layout of the panel, showing the tag connections.

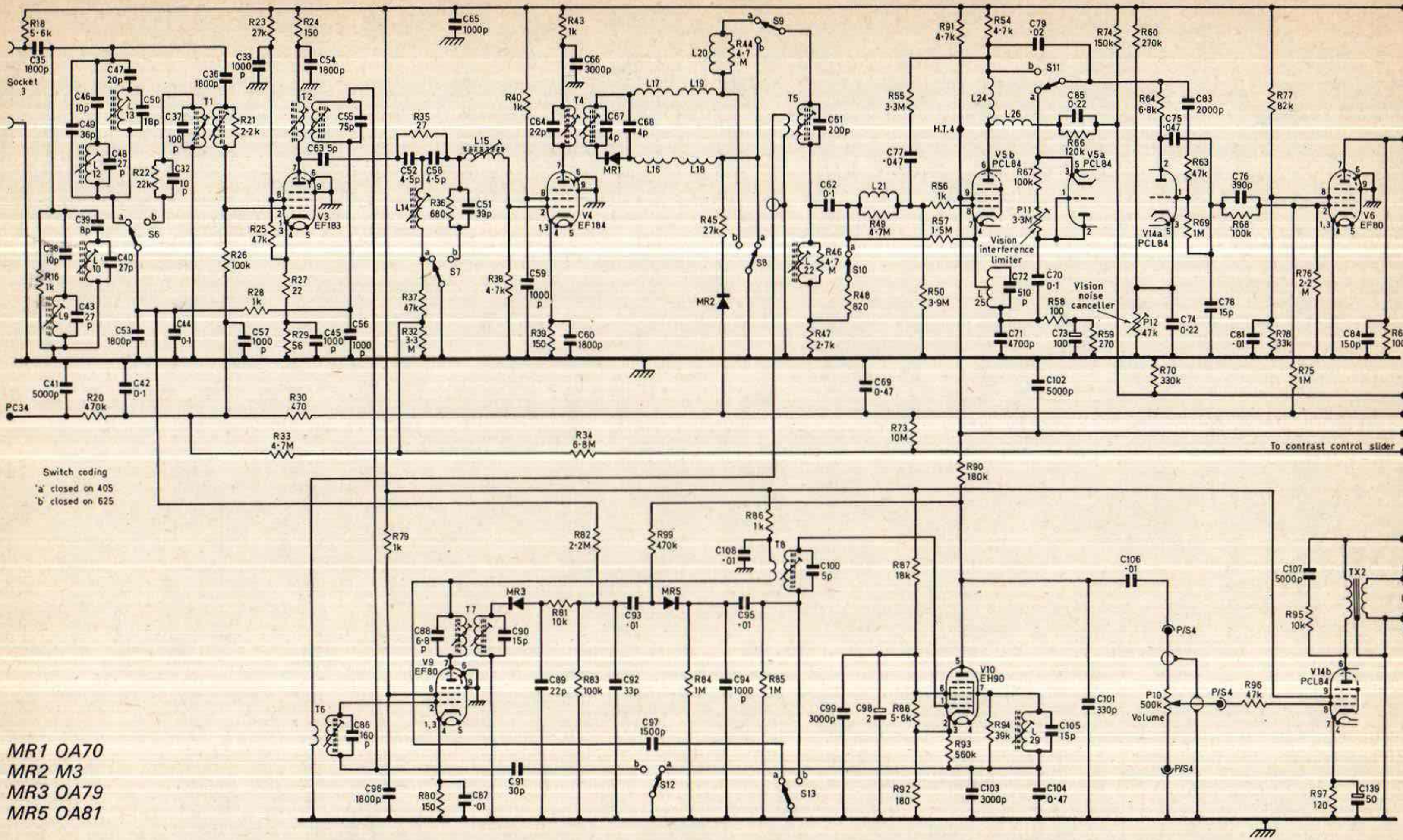


Fig. 2: Complete circuit of the panel before modification. Note that P10 is not supplied with the panel.

Tag number	*Connection*
20, 21	Loudspeaker
22	H.T. (not more than 200V)
23	C.R.T. cathode
24	With 32, EH90 heater (see below)
25-27	Other heaters (low potential end)
28	Not used
29	To 50μF 250V smoothing capacitor
30	Not used
31	H.T.
32	See 24
33	Heaters (high potential end)
34	Not used
35	To slider of contrast control (500kΩ)
36	To 35 via 3·3MΩ
37	To H.T. via 100kΩ and to time-bases (sync feed) via isolating capacitors

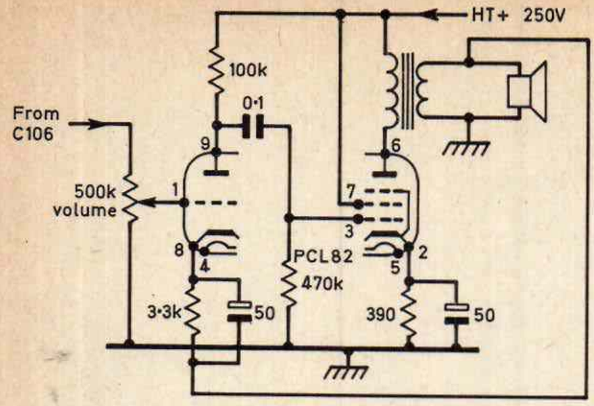


Fig. 3: Suggested audio amplifier circuit.

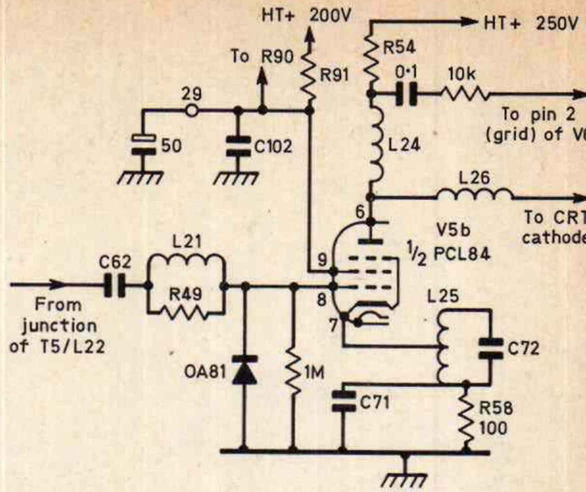


Fig. 5: Modified video amplifier circuit.

the connections are shown in Fig. 7. For u.h.f. the rounded end of the band switch bar should be pushed in as far as it will go. With this type of tuner the set will also work on 405.

The paxolin switch on the i.f. strip should be set towards the input end for 625, but not too far or it will short to its mountings. It is convenient to remove the metal operating bar and fasten the switch in the 625 position with adhesive tape.

It should be stressed that due to the use of band-pass couplings the alignment of this unit is very critical (in comparison to the Thorn unit, unduly so) and no adjustment should be attempted.

MODIFICATIONS

The unit gives a very good overall performance as it stands but at the expense of losing the 405-line facility—which will not usually be required anyway—the performance can be considerably improved as mentioned at the beginning of this article. The space and valve sections necessary for this are made available by dismantling the original interference limiter circuits (V5a and V14a) which I have not found to be necessary even though I live on a main road with my attic-mounted aerial directly facing the road. The entire circuitry from C79 through to C76-R68 inclusive should be removed and pins 1, 2 and 3 of V5 and V14 completely cleared of leads. The video amplifier V5b is then reconnected to the sync separator V6 by means of an 0·1μF capacitor and 10kΩ resistor in series from the junction of L24 and R54 to V6 pin 2.

The unit should then be retested.

DC RESTORATION

This is best done in two stages, first the replacement of the mean-level a.g.c. system with a true signal-level a.g.c. circuit and secondly the necessary changes in the video amplifier.

AGC

The circuit of my a.g.c. system is shown in Fig. 4 together with the necessary changes to the vision detector circuit. Layout is fairly non-critical except that the connections to the 1kpF decoupling capacitor and the OA81 gating diode must be as short as possible or the i.f. strip may go unstable. Although the circuit is quite simple it will provide more than enough control for all reception conditions.

The operation of the circuit is as follows. The required peak level of detector output is set by the contrast control which provides via the detector network a positive bias on the cathode of the OA81 gating diode. When the signal strength is such that the detector output is greater than the preset level

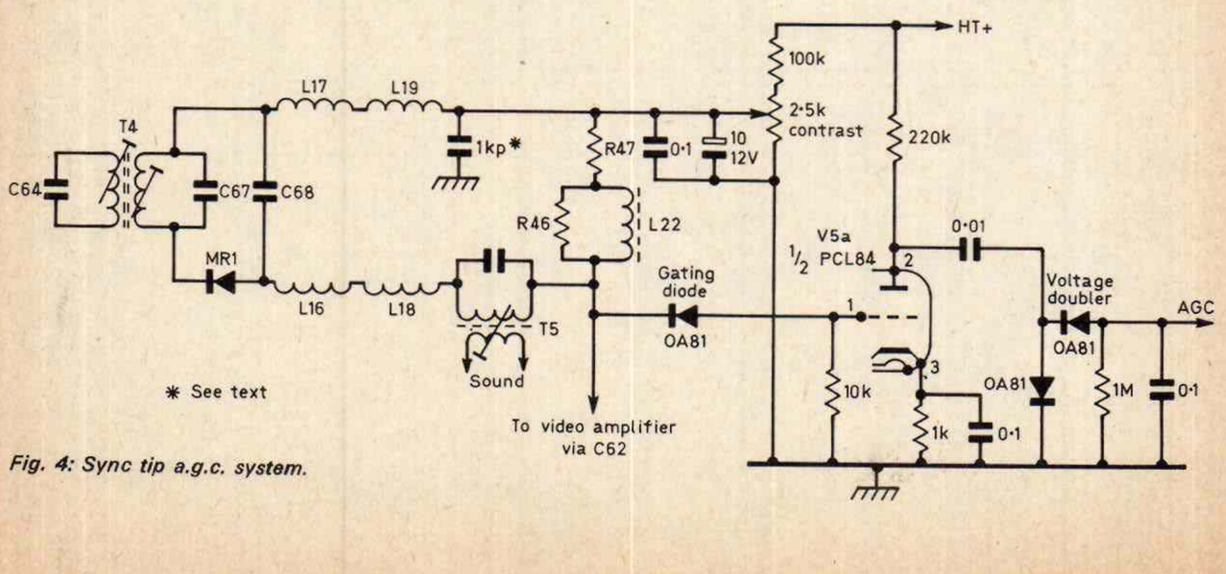


Fig. 4: Sync tip a.g.c. system.

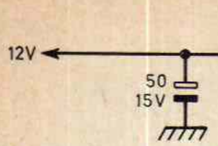


Fig. 6: Tuner feed. R is adjusted for 12V to the tuner (start at about 47kΩ).

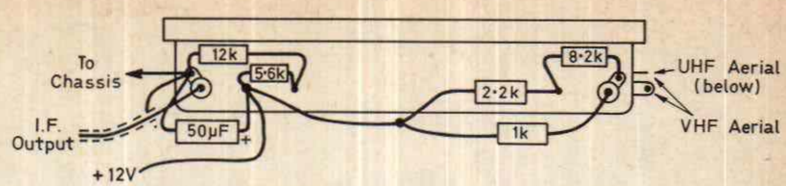


Fig. 7: Connections to the integrated tuner unit.

the most negative portions of the signal (the tips of the sync pulses) will be negative to chassis and will thus pass through the gating diode. The peak amplitude of the signal on V5a grid is thus equal to the difference between the detector output level set by the contrast control and the actual output level. This error signal is amplified by the triode and its output is rectified by the voltage doubler to feed the a.g.c. line.

This voltage is fed to the junction of R26 and C57 on the original circuit, R30 and R33 having been removed. The other components relating to the original a.g.c. system may also be removed, namely resistors R20, R34, R45, R73, R75, the contrast control, capacitors C41, C42 and C69 and also MR2. The unit may now be tested again and a check made with a high-resistance meter from the a.g.c. line to chassis to ensure that the a.g.c. voltage does not now vary with changes in picture content. Needless to say this a.g.c. system will only work on negative modulation and is thus not suitable for 405-line use.

VIDEO AMPLIFIER

A gated a.g.c. system will not of course provide d.c. restoration on its own. It is also necessary to modify the video amplifier to retain the d.c. component. A suitable modified circuit is shown in Fig. 5. The d.c. is restored initially by C62 and the OA81 diode in the usual way and is retained by omitting the 100μF cathode bypass capacitor C73 and also the d.c. attenuating network C85, R66, R70 and R74. Due to omitting C73 the video gain is somewhat less than before but this is compensated to some extent by taking the anode to a 250V line. If only 200V is available then R59 (270Ω) should be left in the cathode circuit. If the d.c. is slightly inadequate (the black level comes up slightly on darker scenes) then a resistor of up to 1kΩ may be connected in series with R54 and decoupled by 32μF to chassis.

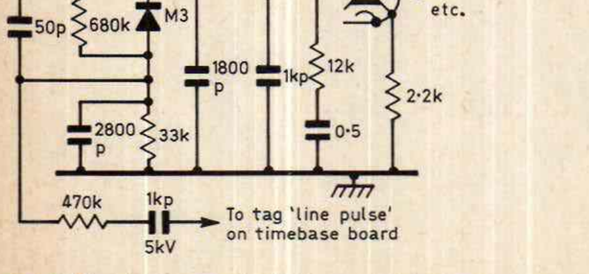


Fig. 8: Flywheel sync circuit for use with Thorn blocking oscillators (from Thorn 850 chassis). Diodes type M3 or similar.

AUDIO AMPLIFIER

The original audio amplifier is not really capable of doing justice either to the quality of the transmissions or to that of the EH90 detector stage output. The PCL84 was not originally intended as an audio output valve and will give only about 2W with a rather high level (about 10%) of distortion in the original circuit. Fig. 3 shows a suitable replacement circuit which should give at least 3W with less than 1% distortion and a much wider frequency response. The original rather puny output transformer should be replaced with a larger type to get the best from this circuit and of course the speaker should be fairly large, of good quality and forward facing. I would recommend either two 7×4in. speakers (correctly phased!) or a single 8in. unit depending on cabinet design.

If the amplifier is unstable when tested the connections to one of the output transformer windings should be reversed.

The unit should now give a very good account of itself in both picture and sound quality.

TIMEBASES

The choice of associated timebases depends mostly on the old receivers which the constructor has available, but one timebase panel which I have found excellent for conversion is that used in the Ferguson 636T receiver among other models (606T series). This timebase works if anything better on 625 than 405, and the line output valve screen resistor has to be increased to about 10kΩ to avoid excessive width!

Conversion is quite easily achieved by changing the line oscillator charging capacitor from 450pF to 250pF, the S-correction capacitor from 0·5μF to 0·1μF and the PL36 screen resistor to 10kΩ. A resistor of about 2.2MΩ will also be needed in place of the 220kΩ feed to the height control.

A suitable flywheel sync circuit for use with this and other blocking oscillator circuits is shown in Fig. 8. The 25pF sync feed capacitor and the 560kΩ resistor in series with the line hold control should be removed.

In conclusion although at first sight 625 conversion may seem a very ambitious project, in fact it only requires a good basic knowledge of television receiver technique and plenty of patience. For a surprisingly low outlay compared with say that for Hi-Fi equipment the constructor can assemble a receiver equal to and in some respects better than a modern commercial model. ■

fault finding FOCUS

S. GEORGE

A DETAILED LOOK AT COLOUR RECEIVER CHROMINANCE CIRCUITS

THE chrominance amplifier section of a colour receiver consists of a two-stage amplifier centred on 4·43MHz, the chrominance subcarrier frequency. There is however probably greater divergence from one make to another in this part of the receiver than in any other section of a colour set. The stages may be tuned or untuned and use valves or transistors while the arrangements made for colour-burst blanking and the manner of the feed to the colour-burst amplifier all differ widely.

The chrominance stages must fulfil five main functions. These are: (1) To amplify the tapped off chroma signal to the level required for subsequent application along with the locally generated 4·43MHz subcarrier to the B−Y and R−Y synchronous detectors. (2) To incorporate a.c.c. (automatic chrominance control) to maintain a constant output level and to compensate for variations in fine tuning which could greatly affect colour intensity. (3) To remove or "blank out" the colour-burst signal to permit correct operation of the colour-difference output clamps and avoid putting a colour cast on scenes of low colour content. (4) To incorporate a means for manually varying the colour intensity or saturation. This is sometimes electrically or mechanically linked to the contrast control so that optimum luminance/chrominance balance is maintained throughout the contrast range. (5) To provide a suitable feed for the burst-signal channel.

Chroma Take-off Point

The take-off point for the chroma signal is commonly a video preamplifier stage in which case the chroma signal is taken via a high-pass filter so that the lower frequency (luminance) component of the composite waveform will be attenuated. Such filters are usually simple *RC* or *LC* series combinations with the chroma signal developed across the resistor or inductor.

Although the system just outlined is widely used it is not universal practice. In Philips receivers fitted with the G6 chassis the signal is derived from the collector of the second vision i.f. amplifier. To extract the chroma information from an i.f. signal it is necessary to employ a separate detector and in these Philips models the tapped-off i.f. signal is first applied to a separate transistor amplifier with the output being applied to a diode demodulator to develop the required chroma content. The signal is then fed to a two-stage valve chrominance amplifier comprising a variable-mu EF183 and straight EF184 with an interstage coupling blanked off during colour-bursts by a switching diode. The idea is to detune the coupling and the arrangement is shown in Fig. 1. A positive-going pulse from the line output stage switches D1 on during the burst-signal period each line so that increased damping is applied to the primary.

A third method of deriving the chroma signal from the composite luminance-chroma signal is to use a separate sound-chroma detector. BRC and certain single-standard models use this technique. In both the dual- and single-standard BRC chassis the demodulated chroma signal is applied via a tuned acceptor circuit to an emitter-follower stage which feeds the untuned chroma amplifier stage(s) (only one chroma amplifier proper is used in the single-standard 3000 chassis). A complex filter with 1·57MHz (sound-chroma beat) and 6MHz (intercarrier sound) rejectors and an acceptor circuit tuned to 4·2MHz is interposed between the emitter-follower and first chroma stage in the 2000 dual-standard chassis. The emitter-follower stage is on the i.f. board and the chroma stages of course on the decoder board.

GEC Circuit

However, to get down to detail, Fig. 2 shows the circuits used in the GEC dual-standard colour TV range. The composite video signal—luminance and

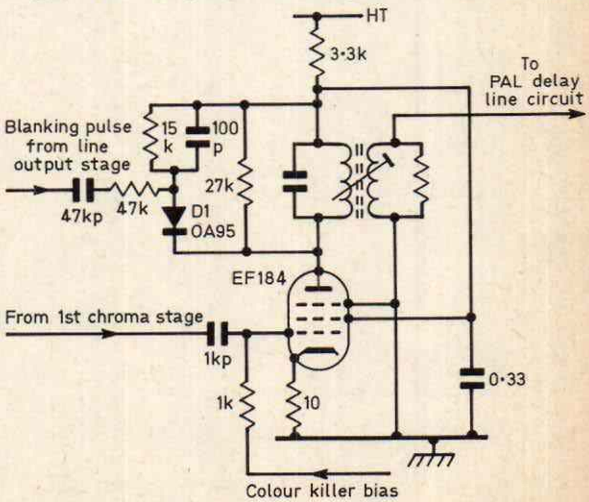


Fig. 1: Second chroma stage in the Philips G6 colour chassis, showing the burst-blanking system.

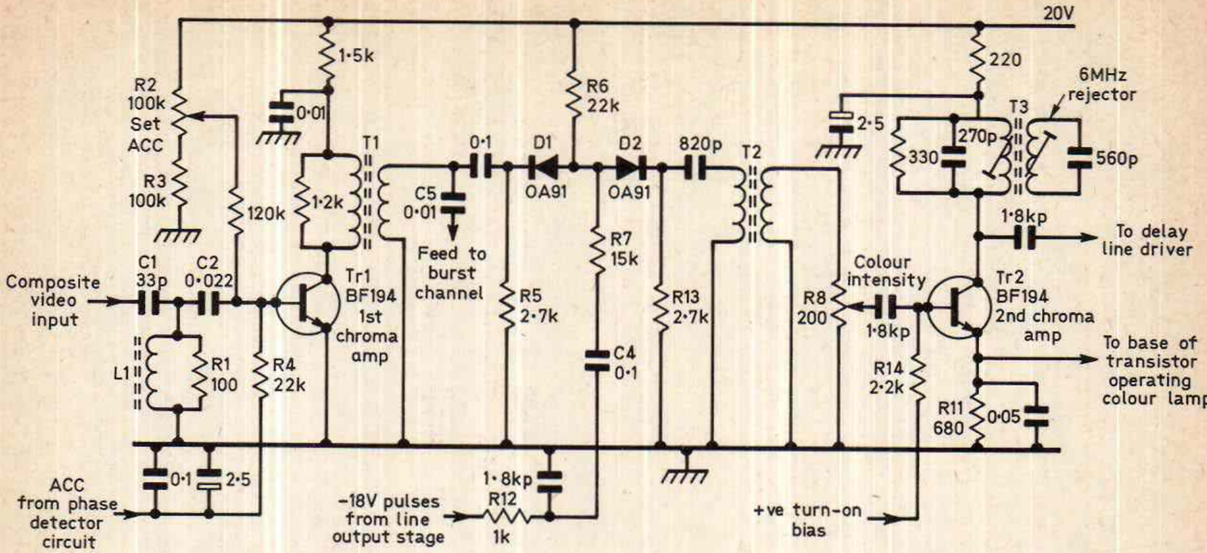


Fig. 2: Chroma amplifier stages in the GEC dual-standard colour chassis.

chrominance—is tapped from the emitter of a video phase-splitter stage. C1, R1 and L1 form a high-pass filter since the increasing reactance of L1 and the decreasing reactance of C1 to the higher frequency chroma content greatly attenuates the lower luminance frequencies. Tr1 bias is dependent on two factors, (a) the setting of R2 which determines the no-signal fixed bias and (b) the positive a.c.c. bias derived from the colour-burst amplifier. Since the amplitude of the colour-burst signal is directly proportional to signal strength a rectified sample provides a d.c. potential accurately related to subcarrier amplitude—unlike mean-level monochrome a.g.c. systems which produce a control potential related to *average* video content.

Burst Blanking

Amplified signals are developed across the primary of T1 with the secondary signal fed two different ways, (a) via the burst-blanking diodes D1 and D2 to the primary of T2 and (b) via C5 to a separate burst amplifier which in turn feeds a second burst amplifier also via blanking diodes. The diodes in the chroma circuit are conductive during the line scan period and non-conductive during the bursts, so allowing only the chroma signal through, while in the colour-burst circuit the opposite applies, only the burst signal ending up at the burst detector (the a.p.c. detector in the subcarrier regenerator circuit).

Confining our attention to the chroma circuitry, however, the positive current drain through R6, D1 and D2 and through R5 and R13 to chassis keeps the diodes conductive throughout the line scan period. During the blanking period at line termination a −18V pulse from the line output stage is timed to reverse bias the diodes—being applied to both anodes via R12, C4 and R7—and thus prevents transmission of the burst signal to the second chroma amplifier Tr2. Colour intensity is manually adjustable by means of the 200Ω potentiometer R8 shunted across T2 secondary.

Following general practice the second chroma amplifier Tr2 has no fixed positive bias and is rendered operative only by the rectified ident signal which is applied to its base via R14 as a turn-on bias when a colour transmission is being received. This is the colour-killer action: it ensures that on monochrome reception the chroma channel is cut off to avoid spurious colour patterning due to noise.

Colour Beacon

An interesting point of detail in this circuit is the colour "beacon" light. On monochrome there is no voltage drop across Tr2 emitter resistor R11. On colour reception, however, when Tr2 is conducting its emitter voltage rises to between 3 and 8V. This voltage forward biases a BC107 transistor in series with a "colour on" indicator lamp which glows to indicate colour signal reception. This can be a valuable clue when there is complete colour loss since if glowing it indicates that all the circuitry necessary for the production of the turn-on bias—i.e., the burst channel and ident circuits—is in order and that the complete loss of colour is therefore due to loss of local oscillator signal or a defect associated with the chrominance output circuitry since the first chroma stage must be operative to produce the feed for the burst channel which subsequently provides the input for the ident circuits.

The output from the collector of the second stage Tr2 is capacitively fed to a PAL delay line driver stage.

Decca CTV25

Figure 3 shows another example of transistor chroma circuitry, as used in the Decca Model CTV25. This differs from the previous example in that colour-burst blanking is achieved at the second chroma stage instead of in the interstage coupling while the turn-on bias for this stage is clamped at optimum value by an additional diode D1.

C1 and L1 form a high-pass input filter designed to attenuate the luminance component of the composite input signal in similar fashion to C1, R1 and L1 in the GEC circuit. A 6MHz intercarrier rejec-

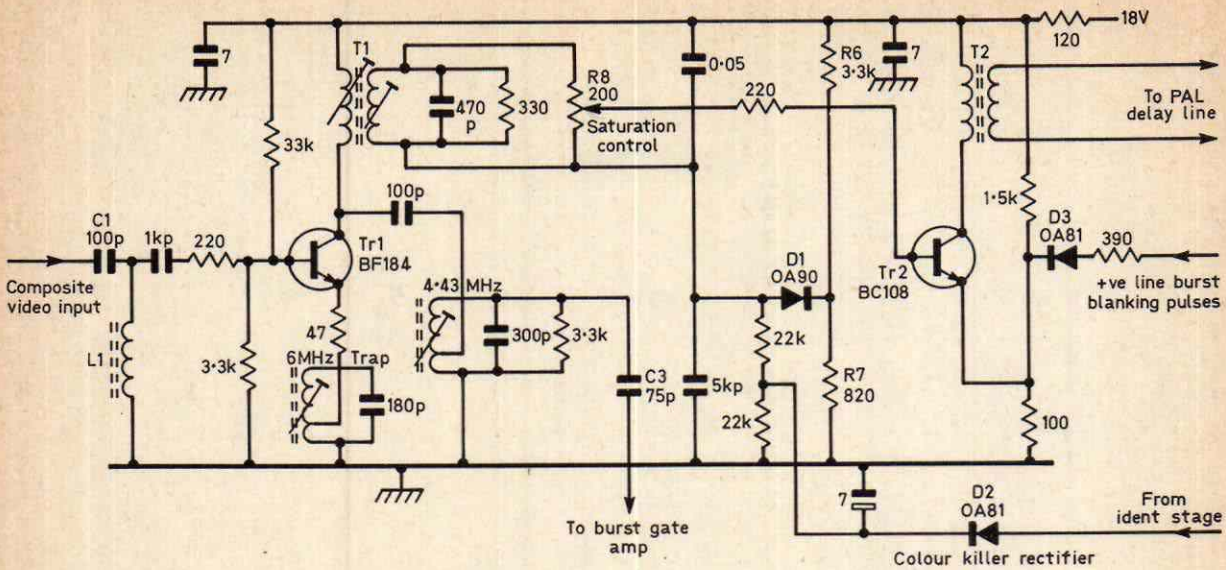


Fig. 3: Decca chroma amplifier circuit with burst blanking at Tr2 emitter.

tor is incorporated in the emitter lead of Tr1 with the amplified chroma output being developed across T1 primary in its collector lead. T1 secondary then feeds a 200Ω colour intensity (saturation) potentiometer from which the required degree of drive for Tr2 is taken. A capacitance feed also supplies the base of the gated colour-burst amplifier stage which is operative only during the burst periods.

The clamped biasing arrangements for Tr2 are interesting. A fixed potential divider R6 and R7 is connected across the l.t. rail and chassis but the positive potential developed at the junction is prevented from being applied to Tr2 base since it reverse biases D1. On colour reception, however, a positive voltage is developed when D2 conducts as a result of the ident stage coming into operation. This potential is applied to D1 anode and via the saturation control to Tr2 base. D1 is thus forward biased and clamps the colour-killer supply to the voltage at the potential divider junction. In this way the turn-on bias for Tr2 is maintained at optimum value. To provide this clamping action the values of R6 and R7 are carefully chosen in relation to D2 output and the supply impedance. If D2 output rises unduly for any reason the current flow through D1 and R7 will increase proportionately to increase the loading on the D2 supply and maintain Tr2 bias constant.

The chrominance output is developed across T2 for feeding to the decoder delay line circuit and burst blanking is achieved by applying positive-going pulses to Tr2 emitter during the colour-burst periods. Being npn types the transistors require a positive forward bias but a similar potential applied to the emitter will reduce or completely offset any forward bias at the base and thus stop emitter current.

Pye-Ekco Circuit

Now to turn to a slightly more involved chroma circuit as used in Pye-Ekco colour receivers (Fig. 4). Again a two-transistor circuit is used but with the user saturation control linked to the contrast control so that as the latter is advanced or reduced the colour intensity similarly varies to maintain the correct colour-luminance ratio throughout the receiver's operational range.

The high-pass input filter in this circuit is a series *RC* combination C1 and R1 with the values chosen so that the capacitor's reactance to the lower luminance frequencies is high compared to the resistance of R1 across which the signal is developed. In this way the luminance information is attenuated. The capacitor's reactance to the higher chroma frequencies centred on 4·43MHz and extending from 3·43MHz to 5·43MHz is proportionately lower so that the signal input to the first chroma stage Tr1 is mainly composed of the chroma content developed across R1.

The output from T1 secondary is applied to (a) the base of the colour-burst amplifier via C3 and (b) the base of the second chroma amplifier via burst-blanking diodes D3 and D4. The output from the burst amplifier is applied to a burst-gate amplifier which is only made operative during the burst periods by a pulse at line frequency.

Saturation Control System

However, keeping to the chrominance circuitry shown in Fig. 4 coupling to Tr2 is via C4 to the cathode of D3, then through both diodes and C11 to Tr2 base. D3 and D4 are normally held conductive by a positive potential tapped from the saturation control. The current filters from each anode to cathode and then through R11 and R12 respectively to chassis.

Increasing the potential applied in this way to the diodes increases their conductivity and thereby increases the signal proportion developed across R12. By linking the contrast control slider to the saturation control slider this positive control voltage is raised to increase colour intensity whenever the contrast level is increased. D3 and D4 can therefore be regarded as the top variable-impedance section of a

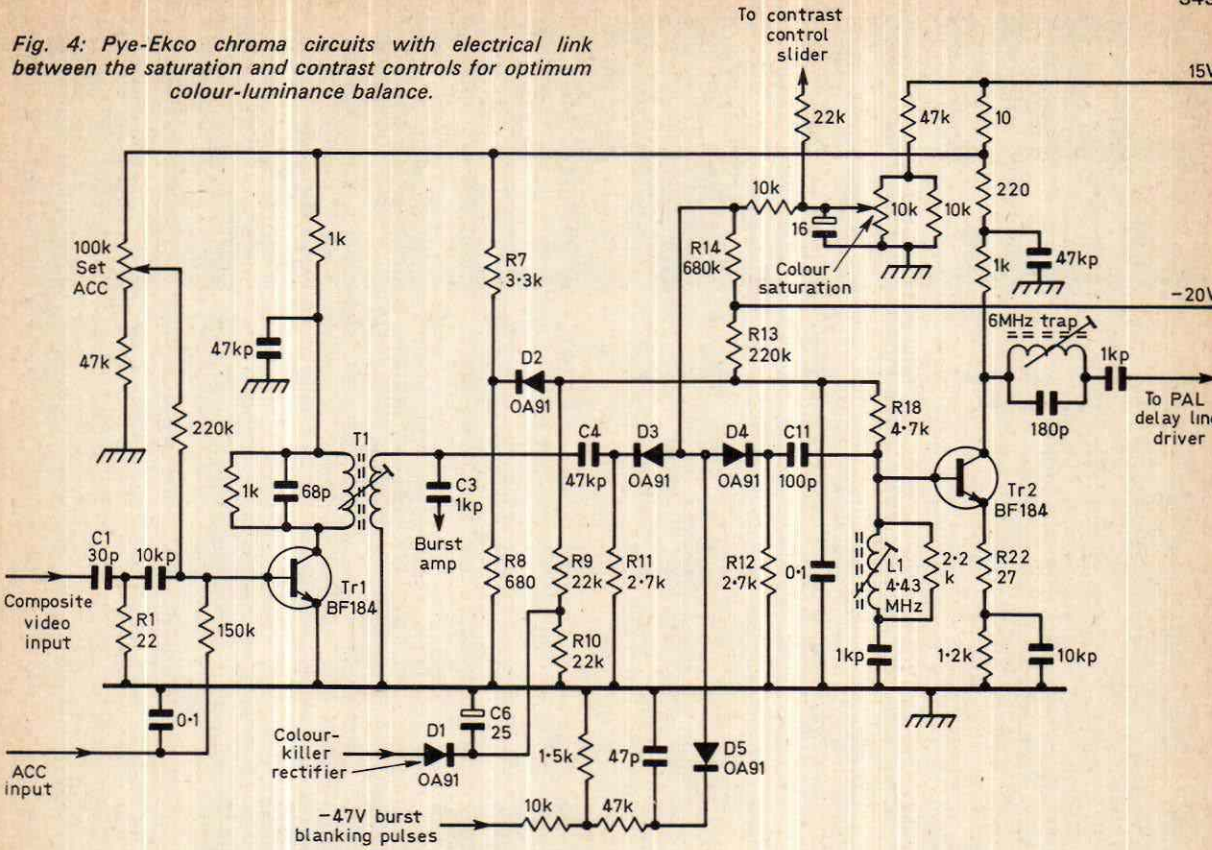


Fig. 4: Pye-Ekco chroma circuits with electrical link between the saturation and contrast controls for optimum colour-luminance balance.

potentiometer with R12 as the lower section. Being arranged back-to-back in this manner the non-linearity of the diodes, which would otherwise be especially evident at low-signal levels, is cancelled out.

Colour-killer Action

As in other receivers the second chroma stage is turned on by application of a bias derived from the ident stage during colour reception, but the method is rather more involved in this instance. The base of Tr2 is returned via R18 to the junction of R9 and R13 and although the top of R14 takes a small positive potential from the saturation control this is outweighed on monochrome by the –20V feed to the junction of R13 and R14. The positive potential at the junction of R7 and R8 applied to D2 cathode cannot bias Tr2 on since it reverse biases D2. On colour reception however D1 produces a d.c. output of about 7V across smoothing capacitor C6 by rectifying the ident signal and this turns Tr2 on. It also makes D2 conduct by making its anode more positive than its cathode. Tr2 bias is then clamped to the constant value of about 3V produced at D2 cathode by the fixed potential divider R7 and R8.

As well as providing a means for electronically controlling the degree of interstage coupling, the junction of D3 and D4 also provides a convenient injection point for a negative-going pulse train from the line output transformer via D5 to bias D3 and D4 off during burst periods to provide burst blanking.

L1 is tuned with the base circuit capacitance of Tr2 to 4·43MHz and the stage gain is stabilised by the inclusion of an undecoupled resistor R22 in the emitter lead. The output at Tr2 collector is then applied to a delay line driver stage via a 6MHz rejector which prevents any intercarrier sound signal being passed to later stages.

Servicing

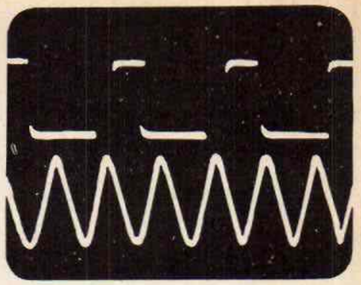
Chrominance amplifiers give little trouble in practice and the faults that do arise are mostly due to high-resistance or open-circuit diodes or a circuit disconnection.

When complete colour loss develops so that the possibility of a chroma amplifier failure is present undoubtedly the first move must be to over-ride the colour-killer action to ensure that the second stage, whether valve or transistor, is not biased off. If this action restores normal reception clearly the colour-killer circuitry is at fault but if there is no change in results there could be zero output from the local 4·43MHz oscillator or buffer stage or a fault in the chrominance output circuitry. First stage failure can be discounted since its operation is necessary to provide a feed to the colour-burst circuitry which in turn gives an output to the ident stage which develops the turn-on bias for the second stage.

As with most colour-receiver faults, scope testing will quickly locate a defective stage after which conventional voltage and resistance checks should soon identify the faulty component.

SERIES TO BE CONTINUED

STROBE-TRIGGER TIMEBASE UNIT



PART 2

Martin L. Michaelis M.A.

THE master multivibrator circuit module employs a conventional free-running multivibrator with capacitive cross-coupling from the collector of each transistor to the base of the other one (Tr1 and Tr4). This produces a squarewave at each collector and a ramp at each base. The coarse frequency control is a switch (S1) selecting various cross-coupling capacitors while fine frequency control is provided by a variable base bias resistor (VR1) in one of the transistor base circuits. The squarewave pulse and ramp durations for this transistor are roughly equal to those of the other transistor when the fine frequency control is at its maximum setting, or about three times as long when the fine frequency control is at its minimum setting. This is shown by the respective top traces of oscillograms D(a) and C(b).

The ramp at the base of the transistor (Tr4) whose base bias resistor—and thus the pulse and ramp durations—are varied is applied as variable bias (VR2) to the transistor (Tr5) producing the delayed strobe trigger. The duration of this ramp is always from the end of one positive pulse of the master pulse waveform—oscillogram C—to the start of the next positive pulse. Depending on the bias for the threshold discriminator selected with the manual gate delay control VR2 the strobe trigger pulse may be produced at any desired point on the base ramp.

Oscillograms C show the relative timing of the master pulse and the final strobe ramp produced by the delayed strobe gate. By adjusting the manual gate delay control the *start* of the strobe ramp may be brought to lie at any desired point between almost immediately after the termination of the master pulse—oscillogram C(a)—and just before the start of the next master pulse—oscillogram C(c). Oscillogram C(b) shows the midway setting of the strobe gate delay control.

Note that the adjustments are independent of the signal frequency. The master multivibrator is tuned and synchronised to the signal to be displayed in the same manner as used for any ordinary timebase, and *quite independently of the strobe gate delay and strobe gate width controls.* This greatly simplifies operation as has already been mentioned. Any given setting of the strobe gate delay control represents a constant phase position of the start of the strobe ramp *independent of the signal frequency.*

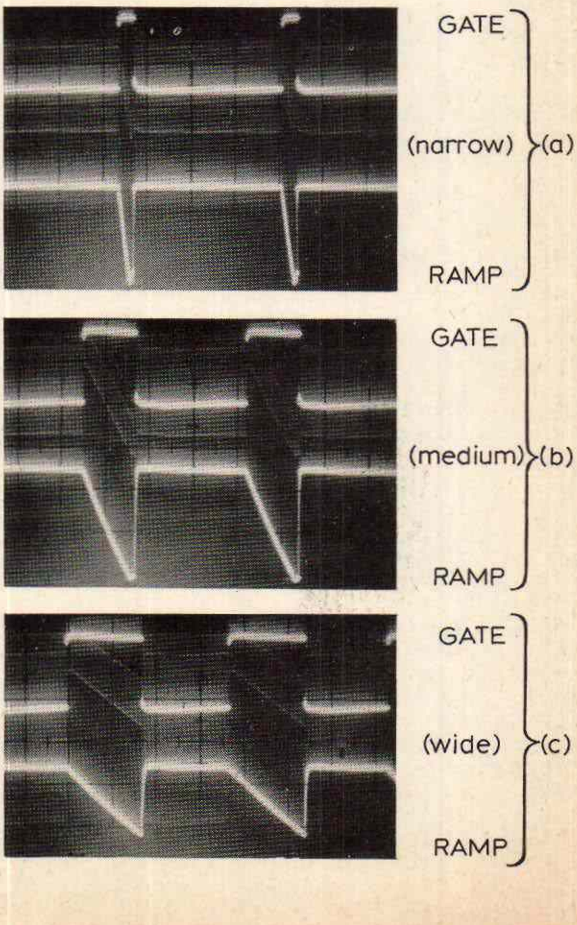
The strobe gate width and thus the strobe ramp duration can be selected quite independently as shown by the set of oscillograms B(a-c). Here the strobe gate delay control has been set about midway so that the strobe gate and ramp always commence midway between the end of one master pulse and the start of the next one (any other phase setting would serve just as well for this demonstration). The duration of the strobe ramp is determined solely by the gate width setting which has been varied progressively in the oscillograms B(a-c).

Note that whereas the *start* of the strobe gate and strobe ramp must lie between two master pulses the ramp *run* can always be made to coincide partly or entirely with a master pulse by moving its start close to the start of the next master pulse. This is demonstrated most clearly in oscillogram C(c). It is important for slaved transient studies discussed later.

SYNCHRONISATION

We have seen that the function of any timebase synchronising circuit is to speed-up the timebase

A EFFECT OF GATE WIDTH CONTROL S5



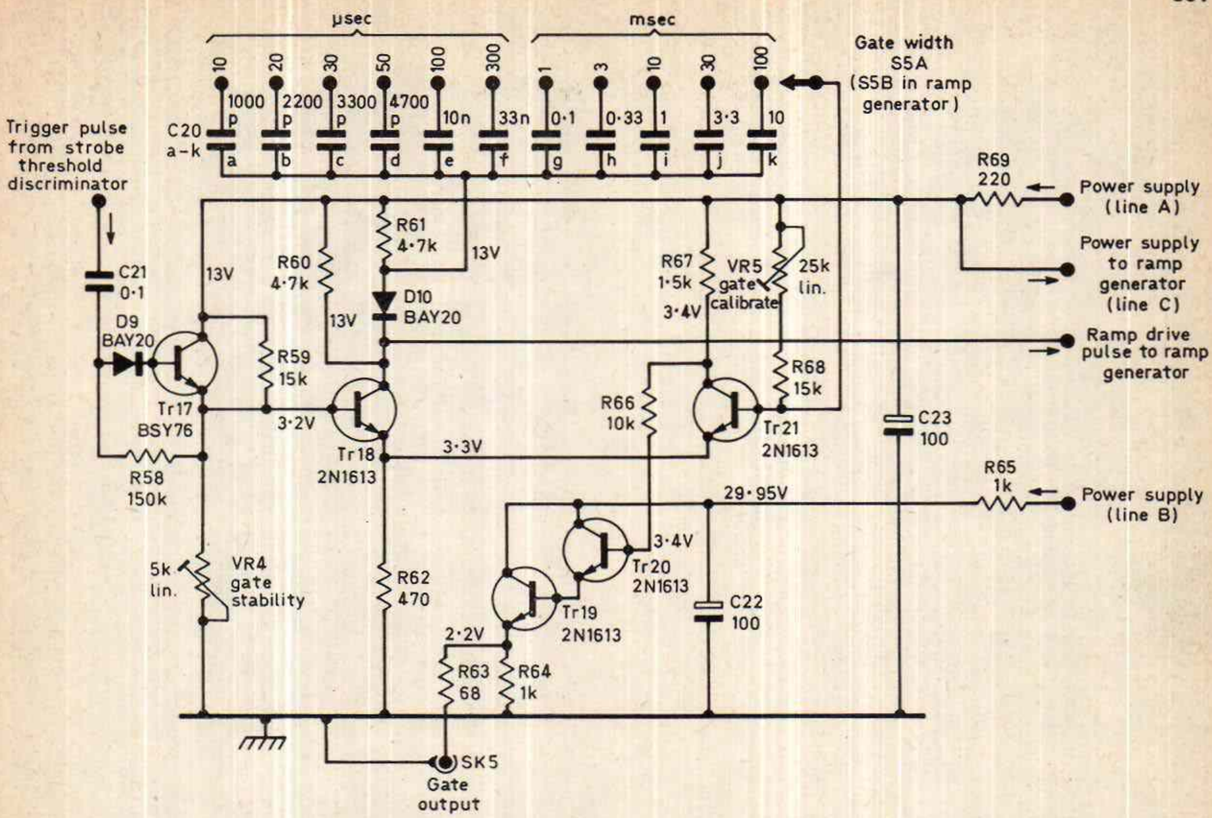


Fig. 5: Circuit diagram of the strobe gate generator. Voltages were measured with the master multivibrator off, gate width 100mS, gate delay maximum, zero sync and in the trigger setting, using a valve voltmeter.

oscillator which is otherwise, when running free, slightly too slow in relation to a whole number of cycles of the signal waveform. The type of synchronisation adopted for the master multivibrator in this circuit is gated so that the multivibrator is sensitive to applied sync only during the master pulses, i.e. only when the delay ramp is *not* running. This means that sync action and strobe trigger can never take place at the same moment. Sync action is possible only during the master pulse, and its effect is always to terminate the master pulse prematurely by the right amount. This means that the width of the unsynchronised master pulse is also the sync lock range.

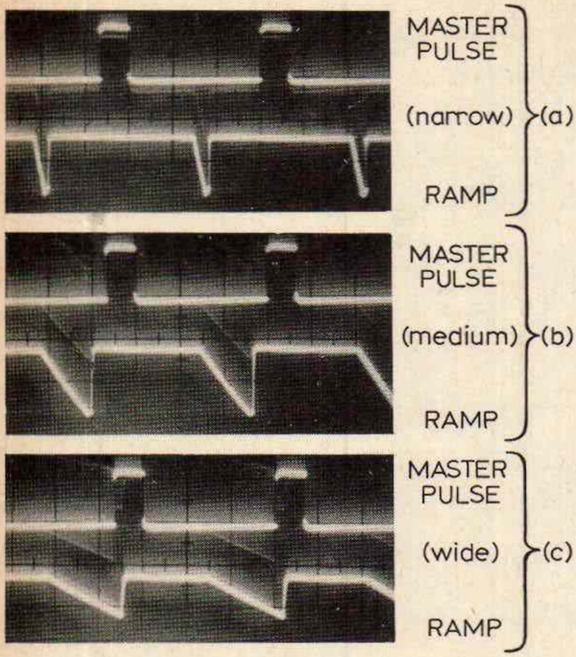
Synchronisation takes place at the moment of a positive-going or a negative-going zero transition of the signal waveform, according to the respective setting of the sync polarity switch S4. The action is largely independent of signal waveform in other respects so that synchronisation is equally rigid with sinewave signals and with pulse signals. The oscillograms E(a) and (b) show a typical example with a sinewave signal. In E(a) the sync amplitude control VR3 is at zero so that the signal waveform (bottom trace) is running wild. The sync polarity switch was set to negative and the sync amplitude control turned up very slightly to give signal lock shown in E(b). We see that the master pulse is now slightly narrower than in E(a) because sync action has terminated it prematurely by just the right amount to make the end of the master pulse coincide with the negative-going zero transition of the signal sinewave. If the sync polarity switch is changed over to positive the phasing would jump through half a cycle of the signal waveform so that the positive-going zero transition coincides with the end of the master pulse.

The depicted settings represent a point close to one end of the sync lock range because the negative-going zero transition of the signal occurs only *just* before the master pulse would terminate anyway of its own accord. Thus if the master multivibrator frequency is increased very slightly, or the signal frequency decreased very slightly, sync is lost. On the other hand if the master multivibrator frequency is decreased progressively, or the signal frequency is increased progressively, the synchronising point arrives earlier in relation to the free-running termination of the master pulse so that the latter is terminated prematurely to an ever increasing extent. In other words the master pulse becomes narrower and narrower until the other end of the sync-lock range has been reached where the master pulse is on the point of vanishing entirely. This large effective sync-lock range gives extremely stable synchronisation and the inherent gating which prevents sync response at all times when a delay ramp is running rules out all sync breakthrough into the strobe section so that the sync action is not only rigid but also very smooth.

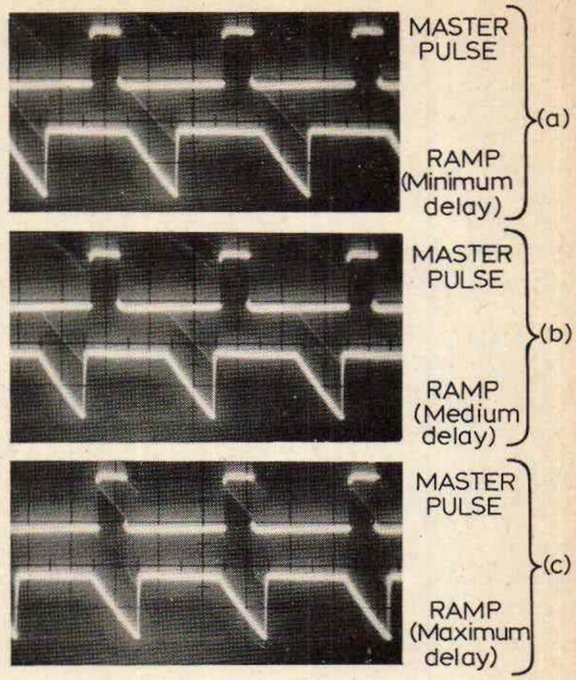
NUMBER OF CYCLES

The interval between two master pulses is variable from one to three times the master pulse width with the fine frequency control, and this interval is always

B EFFECT OF GATE WIDTH CONTROL S5
(Medium delay, i.e. VR2 mid-way)



C EFFECT OF GATE DELAY CONTROL VR2



the full range within which the strobe trigger point may lie.

The aim of a strobe timebase is to permit selection of the strobe trigger point at any desired phase point on the signal waveform. In other words the interval between two master pulses, which is the strobe trigger shift range, must contain at least one complete cycle of the signal waveform in the synchronised state. This condition is satisfied under all possible circumstances if the master multivibrator is synchronised to one half of the signal frequency so that two cycles of the signal appear between two corresponding master pulse flanks. This is the normal synchronised state shown in oscillogram E(b).

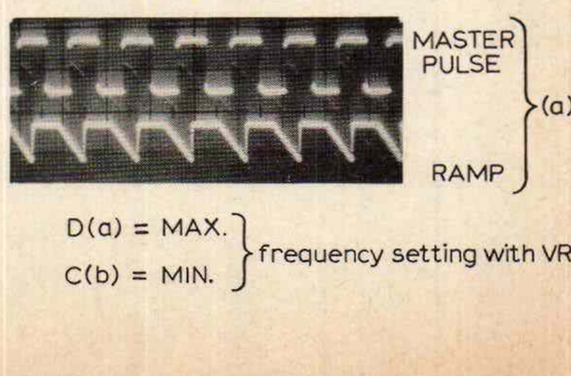
As far as strobe resolution is concerned there is nothing to be gained by synchronising to give only one or more than two signal cycles per master multivibrator cycle. The phase angle of the signal waveform displayed on the strobe trace is determined solely by the strobe gate width. Jitter is a function of the master multivibrator phase angle occupied by the strobe gate so that we merely aggravate jitter if many signal cycles are synchronised on to a single multivibrator cycle. Furthermore the strobe gate delay control then becomes critical because its range covers not just one signal but several, so that phase positioning in one signal cycle becomes very cramped.

Master multivibrator frequencies up to 60kHz are available so that it is necessary to synchronise more than two signal cycles on to a master multivibrator cycle only if the repetition frequency of the signal exceeds 120kHz which is rarely the case in television work. Rigidity and smoothness of sync action improve rather than deteriorate however at higher frequencies. If four or more signal cycles are synchronised to one multivibrator cycle the successive sync lock ranges overlap and an unlocked state is no longer possible. As the relative frequencies are changed cycles add or subtract abruptly without lock ever being lost. This automatic synchronisation persists up to signal repetition frequencies in the MHz range.

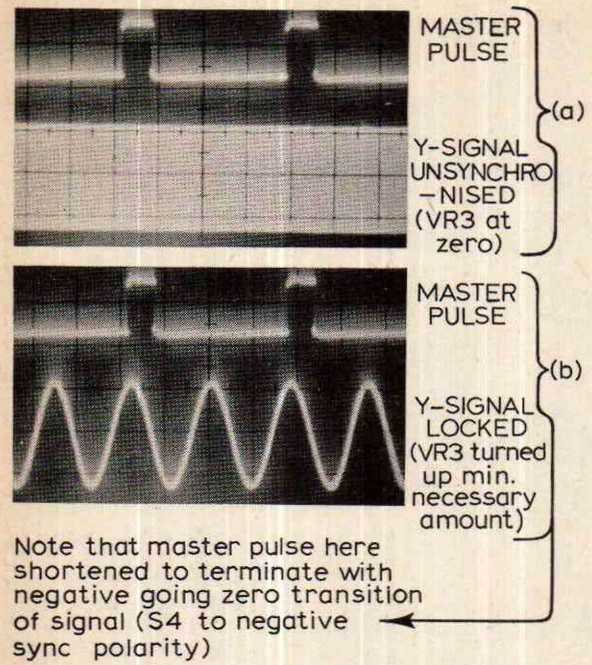
AUTOMATIC SYNC

The transition to automatic sync, as distinct from a sync range with loss of sync at either end, takes place as soon as the master multivibrator frequency is switched down or the signal frequency is increased to such an extent that the free-running master pulse is longer than one signal cycle. By virtue of the gated sync action this condition totally captures the master pulse so that it is always terminated prematurely and has a duration of exactly one signal cycle as soon as the sync control is advanced from zero. The interval between successive master pulses is quite undisturbed and the strobe delay and strobe gate width controls continue to function normally

D EFFECT OF FINE REPETITION FREQUENCY CONTROL, VR1



E SYNCHRONISATION TO MASTER PULSE



because the sync applied to the master multivibrator is effective only during a master pulse.

SINGLE CYCLE SYNCHRONISATION

We have seen that synchronising more than two signal cycles on to a single multivibrator cycle aggravates jitter. Conversely single cycle synchronisation with the signal and multivibrator frequencies equal gives improved jitter rejection because the strobe gate then occupies the largest possible phase angle of the multivibrator waveform. However the strobe gate trigger point cannot now be shifted over a complete signal waveform cycle. Nevertheless, half a cycle can always be covered and it is possible to shift the relative phasing by half a cycle with the sync polarity switch (provided the signal waveform is reasonably time-symmetrical) so that in many cases all points of the signal waveform cycle can be reached by the strobe after all. A strobe ratio of 40 is now usable, because the standard figure of 20 is valid for the normal two-cycle synchronised condition. The intensity available with the DG7-32 c.r.t. is adequate for exploiting a strobe factor of 40 if the ambient illumination is subdued.

Thus typical examples of the performance limit are the selection of groups of 10 to 15 lines of a television field on to the strobe trace, magnified display of the colour burst, or a display of a single cycle of a 100kHz transient sitting on a waveform with 2·5kHz repetition frequency. Transient ringing trains with frequencies up to several MHz are readily observable on TV line frequency pulse waveforms.

STROBE GATE AND STROBE RAMP

It is important to ensure that the strobe gate and strobe ramp are of the same duration and accurately coincident in time because the external function of the strobe gate is to switch on the electron beam in the c.r.t. at the start of the strobe ramp and to blank it again at the end of the strobe ramp. Only if this timing is sufficienly accurate will the strobe trace be clean and free from all aberrations due to signal excursions made during the long waiting periods.

The simplest method of producing accurately coincident strobe gates and ramps is to derive the latter directly from the former. Thus in the absence of a strobe gate a transistor is held conducting heavily thus placing a short-circuit across the timebase capacitor used to produce the ramp. The strobe gate cuts off this transistor for its own duration so that the short-circuit is then removed from the ramp capacitor and it can commence at once to charge towards a large aiming voltage. Only a very small portion of this voltage has been reached by the time the strobe gate terminates, so that the charge waveform is confined to the early portion of an exponential and is thus a substantially linear sawtooth stroke. As soon as the strobe gate terminates the short-circuit is once again placed across the ramp capacitor so that flyback follows at once.

Oscillograms A(a-c) show the accuracy of this action for various strobe gate widths. It is seen that the strobe gate and strobe ramp are in all cases exactly coincident. The ramp commences with the leading flank of the strobe gate, runs very linear for the duration of the gate, and finishes with an abrupt flyback commencing with the terminating flank of the gate. Oscillogram A(c) shows the proper condition. In oscillograms A(a) and A(b) there is some fold-over present at the end of the ramp, before the gate has terminated. This is due to a deliberate displacement of the corresponding internal alignment control, to illustrate the alignment procedure discussed later in conjunction with the detailed circuit description. When properly aligned, all gate widths produce ramps as accurate as the one shown in A(c).

PRACTICAL APPLICATIONS

The majority of practical applications of a stroboscopic timebase in television work are concerned with studies of transients, overshoot and ringing. This is a very important method for assessing and devising methods to improve the response and bandwidths of all manner of pulse circuits, amplifiers and video cable networks. In the majority of practical cases a clean step function waveform is applied to the circuit on test from a suitable signal generator. The leading flank of a squarewave is the most commonly used signal for this purpose. The form in which this flank emerges again out of the test circuit gives valuable information regarding the performance of that circuit.

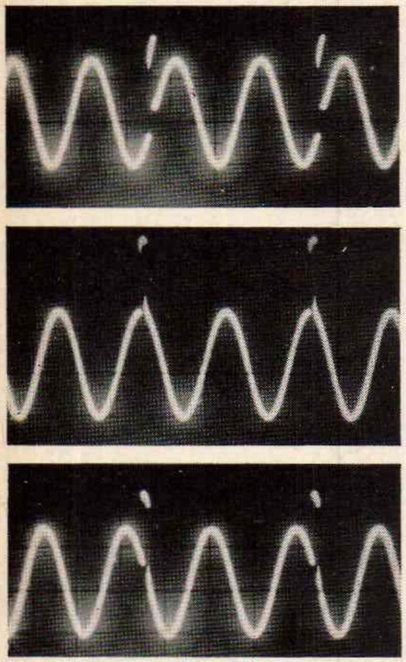
ASSESSING PHASE AND FREQUENCY RESPONSE

A few common examples will illustrate this point. If an accurate squarewave of duration t is applied to the input of an amplifier it will emerge without significant distortion only if the phase and frequency response of the amplifier are level in the frequency range from $1/t$ to $10/t$. The flanks are rounded if

F STROBE ACTION

Signal locked to master pulse according to E (b)

Gate and signal added in operational amplifier for demonstration



(a)

(b)

(c)

Increasing gate delay (a) → (c)

In each case the chunk chopped out of signal by gate is magnified alone over full screen in strobe operation as typically shown in G (b)

gain falls with increasing frequency. The flanks overshoot and then return exponentially to the level roof if gain rises with frequency. In either case the cut-off frequency can be determined from the time-constant of the rounded or overshooting flanks, provided the display can be expanded to permit read-off of the time-constant. This is possible with the stroboscopic timebase since it gives a large expansion and an unambiguous time scale because the calibrated setting of the gate width control states the total time value of the strobe trace, which can be brought to any convenient correlation with the screen graticule by adjusting the X-gain control of the oscilloscope accordingly.

If the squarewave roof emerges sagging, arched or regularly undulated, the phase response is not level in the frequency range concerned.

STUDYING TRANSIENT EFFECTS

The master pulse output provides squarewave pulses with logarithmically graded widths from about 0·1sec to about 10μsec, permitting amplifier phase and frequency response assessments throughout the range from 10Hz to 1MHz with ease, and with some practice up to several MHz.

A separate signal generator is not required. The master pulse output is taken to the circuit to be tested, the output from this circuit is taken straight to the oscilloscope (looping through the stroboscopic timebase unit is required only when using the internal sync function), and the strobe gate delay is set close to maximum so that the strobe ramp commences just before the leading flank of the next master pulse—see oscillogram C (c). The strobe gate width is now set to correspond approximately to the duration of any transient effects expected or observed. No synchronisation of any kind is required since the system is obviously self-slaved. Thus the sync amplitude control is left at zero. The fine frequency control is set to minimum and the coarse frequency control set to range f1-f2. The amplifier or other test circuit is then being assessed for performance roughly in the frequency range from 2f2 to 20f2.

Note that this arrangement displays the entire flank as it comes out of the test circuit because the strobe ramp can be made to commence the appropriate amount earlier. Conventional trigger display of flanks and transients invariably misses the often all-important start.

If the flank distortion is not a simple rounded or overshoot exponential but consists of several cycles, ringing or instability in the test circuit is indicated. If the cause is ringing the cycles rapidly decrease in amplitude. If a train of cycles of constant amplitude is followed by a more or less abrupt decay, or if the amplitude first rises and then decays with a considerable train of nearly constant amplitude in between, the cause is feedback instability in the circuit being tested. This form of parasitic instability in an amplifier often does not produce self-oscillation with no input signal but appears only in the presence of a sharp transient such as the test squarewave or high-frequency components in an applied audio or video waveform. The effect in an audio amplifier is usually lack of clarity and maybe quite heavy distortion, without any indication to the uninitiated person as to what the real cause is.

CABLE RINGING

Ringing is not normally a sign of instability but rather of the presence of oscillatory circuits which may be intentional or may be combinations of stray inductance and capacitance distributed in the test circuit. Very valuable information is obtainable when a ringing transient can be blown up to full screen size so that its exact form may be observed. This is readily possible with the stroboscopic timebase unit.

Oscillograms G(a) and (b) show a typical practical example. Here the shielding lead of the coaxial CCTV distribution cable in the author's home was disconnected at one of the outlet junction boxes about midway on the cable run and the d.c. continuity maintained only via the equipment connected at each end. A clean 7kHz squarewave was fed in at one end and the waveform was observed as it emerged at the other end. Oscillogram G(a) is the normal display obtained with the ordinary built-in timebase of the videoscope. The presence of a ringing transient is clearly evident but its form cannot be scrutinised. Oscillogram G(b) shows the corresponding strobe timebase display of this transient.

We see at once that the ringing frequency is about 1MHz and that in addition to the exponential decay of amplitude there is a pulsation component—the third cycle is smaller than the fourth. This form of ringing is always an indication of two or more over critically coupled tuned circuits, i.e. a bandpass filter characteristic. If a single tuned circuit is excited with a step function the ringing transient always shows a direct exponential decay.

To the engineer familiar with these facts a cable transient of the kind shown in G(b) reveals at a glance that there is a break in the outer conductor somewhere near the mid-point of the cable run. The nearly equal lengths of intact cable either side of the fault constitute the twin tuned circuit bandpass filter with their distributed inductance and capacitance. If the fault is well removed from the centre point of the cable run its position can still be determined reasonably well from the transient frequency and the listed cable characteristics. In this manner it is possible to test extensive cable runs in communal aerial or CCTV distribution systems.

The ringing transient vanishes entirely as soon as the proper connection is restored in the outlet junction box.

ADJUSTING TUNED CIRCUITS

Slaved ringing with the internal multivibrator as signal generator is also useful for adjusting tuned circuits which are inaccessible to a grid dip oscillator, e.g. because the coil is in a completely enclosed ferrite pot core. In such cases apply the master pulse to the tuned circuit in series with a carbon resistor of value 2 to 47kΩ (to be determined by trial and error) and at the same time connect the tuned circuit via the signal probe directly to the oscilloscope. Use the strobe unit to display the resulting transient whose frequency can thus be determined and is the resonant frequency of the tuned circuit being tested.

OTHER APPLICATIONS

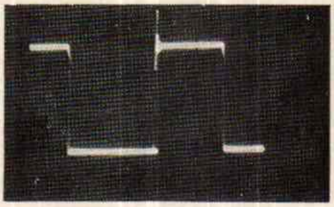
Ringing transients or transients due to instability need not be coincident with a step function. For example if a faulty amplifier is driven with a large sinewave signal, bursts of parasitic oscillation may appear with any phase relationship to this sinewave. Even step function ringing or parasitics may be the result of other drive waveforms produced inside the equipment in question. For all these cases the general strobe function with free choice of strobe ramp phase position, usually with internal sync of the master multivibrator, will be required. It is necessary to loop the signal through the strobe timebase unit only if internal sync is used.

External sync must be used if certain phase relationships with respect to a reference waveform are of interest or if the signal waveform is not truly periodic. This is the case for a composite video waveform which is strictly periodic only with respect to the sync pulses. The picture content is aperiodic with a mean repetition frequency. This is unacceptable for any normal sync circuit which is also the reason why a television receiver must employ a sync separator to isolate the truly periodic sync pulses from the quasi-periodic picture content.

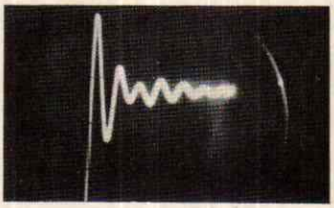
Similarly, synchronisation is possible but strongly dependent on picture content if taken directly from a television waveform in the strobe timebase unit. When working on CCTV and broadcast television equipment it is preferable to switch to external sync and feed in a clean line or field waveform from some suitable point of the equipment, such as the scan coils or an early stage of the line or field timebase. The display signal then need not be looped through the strobe timebase unit but can be taken via the signal probe straight to the oscilloscope Y-input in the normal manner, the probe being moved in succession to all test points of interest without ever losing sync. External sync is thus desirable whenever numerous waveforms having the same repetition frequency but widely differing shapes and amplitudes are to be observed in succession, as is usually the case when checking through a television receiver.

G PRACTICAL EXAMPLE OF STROBE USE

7kHz squarewave with 1MHz damped ringing on leading flank



(a)
NORMAL DISPLAY
With ordinary synchronised timebase



(b)
GATED STROBE DISPLAY
Showing transient over full screen

Once the master multivibrator has been synchronised to half the line or field frequency—using an external sync signal taken via a separate sync cable from any convenient point in the TV receiver—it is merely necessary to use the vertical gain control on the oscilloscope and the gate delay and gate width controls on the strobe timebase unit whilst checking through the TV receiver. These three controls are all independent of each other so that operation is extremely simple and straightforward. If the vertical amplitude of the display is too small or too large when the signal probe is moved to a new test point in the TV receiver, adjust the vertical gain control on the oscilloscope. The gate delay control is adjusted to select the phase position at which the signal waveform is to be observed and the gate width control is set independently to the desired phase angle of the waveform which is to be included in the strobe display.

One complete cycle can always be accommodated in the strobe trace simply by switching the gate width to 100μsec (line) or 30msec (field). Each new waveform is first observed in this full cycle setting. If transient detail is seen to be present, move it with the gate delay control so that it is close to the start of the full cycle trace and then switch down the gate width so that the transient detail expands progressively across the screen.

TO BE CONTINUED

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

CHARLES RAFAREL

THERE has been just no change so far in the disastrous SpE DX conditions we reported last month, and what openings there were did not seem to be as good. I hope this time I can safely say that things have been so bad they just cannot get worse. This has been an all time low for winter SpE and the generally bad weather with snow etc. has ruined any chances of compensation in the form of usable tropospheric reception. The only bright spot this time has been a further increase in F2 activity which was even better than in January.

I suspect that in due course when we get more reports from our US DX-TV friends we shall be hearing of their reception of BBC-ORTF in Band I complete with images, which is alas rather unlikely for us over here. Just to recapitulate, the lowest US channel is A2 (vision 55·25MHz, sound 59·75MHz), both "high" frequencies unless F2 conditions are superb, whereas our American friends have BBC-1 available on 45MHz vision, 41·50MHz sound, and ORFT Ch.F2 on 52·40MHz vision and 41·25MHz sound, which must help quite a lot at this period of the 10-11 year cycle.

Now to the SpE log here for the period 1-28/2/70:

3/2/70 Sweden E4.
8/2/70 USSR R1.
9/2/70 USSR R1 and Poland R1.
12/2/70 Sweden E2.
19/2/70 Poland R1.
21/2/70 Poland R1.

As noted above F2 was better with the USSR 38-41MHz forward-scatter network very good on the 9th, 15th, 20th, 21st, 22nd, 23rd, 24th, 25th, 26th and 27th. Even better was the reception of the US paging stations, often at good strength, on the 23rd to 25th inclusive.

The Trops were just terrible. The only day here showing some promise was the 19th when the "local" French came in at reasonable strength. By the 20th they had dropped back again into the background "hash". As I write however the plants are in bud so spring with better conditions cannot be long delayed now.

As promised we continue with the possibilities of meteor reflections in Band III, including the promised meteor table. To use this table simply pick the date that you wish to know about in the extreme left column then under the month involved read down until the date and month lines cross. For example the count on the 10th of October is 12.

RANDOM METEOR TABLE FOR ANY YEAR, SHOWING FREQUENCY AT ANY DATE

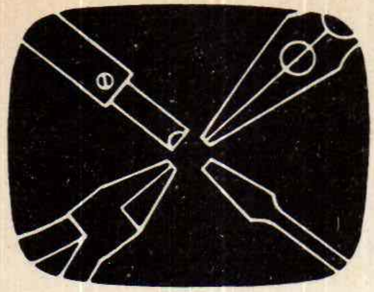
Date	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	19	24	12	10	13	14	9	37	10	10	15	22
2	33	3	8	9	14	6	16	32	18	12	16	18
3	30	21	5	12	19	8	21	22	15	18	23	30
4	20	16	13	5	19	10	15	32	10	19	17	19
5	17	16	5	7	18	4	26	14	23	17	11	18
6	16	16	14	4	19	9	14	20	22	15	12	19
7	16	4	11	9	18	8	21	21	19	18	17	36
8	17	10	10	5	15	13	19	35	16	20	10	18
9	25	11	14	12	18	16	32	33	14	17	15	12
10	20	12	11	21	12	21	18	42	14	12	11	29
11	14	12	11	8	25	17	22	66	34	23	19	25
12	26	11	12	11	26	13	13	39	22	18	15	83
13	19	19	13	20	21	20	20	32	10	20	14	44
14	12	13	26	8	9	7	35	29	13	17	21	30
15	11	13	11	10	10	19	9	17	13	21	25	18
16	20	9	5	9	13	17	24	16	28	20	20	23
17	16	3	11	7	12	16	22	26	13	20	15	18
18	20	17	17	18	12	15	11	18	8	21	21	18
19	12	20	8	7	11	14	13	19	19	24	13	22
20	16	15	8	10	12	31	23	24	18	25	13	17
21	19	15	10	14	13	13	14	22	25	41	31	16
22	17	15	12	14	13	23	33	32	25	25	28	7
23	12	15	6	9	14	40	17	24	21	25	19	27
24	12	15	2	6	20	5	36	11	20	19	15	16
25	14	9	8	14	14	9	31	21	19	17	17	23
26	12	12	6	8	21	12	34	22	17	22	19	16
27	10	16	8	11	9	22	24	24	27	28	21	28
28	14	8	5	14	20	20	28	23	15	22	16	15
29	16	15	1	13	7	14	23	17	10	10	30	19
30	20	—	12	10	28	18	29	20	11	22	15	25
31	14	—	11	—	21	—	30	15	—	22	—	11

This table is "brand new" to DX-TV work and opens up the possibility of predicting the chances of getting meteor-reflected signals (in Bands I/II and *also in Band III*) on any given date. Your reports will be of great interest to us and to Bob Cooper, as mentioned last month. I will be pleased to forward your reports to him as a measure of repayment for furnishing this most interesting information about this new DX-TV system.

Bob Cooper goes on to say: "It has been my own experience that dates with counts of under 20 are seldom worth losing sleep over, 20-30 are above average and 31 plus are in the meteor shower category. The peak dates shown of course reflect the occurrence dates of all major night-time meteor showers. You may find it useful to make up a calendar for each month in advance, listing the dates with different coloured pens. My working one has dates in blue for counts of 20 or under, green for 21-29 and red for 30 and over. In this way I can easily spot when I should be active with my gear (a red date is a "must", a green is worthwhile and a blue is "forget it")".

Now for some comment from Bob Cooper, Roger Bunney and myself as to the reception techniques that must be employed—I must stress that the requirements noted are really important. (1) A really high-gain receiver. (2) A good aerial preamplifier, 20dB gain or better. (3) A good aerial array for

—continued on page 365



SERVICING television receivers

L. LAWRY-JOHNS

BUSH-MURPHY TV161U/V1910U—continued

The Video Stage

A PFL200 valve functions as the video amplifier and sync separator. This valve can give trouble resulting in a variety of effects from straightforward loss of contrast or sync to a more disastrous cook up of components and damage to the printed panel which may necessitate stripping back one or more tracks and replacing with wiring. This sort of thing is pretty well self-evident and is irritating rather than mystifying.

A little more subtle is the habit of 2C44 (10μF) drying up or becoming otherwise open-circuit. This affects u.h.f. reception more than v.h.f. The effect is one of very weak sync where the field tends to roll up or down. A similar effect, attended by more marked loss of contrast, is caused by 2C45 (320μF) becoming open-circuit. When the loss of sync also affects v.h.f. it is well to check the heater current as this may be the only indication that the heater circuit diode has shorted. No accurate measurements are required; a look is all that is needed to see if the valve heaters are glowing more brightly than normal. To make certain a check can be made for 75V d.c. at the junction of 3R58 and P/S8.

Line Timebase

It is the writer's own experience that the line oscillator and output valves do not give a lot of trouble. The main defects seem to centre around the discriminator diodes (3MR1, 2) the boost line capacitor 3C18 0·1μF which is at chassis potential at one end, and the PL504 screen feed resistor 3R22 (2kΩ).

Discriminator diodes 3MR1 and 3MR2 cause loss of line hold etc. and being combined with 3MR3 can be replaced with a direct replacement block or by three separate diodes which is not difficult if the correct polarity is observed.

The boost capacitor causes more trouble since it can trigger off a chain reaction and the best thing which can happen (and does) is that the

4R3 may be 18kΩ and 4C17 120pF.

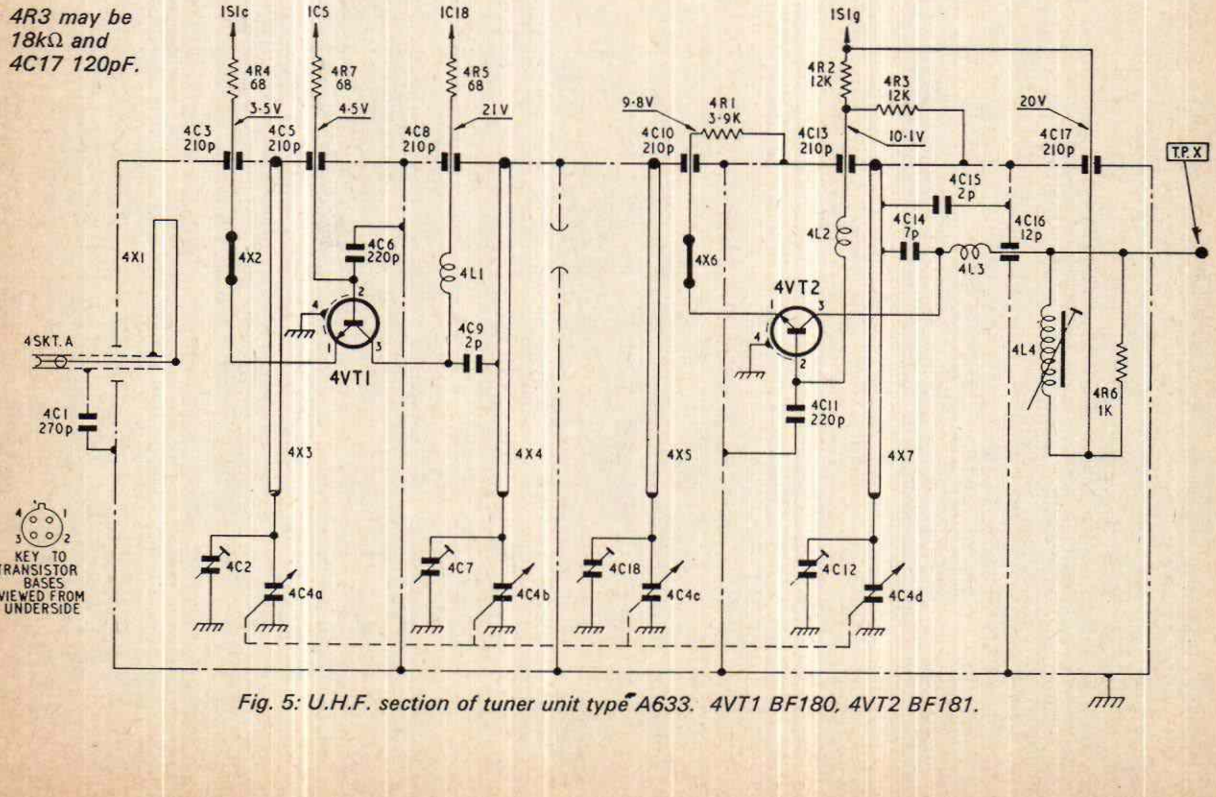


Fig. 5: U.H.F. section of tuner unit type A633. 4VT1 BF180, 4VT2 BF181.

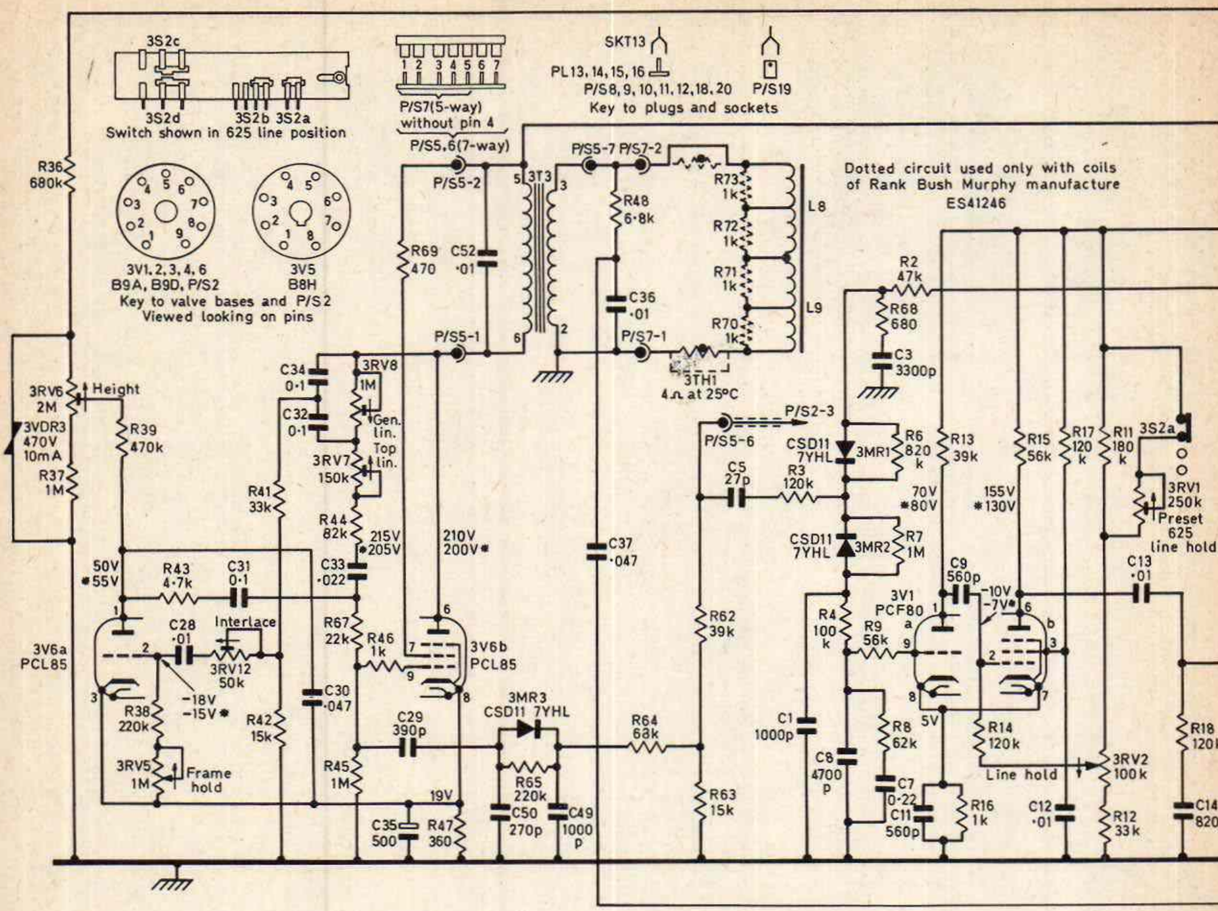


Fig. 6: Circuit diagram of the main chassis incorporating timebase

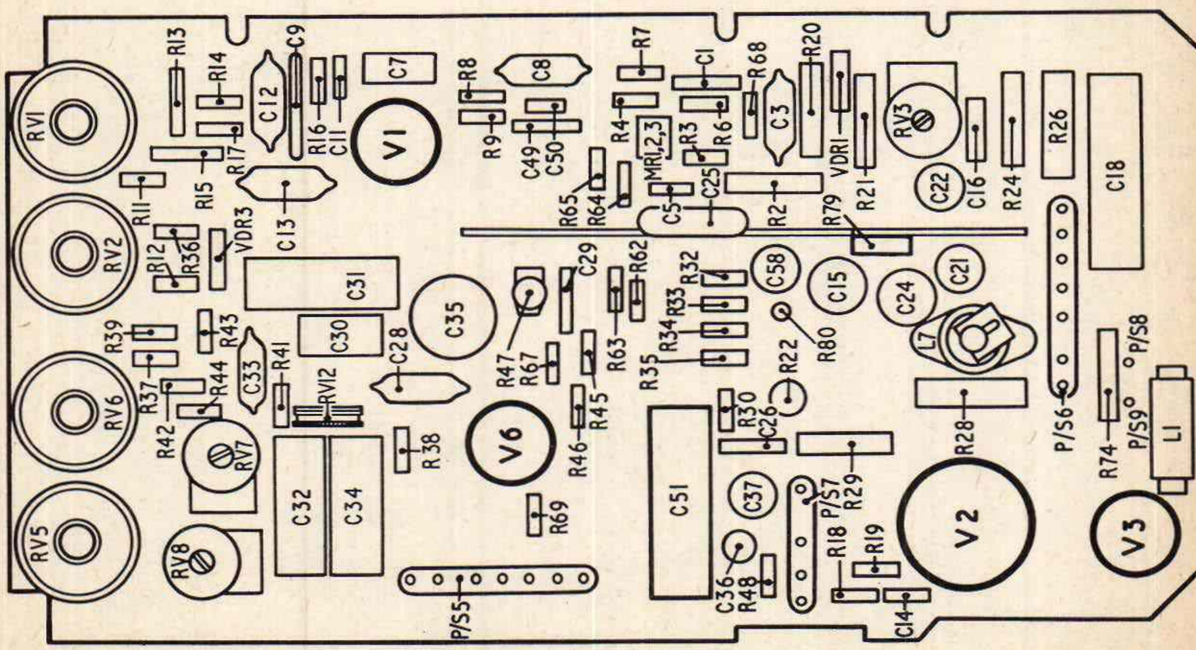
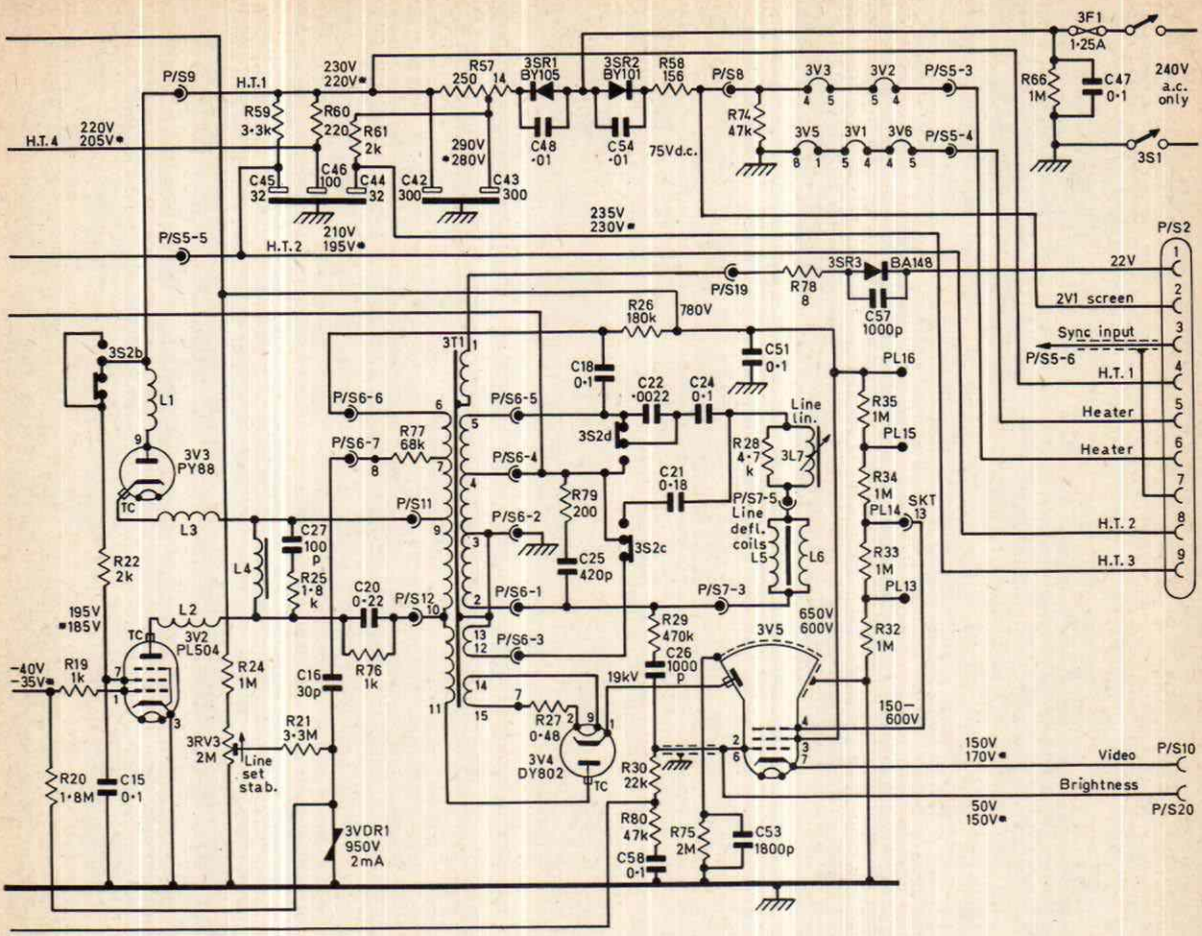


Fig. 7: Component layout for timebase unit type A634.



unit A634 and line output unit A581/A585.

previously mentioned dropper section of 14Ω goes open-circuit. The alternative is that the fuse fails (nice) or that the PY88 develops a heater-cathode short (nasty) with the risk of damage to one of the rectifiers before the fuse fails. This risk was doubled in earlier models (TV145U etc.) since the boost capacitor was made up of two 0·1μF capacitors connected in parallel.

The screen feed resistor 3R22 may fail of its own account in which case the print will not be damaged, but where there are obvious signs of over-heating, melted solder etc. it is well to check both the PL504 and 3C15.

Check the 4·7kΩ resistor (3R28) across the line linearity coil 3L7 if striations are present.

Lack of Width

This follows the usual pattern of either a low emission PL504 or a faulty resistor (3R20, 3R21)—possibly 3VDR1—in the width circuit and should not cause any trouble.

IF Stages

One of the annoying things about transistorised receivers is the tendency for one or more transistors to fail in the event of an arc-over or spark at some other part of the receiver, e.g. the tube base, line or field output stages. Whilst the inclusion of resistors in the collector circuit reduces the failure rate, it still occurs. Hence a sharp disturbance in a valved stage can cause the failure of a transistor in another.

A faulty stage or transistor can quickly be located by signal injection and then voltage readings at the collector, base and emitter of the suspect. The transistors are npn types with a positive collector rail. The voltages to be expected are given in the circuit diagrams and no difficulty should be experienced.

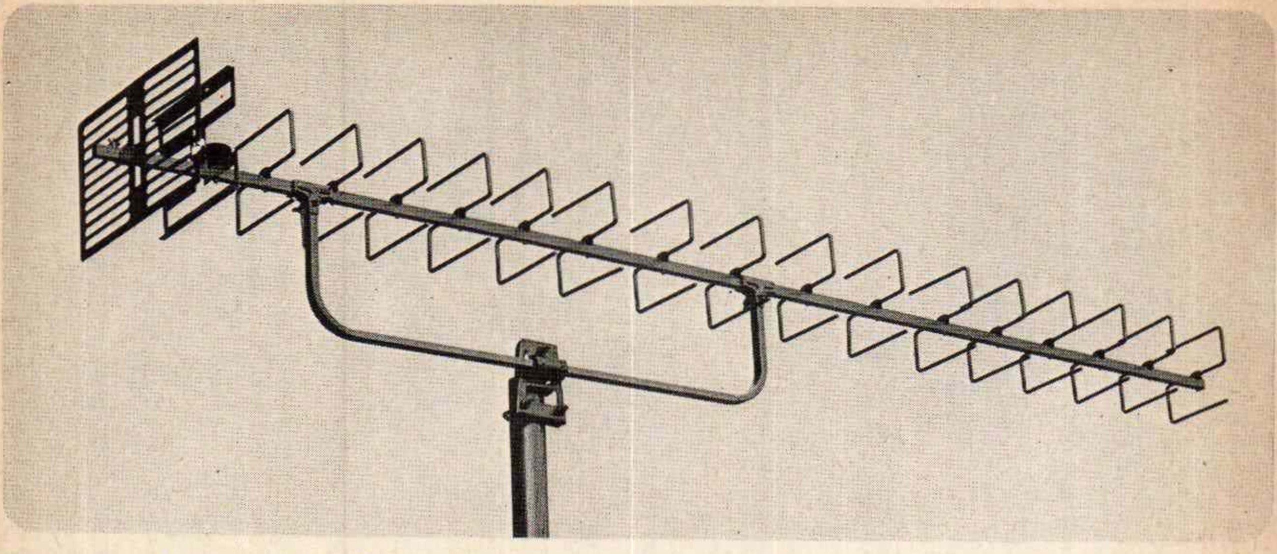
The contrast and a.g.c. controls tend to have a sharp cut-off so the settings should be checked before suspecting a fault in the tuner or i.f. stages.

Tuner Unit

This is in two sections as shown. Trouble is usually confined to faulty switching or a faulty transistor.

Do not disturb the layout in any way and ensure that replacements are exact and occupy the same position as the original. Weak u.h.f. signals where the aerial is known to be good should direct attention to 4VT1 (BF180) and wrong readings at 4R4

—continued on page 365



QUITE a few old hands will recall the days of Band I only aerials. It seemed wonderful then that domestic-quality signals could be transmitted, propagated and received at such high frequencies on channel 1. A lot was written about the problems that would almost certainly be involved when the top end of Band I (channel 5) was made active. Not only did we overcome the problems of rising noise with increasing frequency in the front-ends and those associated with propagation but we then entered even higher frequency realms and gallantly opened up Band III for a second TV programme and activated lots of channels to provide a country-wide service. Apart from the intrinsically insoluble co- and adjacent-channel shortcomings of covering the whole country with two programmes within a somewhat restricted v.h.f. spectrum (v.h.f. in reality extends from 30 to 300MHz or from 10 metres to 1 metre) we progressively overcame the new problems of Band III working at transmitter, aerial and set and ended up with a remarkably efficient two-programme TV service that could neither be improved in terms of picture definition nor in terms of programme multiplication. We were stuck.

We then followed America, explored the u.h.f. spectrum and eventually introduced a third programme within this spectrum (u.h.f. extends from 300 to 3,000MHz or from 1 to 0·1 metre). This time we gave ourselves much more elbow room, so to speak, for a significantly greater number of TV channels can be accommodated in the overall 2,700MHz spectrum of u.h.f. than in the 270MHz spectrum of v.h.f. Although this may appear to be an excessive amount of additional TV spectrum it was necessary for three prime reasons. One because we decided early in the game that we would ultimately abandon the v.h.f. spectrum for the major part of domestic television and concentrate on up to a total of four programmes, country-wide, in the u.h.f. spectrum; two because we decided to enhance the display definition by changing from the early 405-line system to the better 625-line system which demands greater channel width than the former; and three because the effective area over which consistently good u.h.f. reception is possible from any given transmitter is less than in the v.h.f. spectrum, calling for many more u.h.f. transmitters than v.h.f. ones for country-wide coverage.

Table 1: Standard u.h.f. aerial groups.

Group	Colour Code	Channels	Frequencies MHz	Range MHz
A	Red	21-34	470-582	112
B	Yellow	39-51	614-718	104
C	Green	50-66	702-838	136
D	Blue	49-68	694-854	160
E	Brown	39-68	614-854	240

Reproduced from "The Practical Aerial Handbook," 2nd Edition, by Gordon J. King, published by Butterworths.

Co-channel Interference

Thus although the u.h.f. spectrum may appear unduly wide the number of 625-line TV channels that it provides is still below that required for four programmes in all parts of the country on separate channels. This means that we still have to go in for channel sharing but as in the v.h.f. spectrum this is very carefully engineered so that the transmitters sharing channels are as far as practicable away from each other. Moreover the directivity of the transmitting aerials and their orientation are arranged so that the smallest possible signal field is radiated towards the area in which the nearest u.h.f. transmitter is using the same channel. In this way it is hoped to avoid co-channel interference problems; *but just how well this arrangement will work in practice when each area is provided with three (BBC-1, BBC-2 and ITV) and subsequently four lots of programme signals will significantly depend on the efficiency of the receiving aerials* as we shall see. And since it is assumed that we know a bit more about television than the chap in the street, it is our duty at least to ensure that our own installations are perfectly in order and operating as efficiently as possible. It is indeed noteworthy that about half the complaints received by the BBC (and this is only one of a number of authorities) about adverse

Our heading photograph shows the Aerialite Golden Gain Supreme fringe u.h.f. array.

AERIALS FOR THE 70s

K. ROYAL

u.h.f. reception are eventually traced to badly erected, wrong type or inadequate aerials.

In addition to reducing the possibility of co-channel interference, the u.h.f. receiving aerial is also a highly critical link to good colour reception, to correct balance of the received signals of a local group and to optimum signal-to-noise performance (i.e. least grain on the picture and hiss on sound) of the receiving system as a whole.

Each area has been assigned a group of four u.h.f. channels. Quite a few are currently using one of the assigned channels for BBC-2 and some are also using two more channels for BBC-1 and ITV, both in monochrome and colour. At the time of writing about half Britain's television viewers could if they wanted to receive all three programmes in monochrome and often in colour on u.h.f. This means that they could abandon their old v.h.f. aerials and instead employ a solitary, neat u.h.f. wideband array for the existing three programmes with the knowledge that this single array will be suitable for the fourth programme when it becomes available (there is nothing definite about this fourth programme yet).

One Aerial All Programmes

The aerial of the seventies is therefore a compact u.h.f. array which will satisfy all foreseeable developments in domestic entertainment television. It is important fully to realise that this one aerial will cater for all the channels of a local group, but—very important—it will only do this when it is very accurately designed, erected and orientated. There is a great deal more to the design of wideband u.h.f. aerials than many readers seem to realise. In the good old v.h.f. days we used an aerial "peaked" to a single channel and if we wanted to make one of these ourselves the problems were relatively small provided we used the well-known formulae for element dimensions, spacings and so on. A peaked aerial like this can be designed so that it "looks" pretty well resistive to the feeder through which the signal is conveyed to the set. Moreover when it is so peaked the directivity of a yagi type automatically maximises in the forward direction and so both prime parameters—frequency and directivity—are reasonably well satisfied and we can also be fairly sure that the dipole terminals will appear resistive to the feeder.

When however an aerial is designed for wideband working over a spectrum of up to 100MHz or more for four-channel operation trouble really starts. There are three main factors that we have to control. One is the dipole or radiator terminal resistance, for we have to ensure that this holds sensibly constant at the matching feeder impedance (typically 75 ohms) over the entire bandwidth without deep changes into reactance—*C* or *L*. Two is the overall response itself, for steps in this—especially at frequencies corresponding to the required u.h.f. channels—could impair the luminance-chroma ratio of a colour signal and thus disturb the colour displays at the set or at least put the set into some difficulty, while excessive end-of-response roll-off could diminish the array's efficiency at the group's terminal channels, again affecting colour reception. Three is the polar response, for this too should remain essentially constant over the entire spectrum and the design must avoid lobes appearing at the sides and at the rear of an array at the different frequencies over the group of channels as these lobes would defeat the requirement of maximum co-channel discrimination previously referred to.

Poor or Incorrect Design

These are no mean tasks and the majority of home-made aerials are unlikely to satisfy them all. A lab-full of specialised equipment and a well tailored test site are necessary for proper test plottings of new designs, such plottings then revealing how the polar response, impedance, bandwidth and so on are collectively or separately affected when a change is made, for example to the length or spacing of an element.

This is *not* to imply that home-made aerials will not work at all. Indeed it is possible that an array of given complexity when home-made and constructed in accordance with the old-established rules will exhibit better gain on one specific channel than a very carefully designed wideband commercial aerial. This is all very well at the moment in those areas where only BBC-2 is being transmitted. But where the three channels are active, users of such aerials will almost certainly find that some channels—if receivable at all—will carry more noise (i.e. background grain) than the one to which the aerial is peaked.

Sadly this effect is not confined only to home-made arrays, for some early commercial u.h.f. aerials appear to have been made in a hurry to satisfy the initial demand for a BBC-2 aerial and as a consequence are peaked to BBC-2. Thus their owners are having difficulty in obtaining good reception from the recently introduced BBC-1 and ITV programmes, especially when these are in colour.

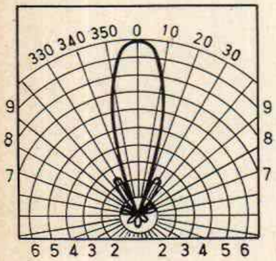
If you have an aerial like this the only thing to do is to replace it with one of the latest wideband models and cut your losses! It is pointless to tolerate noisy pictures and excessive interference on a potentially high-definition TV system for the sake of a few pounds, particularly if you are running a new single-standard set or a colour set costing several hundred pounds. The same applies to u.h.f. aerial preamplifiers. Some of the early ones were purposely designed to peak BBC-2; but those made now are (or should) be wideband models.

Minimum Standards

Some years ago the major aerial manufacturers worked out certain minimum standards for u.h.f. aerials in terms of response, directivity and so forth and have since kept rigidly to these. So even an early aerial originating from such reputable manufacturers should not be plagued with the above-mentioned shortcomings. Regarding bandwidth versus gain the standard dictates a variation not exceeding 1dB over a channel and 3dB over the entire bandwidth. For directivity a minimum front-to-back ratio of 16dB for arrays of five or more elements is specified. Such parameters are very difficult for the amateur aerial constructor to control.

The latter aspect might seem relatively unimportant right now in some areas, but it must be remembered that there will be ultimately in excess of 1,000 u.h.f. transmitters sharing about 44 channels! Thus an aerial with a poor front-to-back ratio installed now would certainly be likely to respond later to unwanted signals arriving at the rear and sharing the same channel as the wanted signal arriving at the front. Front-to-back ratio expresses the "pickup efficiency" at the front of the aerial relative to that at the rear. As I have already pointed out, similar trouble can result from co-channel signals arriving at the sides of an aerial or at various angles relative to its axis if its overall design is poor with side lobes or pickup.

It is of course well known that the distance over which u.h.f. signals travel is limited. Nevertheless under certain reception conditions such signals can produce quite a strong field at distances of several hundred miles from the transmitter, so one can imagine the magnitude of interference that could result from 1,000 transmitters sharing 40-odd channels under such reception conditions if the receiving aerial has spurious responses at the rear and sides.



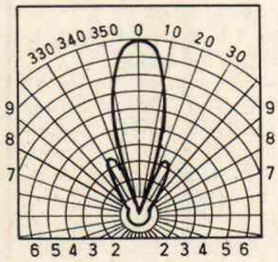


Fig. 1 (left): Horizontal polar diagram of 18-element yagi (including reflector system). This has a front-to-back ratio of about 26dB.

Fig. 2 (right): Horizontal polar diagram of four 12-element yagi arrays in side-by-side and stacked formation. While this has a front-to-back ratio of about 26dB, as in Fig. 1, the overall gain is some 3dB better than the single 18-element yagi. Note the development of the minor side lobes which is sometimes a tendency with stacking.

Technicalities

Now let us look a little more technically at some of the points so far discussed. Fig. 1 shows the horizontal polar response (or "diagram" as it is often called) of an eighteen-element yagi. The major elongated pattern indicates the angles, relative to 0 degrees (the on-beam orientation), over which the aerial picks up signal. This indicates that if the array is about 10 degrees off-beam either side the response falls by about 2 points from maximum, given as 10, while if it is 20 degrees off there is virtually no pick-up at all. The importance of accurately beaming a yagi to the station is thus clearly shown. The minor patterns (or lobes as they are called) are not uncommon with high-gain arrays and it is the job of the designer to keep these as small as possible. Sometimes the lobes tend to expand and/or multiply by mounting two aerials broadside or one above the other, but such stacking can improve the main lobe directivity and increase the gain. Two in-line (yagi) arrays properly connected together can give a gain increase of up to 3dB and four up to 6dB. Fig. 2 shows how the minor lobes increase with stacking.

Pick-up efficiency is expressed in dB gain relative to a single dipole tuned to the same frequency. Thus an array with a gain of 3dB means that on-beam the signal extracted from a given field intensity is twice that of the dipole alone.

One thing about u.h.f. arrays is that we can use many more elements than on v.h.f. without making the system unduly bulky. This is just as well because the shorter the aerial the less signal it extracts from the passing radio wave. TV aerials are tuned devices and the efficiency of a dipole for instance is maximum when its length is almost *half* the wavelength of the signal it is required to receive. We say almost half because the wave velocity is reduced by about 5% owing to the wave passing into the aerial from free space: this means that the tuned length of the aerial is about 5% shorter than the in-space signal half wavelength. No significant improvement in pick-up efficiency results by increasing the length of the aerial since this will merely detune it and possibly detract from its efficiency. Thus a u.h.f. half-wave dipole working in say the C group of channels (Band V) is only about 7in. long as compared with about 127in. for a Band I, channel 1 dipole. This is the reason why u.h.f. aerials, even those working close to a transmitter, generally have more parasitic elements (i.e. directors and a reflector system) than their v.h.f. counterparts whose elements are longer when tuned.

The strength of the signal delivered by a tuned dipole is equal to the product of the dipole's *effective length* in metres and the signal field in volts/metre divided by two. The effective length of a tuned dipole is given by λ/π. However the signal actually received by the set is less than this owing to the attenuation of the coaxial cable and the losses at u.h.f. in plugs, sockets, filters and so forth. In weak signal areas therefore only the best low-loss u.h.f. coaxial cable should be used; plugs and sockets should be very carefully fitted and filters should be avoided.

Fortunately the fall in the effective efficiency of a dipole as the signal frequency is increased (excluding the extra "gain" provided by parastic elements) is countered by the stronger signal field evoked by transmitters at increasing frequency, even though the power remains constant, coupled with the relatively high gain provided by u.h.f. transmitting aerials of feasible size, the design laws of which are similar to those of receiving aerials. A transmitting aerial with say a gain of 10 times would give an effective radiated power of 1kW from a 100W transmitter, but generally this power would be concentrated in a specific direction.

The signal field in volts/metre can be expressed as

$$2{\cdot}58\sqrt{W\frac{h_t \times h_r}{\lambda \times d^2}}$$

where h_t and h_r are the heights of the transmitting and receiving aerials in metres, W is the power of the aerial signal in kilowatts, λ the signal wavelength in metres and d the distance from the transmitter. This clearly shows that the signal field is proportional to the height of the aerials and inversely proportional to the wavelength. Thus as the wavelength is made smaller (frequency increased) the signal field increases. The expression also reveals that the signal field falls off in accordance with the well-known inverse square law (i.e. $1/d^2$). The power at the aerial of course also affects the strength of the signal field, but less than generally realised. The height of the aerials is more important, especially towards the edge of the service area and into the fringe. Remember therefore that one of the most important factors involved in good u.h.f. reception is that of receiving aerial height. The transmitting people make sure they satisfy this factor adequately at their end!

Aerial Design

The majority of u.h.f. aerials are based on the yagi principle where the tuned dipole (about 5% shorter than the in-space signal half wavelength) has a reflector or reflector system behind it and a number of spaced directors in front of it. The centre impedance of a tuned dipole is about 75 ohms which

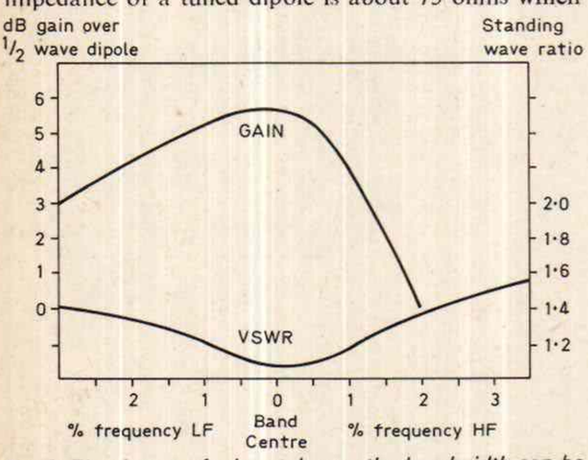


Fig. 3: The degree of mismatch over the bandwidth can be expressed as volts-standing-wave-ratio (VSWR in the diagram). The smaller the ratio the better the matching. The diagram shows that at band-centre the matching is almost perfect while either side of resonance it falls. A wideband aerial is designed to minimize the increase in VSWR over the entire channel group.

makes a very good match to 75-ohm coaxial cable. However when directors and a reflector system are added the impedance falls significantly and to bring it back to about 75 ohms again the artifice of folding the dipole is adopted. This allows the signal current to divide between two parallel paths and because of this the centre or feed impedance is stepped up by a factor of four. This factor of four arises because the power is proportional to the square of the current.

To keep the centre impedance essentially resistive and at a constant value over the aerial's bandwidth one fold of the dipole may be of a greater metal mass than the other, or it may be differently shaped. A simple half-wave dipole is akin to a tuned circuit and because of this it exhibits an increasing inductive reactance and a decreasing capacitive reactance across its terminals when the length is in excess of the signal wavelength, and vice versa (see Fig. 3). Thus to maintain an essentially constant resistive "impedance" over the aerial's bandwidth the designer has to work one electrical parameter against another and compromise to some extent. However the wideband design is influenced by the presence of the parastic elements which work something like tuned and coupled circuits which when they are all resonated to the same frequency tends to increase the effective Q and *reduce* the bandwidth, just the opposite to requirements.

However by staggering the tuning so to speak, by "phasing" the elements and by carefully adjusting their coupling, the bandwidth can be increased just as it can in radio circuits. Tuning is achieved by adjusting the length of the parastic elements while the spacing between them determines the coupling coefficient and phasing. Even when an array has been optimised in this way there is still the possibility of the dipole impedance swinging reactive or away from the nominal 75 ohms unless precautions against this have been engineered into the design. Conditions like these can seriously reduce the signal transfer to the receiver by giving rise to standing waves on the feeder and by impairing the power coupling to the first r.f. amplifier, especially when this is a u.h.f. transistor.

Commercial Ideas

Schemes for maintaining a resistive load over the required bandwidth have resulted in the diverse u.h.f. aerial designs of recent years. Belling and Lee for example employed dipoles of special shape (now continued by Antiference) while Antiference have used a pair of coupled dipoles working "differentially" to counter mismatching arising from reactive swings over the bandwidth. J-Beam have used special balun transformers and continue to do so on their latest Multibeam and earlier Parabeam arrays. The radiator of these arrays is based on the skeleton slot principle rather than the dipole and since the terminal impedance is high on the slot compared with 75 ohms the balun, which is patented, serves both as an impedance transformer and as a wideband matching device. Fig. 4 shows how the J-Beam balun is formed.

All the major aerial manufactures have their own pet ideas for securing a resistive feed over the required wide spectrum of the channel groups (listed in Table 1) but in addition to taming this area of the overall design the polar response must hold fairly accurately over the bandwidth. Indeed if the designer

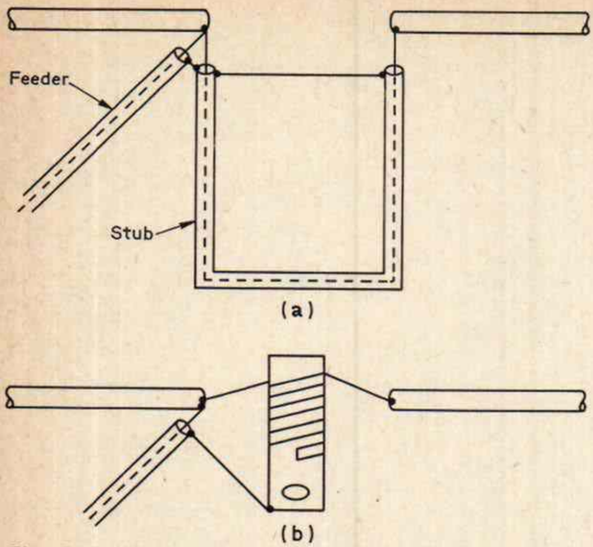


Fig. 4: Development of the J-Beam inverse balun: (a) shows the basic matching stub principle which gives a 75-ohm coax feed from the relatively higher terminal impedance of a skeleton slot radiator while (b) shows how J-Beam simulate the principle by means of a wound component.

fails to do his sums correctly it is possible for the array to "back-fire" at certain frequencies within the bandwidth with obvious impairment to the front-to-back ratio as shown in Fig. 5.

A technique that has recently been applied to domestic television aerials by Antiference, first in Band III and later in Bands IV and V, has given birth to the so-called log-periodic aerial. Although it looks like the conventional yagi its principle of working differs considerably. The array is composed of a series of in-line *dipoles* correctly matched to a special transmission line forming the boom which takes the normal feeder (see Fig. 6). The tuned frequency of successive dipoles is tapered so that as the signal frequency is varied over the bandwidth the resonance swings smoothly from one dipole to the next and so on over the series. Length and spacing of the dipoles are based on a logarithmic law (hence the aerial's name) and the system will only work when the dipoles are alternately phased along the boom. This is where the special boom-type transmission line comes in. At any frequency within the bandwidth the dipoles which are inactive tend to

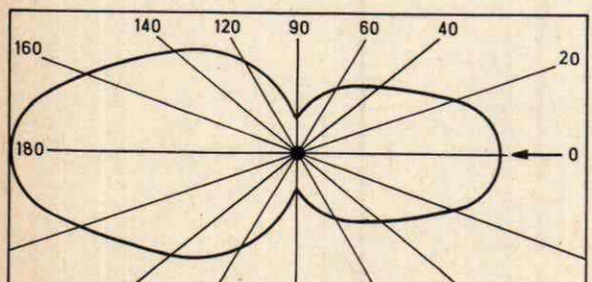


Fig. 5: Wrong design can cause a yagi to "back-fire" at certain frequencies within the bandwidth with a resulting impairment to the front-to-back ratio.

act something like parasitic elements, and in this way a very smooth bandwidth with consistency of polar diagram and loading is achieved. The gain is intrinsically less than that of a comparable yagi

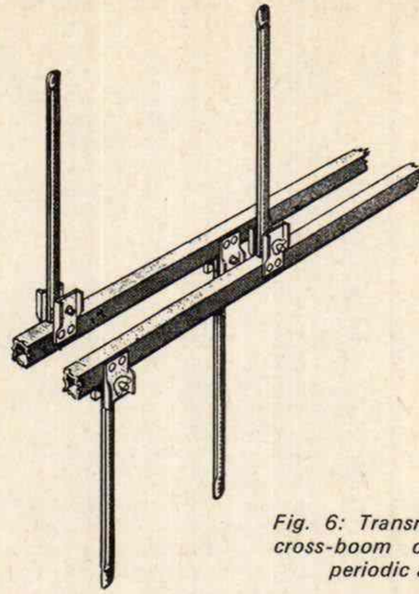


Fig. 6: Transmission-line cross-boom of the log-periodic aerial.

array but in areas of fair signals its other attributes can be very desirable.

Another idea, promoted by J-Beam, involves the use of special director elements. Those of the J-Beam Multibeam range for example are four-pronged devices and a considerable amount of basic research undertaken by J-Beam Aerials revealed that a single array employing this kind of "pronged" director throughout in conjunction with the J-Beam skeleton-slot radiator and inverse balun already described yielded almost the same high gain as a far more complicated stack of ordinary yagi arrays. Fig. 7 gives some idea of the gain versus bandwidth characteristics of a Multibeam aerial.

Basic Design Material

We have seen that there is a great deal to the design of efficient wideband u.h.f. aerials, possibly more than may have been realised. Bearing in mind the relatively low cost of guaranteed commercial arrays one wonders whether it is worthwhile to go to the trouble of making one's own, especially taking into account the "gamble" involved—when designing

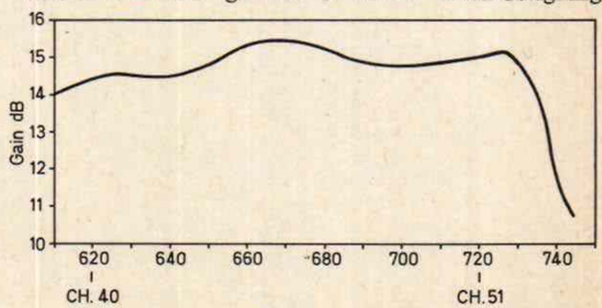


Fig. 7: Gain-bandwidth characteristic of the J-Beam Multibeam MBM38 array.

without specialised equipment—in obtaining an overall optimised design. Nevertheless quite successful u.h.f. aerials *have* been made at home and for enthusiasts wishing to have a go the following formulae will be of interest:

(1) Length of dipole in inches=5,616/frequency in MHz.
(2) Length of reflector in inches=5,976/frequency in MHz.
(3) Length of first director in inches=5,400/frequency in MHz.
(4) Spacing ($0{\cdot}25\lambda$) reflector to dipole in inches=3,052/frequency in MHz.
(5) Spacing ($0{\cdot}13\lambda$) director to dipole in inches=1,546/frequency in MHz.
(6) Spacing ($0{\cdot}13\lambda$) director to director as (5).
(7) Directors after the first can reduce progressively in length by $2\frac{1}{2}\%$.

These parameters will result essentially in a "channelised" response and adjustments along the lines examined in this article will be required to obtain wideband characteristics. Table 1 lists the five standard channel groups, the identification letters and colours, the channels and frequencies involved and the range of the groups in MHz. It will be seen that the frequency range is not the same for all groups, becoming wider with ascending group letter. Groups D and E cater for those areas which for some reason cannot use the basic 88 MHz bandwidth. ■

SERVICING TV RECEIVERS

—continued from page 359

and 4R7 will normally show whether this transistor is in fact the cause of the trouble.

System Switching

The method of switching on both panels is somewhat less than ideal and should be checked several times as the throw can vary. The left side is adjusted by moving the panel up or down and tightening the top and bottom screws in the correct positions. The right side is adjusted by opening or closing the V-shaped wire at the top.

Voltage Conditions

The readings given on the circuit diagrams were measured with 240V a.c. mains input, small signal input, contrast set for normal picture and normal width and height using an Avo Model 8 (20,000Ω/V). Voltages followed by an asterisk were taken on 625 lines.

Picture Tube

19in. models are fitted with an A47-11W or CME1905 picture tube, 23in. models with an A59-11W or CME2305 tube.

Associated Models

Many Defiant models marketed by the C.W.S., for example the 903 and 303, employ this as well as earlier and later Bush chassis.

NEXT MONTH: GEC-SOBELL 2010-1010 SERIES

DX-TV

—continued from page 356

the appropriate Band/Channel, in excess of 13dB forward gain if possible. (4) It is very important that your receiver is (a) accurately calibrated for each channel you wish to investigate and that (b) your line and field lock controls are correctly set for 625 lines, 50 fields.

The set must lock-in on any picture received immediately. You will appreciate that one second or so signal bursts allow no time for readjustment of the controls. So get your receiver set up correctly, position the aerial towards the area of hoped for reception—for the British Isles I would suggest towards the North East, midway between the USSR and Scandinavia—then keep your attention riveted on the screen, and the best of good luck to you all!

Bob Cooper says that so far his reactions have been too slow to get any off-screen photos, so you know what we are up against! This new type of reception is I feel strictly for the established DXer and not for beginners until they have had a lot of SpE experience. It is however a very worthwhile project and can open up further DX fields for us that are independent of SpE and/or Trop conditions. Reception has already been achieved at the l.f. end of Band III and further investigation could show that it applies throughout the band.

IN NEXT MONTH'S ISSUE . . .

TV IN THE DARK

Most TV camera tubes are relatively insensitive, requiring high studio light levels. Techniques used in some specialised modern tubes have however led to remarkable advances, with clear TV pictures produced under starlight conditions, i.e. illumination levels millions of times less than those used in broadcasting studios. These new techniques are fully described.

THE 625-LINE RECEIVER

Next month we shall be publishing full underchassis wiring details for the constructor's single-standard 625-line receiver.

POWER SUPPLY CIRCUITS

A detailed account of the power supply arrangements used in TV receivers—including hybrid and colour sets—with fault summary.

R−Y PHASE ALTERNATION

The heart of a PAL colour receiver is the circuitry needed to process the line-by-line phase alternation of the R−Y chroma signal in the PAL system. The principles involved and circuits used are explained.

SERVICING TV RECEIVERS

A large number of models are fitted with the basic GEC-Sobell 2010-1010 chassis, the subject of our next servicing feature.

PLUS ALL THE REGULAR FEATURES

JUNE ISSUE ON SALE MAY 21

SINGLE-STANDARD 625-LINE RECEIVER FOR THE CONSTRUCTOR PART 3

KEITH CUMMINS

We have now reached the stage when the line timebase arrangements can be examined in detail. Four of the eight valves used in the receiver are employed in the line timebase section so it will be realised that this part represents a large proportion of the circuit the constructor is required to build.

As the majority of readers will be well aware the line timebase besides providing the line scanning for the picture tube also supplies the e.h.t. needed by the tube final anode and a boosted h.t. rail. The boost rail feeds the charging circuit of the field timebase and the first anode of the picture tube. Therefore we can think of the line timebase in relation to the remainder of the receiver as a "black box" with synchronising pulses and power fed in and the boosted h.t., e.h.t. and line scanning coming out. Since it is possible to regard the line timebase section as a unit we will first discuss the circuit as a whole and then deal with its detailed internal functions.

Basic Considerations

The timebase is supplied with a positive h.t. rail of 230V and synchronising pulses from the sync separator stage V2a. While the noise-cancelling sync separator described in last month's issue reduces extraneous pulses to a minimum, it is still possible for noise occurring during a sync pulse period to operate the cancelling circuit so that the output pulse is removed. Considering the rate of line scanning, there is a high probability that sustained interference will bring about the deletion of line pulses. Lower-level interference below the cancellation threshold can produce additional incorrect line sync pulses. It will be appreciated therefore that the timebase should be designed to minimise the effects of sync pulse disturbance.

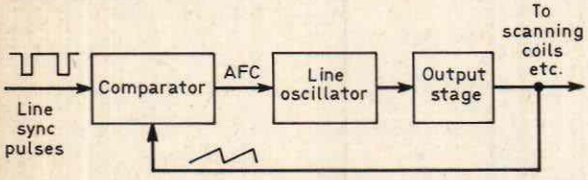


Fig. 5: Block diagram showing the basic operation of a flywheel line timebase.

The type of circuit employed controls the line timebase speed by comparing the mean incoming pulse rate with a sample of the timebase output, rather than having every line triggered by an incoming pulse. Experienced readers will recognise this as the flywheel timebase technique. Random interference with the regular chain of sync pulses has little effect since the timebase responds only to the aggregate comparison of a large number of pulses. The basic system is shown in block form in Fig. 5.

The line oscillator drives the output stage and a sample of the output waveform is taken to the comparator where it is compared with the incoming line sync pulses. Depending upon whether the repetition rate of the incoming pulses is greater or less than the repetition rate of the timebase, the output from the discriminator will be a d.c. potential above or below earth. When the natural repetition rate of the timebase is the same as that of the sync pulses the discriminator output is zero.

Between the discriminator and the line oscillator is interposed a circuit with a time-constant equivalent to several picture lines, so that a significant error-control voltage cannot build up as a result of individual line pulse disturbances. Also the effect of noise on the sync pulses is significantly reduced. In effect this automatic frequency control system gives the timebase a running effect similar to mechanical inertia, hence the term "flywheel timebase".

Some readers will have recognised the foregoing dscription as that of a servo system, which brings us to two further design considerations, pull-in range and timebase stability. The pull-in range simply means the maximum frequency difference between input signal and oscillator that the system can correct before manipulation of the line hold control is necessary. It is important to note that while a wide pull-in range would superficially appear to be worthwhile it also involves a deterioration in noise immunity, tending to defeat the whole object of the exercise! This deterioration results from the necessary choice of time-constant in the filter circuit between the comparator and oscillator. From the noise point of view a narrow pull-in range is best. This however requires good oscillator stability since if the oscillator drifts badly the control circuit will not be able to apply sufficient correction.

The reader will now realise that here, as in the majority of design work, a suitable compromise has to be made between two conflicting requirements. The best oscillator circuit from the stability point of view is one using a tuned circuit. *LC* oscillators are in fact used in the majority of colour receiver line timebase designs. The stability of such an oscillator is determined by the capacitance and inductance and depends little on such factors as ageing valves etc.

From the constructor's point of view however an *LC* oscillator has one daunting disadvantage—the need for a special inductor with a large number of turns. It was decided therefore to adopt a compromise solution, using a multivibrator circuit with as good stability as possible. This course of action appears to have been completely satisfactory and the circuit as shown (Fig. 6) represents the result of a rigorous period of evaluation and test. The

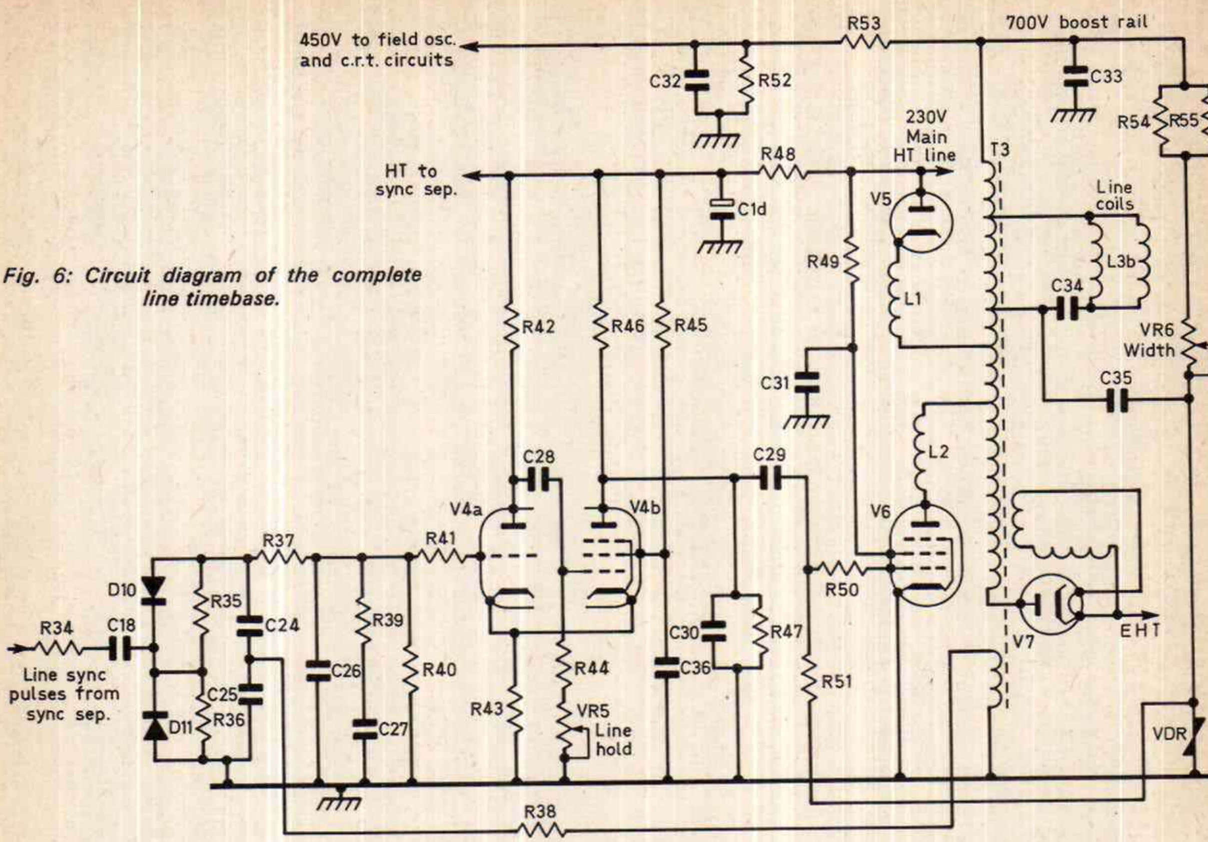


Fig. 6: Circuit diagram of the complete line timebase.

pull-in range has to be wider than would have been necessary had an *LC* oscillator been employed, but the noise immunity has proved to be completely adequate on test.

Flywheel Sync Circuit

We will next look at the circuit (Fig. 6) in detail. The line sync pulses from the sync separator are applied to the cathodes of D10 and D11 via the current-limiting resistor R34 and coupling capacitor C18. The diodes are shunted individually by resistors R35 and R36. The anode of D11 is earthed while the anode of D10 connects to the output line. From the output line to earth are connected capacitors C24 and C25 in series and the junction of these capacitors is fed with the sample of the timebase output via R38.

It will be realised on inspection of the circuit that if no signal is applied to the junction of C24 and C25, while the sync pulses are applied to the junction of D10 and D11, there will be no d.c. signal output from the circuit via R37. This occurs since D10 and D11 are in opposition to one another and while the negative-going sync pulses cause D11 to conduct and the junction of the diodes moves positively, D10 cannot conduct. Similarly if the sync pulses are removed and only the comparison signal from the timebase is applied there is again no output.

When both signals are applied however an output from the discriminator appears, its sense depending upon which signal has the faster repetition. The signal from the timebase is a sawtooth with a large overshoot. The overshoot is effectively removed by the integrating effect of R38 and C25, so that only a sawtooth waveform is left for application to the discriminator. The arrival of both sync pulses and sawtooth waveform brings about conditions of unequal conduction in D10 and D11 if the two signals are not coincident, so producing an out-of-balance voltage which is taken off via R37.

R37 and C26 form the elements of the filter circuit mentioned earlier. In addition R39 and C27 are included. These form an anti-hunt network which stabilises the a.f.c. action. Without these components the correction signal would overshoot its optimum point cyclically, positively and negatively, so that the timebase would never find its correct operating point. By introducing critical damping, R39 and C27 effectively render the system " dead beat ". Finally R40 besides restricting the pull-in range also reduces the d.c. impedance presented to the triode grid of V4.

Line Oscillator

V4a and b form a cathode-coupled multivibrator oscillator. This type of oscillator is useful for applications where a free electrode, namely V4a grid, is needed for the application of a control signal.

The action of the timebase is as follows. We start at a point when V4b control grid is negative and the valve is cut off. V4a is conducting. C30 commences charging exponentially via R46 from the positive h.t. supply. C28 is holding a charge which is decaying at a rate determined by the value of R44 and VR5, the line hold control. Eventually the negative grid potential on V4b has decayed sufficiently to allow the valve to conduct. Anode and screen grid currents start to flow in V4b and pass through the common cathode resistor R43. The cathode potential of both V4b and V4a rises. So far as V4a is concerned this positive drive on its cathode is the same as a negative drive to its grid. Its anode current falls so causing its anode voltage to rise. This positive rise is conveyed via C28 to the grid of V4b, which in turn produces a further rise of the cathode voltage. The effect is cumulative and very rapid. The positive output (anode voltage) of V4a charges C28 via grid current in V4b. When C28 has charged grid current in V4b ceases and the cathode potentials fall, so turning on V4a. V4a anode potential reverts to normal and V4b is cut-off.

During the period of V4b conduction C30 discharges. It commences recharging when V4b cuts-off. So the output of the circuit is an exponential charging waveform with rapid flyback.

It will be noticed that the cut-on time of V4b is not only a function of its grid time-constant but also depends upon its cathode bias, which during the scan time is determined by the current flowing in V4a. This current is controlled by the grid potential of V4a, so it can be seen that the d.c. potential applied to this grid from the a.f.c. circuit will control the cut-on point of V4b and hence the frequency of the oscillator. Note that R45 and C36 have a time-constant chosen to improve the overall frequency stability of the oscillator.

Line Output Stage

The output circuit of the line oscillator consists of R46, R47 and C30. C30 is the charging capacitor and R46 the charging resistor. R47 is included to control the maximum drive amplitude so that it is less dependent upon valve characteristics. The output waveform is coupled to the grid circuit of the PL36 line output valve via C29. The remainder of the grid circuit consists of the stopper resistor R50 to inhibit parasitic oscillations and R51 the grid d.c. return resistor. The timebase is amplitude stabilised, so R51 is returned to the stabilisation circuit instead of to chassis.

As the line output valve does not saturate when operated in a stabilised circuit it can be regarded as an amplifier, the mean working point of which is controlled by a negative bias derived from the stabilisation circuit. To prevent screen grid feedback, the screen grid is decoupled to chassis by C31. Such a capacitor is not incorporated in line output stages which are used as simple switches, keying power into the line transformer.

The line transformer is an autotransformer with two small auxiliary windings, one for the heater of the e.h.t. rectifier V7 and the other for the comparator pulse output to the horizontal discriminator.

While the line output stage follows what has come to be accepted as conventional design it is useful at this point to consider its method of operation.

We shall start at the end of scan period as this is the most convenient point to begin a description of the line scanning cycle. At this point the current in the scan coils, reflected by the line transformer into the line output valve, is at a maximum. During the scan period it has been increasing with time at a rate determined by the inductance of the circuit and the applied voltage. V6 is turned on to an extent dependent upon the stabilisation circuit bias (more of this later). The next event is the initiation of the flyback period, when V6 is suddenly turned off by the drive from V4.

The flow of current in V6 ceases abruptly but energy is still contained in the magnetic flux within the scan coils. This because of the cessation of current flow starts to collapse. The collapse of the flux produces in the scanning coils a voltage peak which tries to maintain the original condition, i.e. the anode potential of V6 moves in a positive direction in an effort to maintain the current flow. As V6 however is completely cut off it will not conduct even with a high anode voltage. The circuit would then ring at a frequency determined by the inductances and capacitances present—were it not for V5.

The second half-cycle of the attempted " ring" just referred to causes the cathode of V5 to move negatively with respect to its anode so that it conducts. As V6 remains cut off the energy in the circuit is transferred to C33 which becomes charged. The efficiency diode V5 effectively damps the circuit and the initial heavy current decreases at a rate again determined by the voltage and inductance.

The reader will probably have observed that the direction of current flow as a result of the damper diode's action is in the opposite direction to that of V6, the line output valve. Also the current is decreasing through V5 whereas it increases with time through V6. This is of course just what we need since the initial high current in V5 places the scan at the extreme left of the screen while the linear decrease moves the spot towards the centre. Thus it will be seen that the damper diode circuit provides the first part of the line scan. The recovered energy stored in C33 is also utilised to provide an increased h.t. rail (the boost rail) which reduces the current demand on V6 so that the efficiency is even further improved.

It will be noticed that the lower end of C33 is connected to earth instead of the h.t. rail as is more usual. This method of connection was adopted in order to reduce the line frequency ripple present on the h.t. rail.

In order to provide e.h.t. for the cathode-ray tube the high voltage positive pulse appearing at V6 anode at the flyback time is stepped up by an overwind on the autotransformer and rectified by V7 the e.h.t. diode. The heater of this valve is supplied by a small winding on the e.h.t. transformer.

The line scanning coils are connected to the line output transformer via capacitor C34. This is an S-correction capacitor. Since 110° scanning is used the c.r.t. is short and its gun is significantly closer to the centre of the screen than to the edges. If the tube is scanned linearly there would thus be more

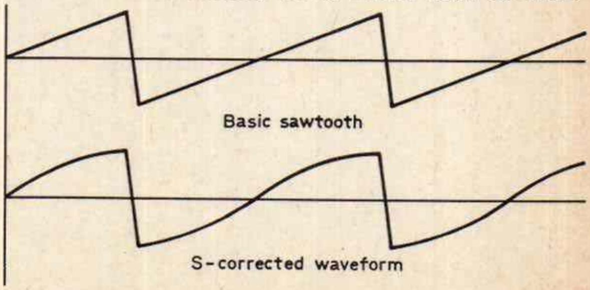


Fig. 7: Illustrating S-correction of line scanning.

movement of the beam near the edge of the screen, where the beam length is greater, than at the centre. Consequently some means has to be devised to increase the scanning speed at the centre of the screen and reduce it at the sides. This means that the scanning current waveform instead of being a saw-tooth must be more S-shaped, as shown in Fig. 7.

The required effect is obtained by placing C34 in series with the scanning coils. The scheme operates by resonance between the inductance of the coils and the correction capacitor. The circuit is pulsed into a damped oscillation by the flyback pulse. It will be seen from Fig. 7 that the correction waveform should be part of a sinewave and by choosing the resonant frequency so that it is around one half of the line frequency or a little less the position of a sinewave initiated by the flyback will modify the scanning waveform to that required.

Stabilisation Circuit

The width stabilisation circuit consists of C35, the v.d.r. E298ZZ/06, VR6 the width control, R54 and R55. The action of the circuit depends upon the characteristics of the varistor—otherwise known as a voltage-dependent resistor. The characteristic is such that when logarithmic applied voltage is plotted graphically against logarithmic internal resistance an approximately straight line results. It will be seen therefore than when presented with unidirectional pulses the v.d.r. behaves as a rectifier conducting significantly on pulses only.

In the circuit shown positive pulses from the scanning coils are applied via C35 to the varistor. Because of the rectification, a mean negative voltage appears at the top end of the varistor. This voltage is coupled to the grid of V6 via R51. Irregularity is effectively smoothed out by C29 and C30 so that the feedback is d.c. only. The negative voltage tends to cut V6 off. It is offset by applying a variable positive current via R54, R55 and VR6 to the varistor. VR6 forms the width control since it sets the operating point of the line output valve. As a result of the action of this circuit any decrease in the output from the timebase will result in the negative bias to V6 becoming less. Thus a greater current will flow, offsetting the decrease in output and stabilising the scan amplitude.

Miscellaneous Details

The heater supply for the line oscillator V4 is taken from the low-voltage 16V winding on the mains transformer. V4 heater is connected in series with that of V2 to make up the 16V. The centre point is decoupled by C42 which serves to shunt transients appearing on the heater line. V5 and V6 heaters are connected in series as part of the 75V heater chain. The heater of V6 is connected to chassis on one side, thus minimising the possibility of a heater-cathode short. In series with the top cap leads of V5 and V6 are small chokes L1 and L2. These chokes may be 1A suppressor types and serve to prevent parasitic oscillations, particularly the Barkhausen-Kurz type, which produce a vertical line on the screen.

The line transformer itself is bolted to the side plate of the receiver by its core securing bolts. In order to mount it this way its mounting lugs as supplied have to be carefully cut off, using tin shears. V7 and its mounting form an integral part of the assembly, the valve being mounted vertically which helps prevent cathode sag, a problem with horizontally-mounted e.h.t. rectifiers.

When the line transformer is mounted in this position it is surrounded by objects which help to screen it without the need for a specially constructed can. There is the vertical side plate of course (also acting as a heat sink) and the main chassis. The c.r.t. has its outer aquadag coating earthed, which also assists since the c.r.t. is in close proximity to the transformer. Ventilation and cooling of the line time-base are thus very efficient.

The layout diagram (next month) shows the disposition of the components in the line timebase. Note that the lead from the sync separator to the horizontal discriminator is screened.

The h.t. supply for the line oscillator valve V4 is filtered by R48 and C1d which ensure that the supply is completely free from mains ripple. This is essential since the oscillator can be phase modulated by ripple, causing bent verticals. And since the transmissions are asynchronous any bending will move up or down the picture. The well-smoothed h.t. supply for the line oscillator is also used to feed the anode of the sync separator stage, via R56, ensuring that a.c. ripple is not superimposed upon the sync pulses. Such ripple could again produce phase modulation of the line timebase and also disrupt the field synchronisation.

Note that the numbers shown against the connections to the line transformer correspond to those marked on the tag connection layout diagram (Fig. 4). The constructor will find some small components attached to the line transformer. These are not used in this design and may be left *in situ* or removed; it makes no difference.

Remember that all the leads associated with the line timebase carry high voltages, d.c. or pulses or both. Therefore the leads should be spaced away from the chassis and sleeved where they pass through holes. Sufficient insulation is provided on the e.h.t. lead to enable it to touch the chassis however where it emerges from the bottom of the line transformer. When fitting the c.r.t. ensure that the e.h.t. cap connection is adjacent to the line timebase.

Audio Stages

The a.f. amplifier and output circuits are shown in Fig. 8. A conventional triode-pentode valve type PCL82 is used with its heater fed directly from the 16V winding on the mains transformer. The constructor may wonder why a valve as opposed to a transistor amplifier has been used. The main reason is simplicity. A transistor amplifier is rather more complicated than its valve counterpart. If it is to be fed from the existing transistor power supply its varying load, associated with normal class B working, could produce fluctuation of the supply voltage. Such fluctuations could disturb the action of the other transistor circuits so that either a separate power supply or a regulated supply would be needed. In the event of a transformerless output stage being used a high-impedance speaker would be necessary, another difficulty. While if a transformer were to be used it would need to be a special component.

In view of the foregoing considerations a valve circuit has been used with a conventional output

—*continued on page 371*

REGULAR LONG-RANGE TV RECEPTION PART 2

K.E.G. PITT, B.Sc.

LAST month we described how it is possible to forecast which television transmissions may be received at a given site, including those normally considered out of range. The aim of these articles is twofold: to help viewers to decide whether or not they are using the best set of transmissions for their location, and to obtain additional ITV or BBC regional programmes to the ones normally used. It may not be generally realised that while the majority of ITV programmes are networked and eventually appear on most of the regional programme companies' schedules, the exact time may vary widely, giving a choice of programmes between adjacent regions. It should be noted however that although a distant transmitter may well give excellent results for most of the time there will be periods in which reception may be marred by interference from much more distant stations sharing the same channel. These freak transmissions often arise as a result of settled weather conditions. During these periods the extra programme may be below entertainment value due to patterning and line pairing effects.

Set Sensitivity

Having first decided which channels may be worth examining by means of transmitter maps as described previously, the set must next be critically examined to see whether it is capable of receiving them. A number of general points are worth considering. The ability of a set to give a reasonable picture on any given channel is governed by its overall sensitivity. If the set is very modern it is probably of high gain with automatic gain control enabling it to peak to its maximum sensitivity without control adjustment. It is also likely to be very much more sensitive than older sets. As a result, if a relatively new set fails to give a picture on a given channel once an aerial for that station is plugged in then probably there is little value in further study.

On an older set a local/distant control or a sensitivity control may preset the gain. Advancing these may bring in a picture. In addition in some earlier sets the contrast control itself acts partially as a gain control and advancing this may help.

The above of course assumes that there is present a set of coils for the required channel. Many modern sets carry coils for all channels or have continuous push-button tuning for Bands I or III. Earlier sets often only had coils for the local BBC/ITA channels, e.g. in the London area 1 and 9 only.

Selectivity

A third factor which may affect the usability of a weak signal is the presence of a strong signal on an adjacent channel which tends to swamp its weaker neighbours. Some recent sets have greater selectivity than earlier ones and are designed to accept adjacent channels without interference. If this is not the case then it is quite possible that reception of an adjacent weak station will not be practicable.

Aerial System

Having decided that the set is suitable it is necessary to install an aerial system for the extra channels. In really favourable cases adequate pictures can be received on the existing aerial but this is an exceptional condition. It is often the case that the distant transmission is of a different polarisation from the local one. It will almost certainly be in a different direction and often on a channel some way away from the local one.

To get adequate reception of a weak signal the correct channel aerial is necessary. Use of an aerial cut for another channel gives poor results. For example a channel 10 aerial gave adequate results on channel 11 but poor results on 12 and 6 whereas a lower gain commercial broadband aerial gave results on channel 6 as good as the other aerial gave on channel 10 and a little better than previously on channel 12.

Possible Arrangements

The ideal system is to mount a correct channel aerial outside on the existing mast and line up accurately for the desired station. If possible use low-loss coaxial cable to improve the results. To change over aerials one can either use a rotary switch with a common coaxial lead to the set or to avoid losses plug over when required. The rotary switch should not be a paxolin type at 200MHz. A p.t.f.e. or ceramic type is necessary and it should be housed near the set in a plastic box with an insulated knob. This avoids risk of live parts if the aerial socket becomes live due to failure of insulation.

An aerial in the loft may in practice be adequate and is easier and cheaper to install. If the two or more signals desired are of the same polarisation then a rotary mast system and an aerial of sufficient bandwidth to cover all the channels is a possible solution. In the author's own case it was necessary to use three separate aerials and cables with a change-over switch. This was because the three stations required were Croydon (channel 9 vertical) south, Dover (channel 10 vertical) south east, and either Mendlesham (channel 11 horizontal) north east or Sandy Heath (channel 6 horizontal) north. As mentioned above the use of the wrong channel aerial gave poor results.

UHF Reception

Duplication of ITA stations on u.h.f. is also giving an opportunity for long-range reception but here the use of outside aerials is very much more beneficial because of the very great attenuation of these frequencies by roofing materials. Good long-range colour results are unlikely with loft aerials. For best results in Bands IV and V a separate outside aerial of the correct channel group, direction and polarisation is generally essential. It is preferable to use separate aerials and to plug over to avoid mismatch trouble with a rotary switch.

Installing a Loft Aerial

In general when installing a loft aerial on any Band it is better for the operator to move well away from the aerial while his partner examines the results on the screen because body capacitance can give very misleading results. When installing in the loft it may often be found that some locations are vastly better than others and a little patience can be very well rewarded in the shape of unexpectedly good results.

Preamplifiers

A further increase in gain can sometimes be obtained by the use of a preamplifier. If however the picture is already noisy there may be little benefit in doing so. Best results are obtained by installing the preamplifier at the aerial end of the cable. Some commercial models are regularly advertised in PRACTICAL TELEVISION.

Experimental Investigations

Although a great deal of useful information on aerial installation is available in books and magazines there is much scope for experimental investigation and improvisation and non-conventional techniques often give surprisingly good results. The one area where improvisation must be avoided is electrical safety. Always ensure that an aerial is isolated from the mains, either by deliberately added capacitors or by capacitors present in the set itself.

Overseas Reception

In general one may well be able to receive results from foreign stations regularly, particularly on the south and south east coasts. However the system standards are all different from the British v.h.f. system. The French u.h.f. and v.h.f. systems both use positive modulation on vision with a.m. sound. This means that on v.h.f. pictures and sound can be received on a normal set but not together due to the different bandwidth. The number of lines on v.h.f. is 819 and this is again non-compatible. The French u.h.f. system is equally incompatible due to the positive vision and a.m. sound. Belgian transmissions are 625 lines and may use either positive or negative modulation and a.m. or f.m. sound depending on whether they are to the French- or Flemish-speaking areas.

Other Continental v.h.f. and u.h.f. systems are virtually compatible with the British u.h.f. system. The only country using the British 405-line system, and that only from one main transmitter, is the Republic of Ireland which still transmits R.T.E. from Mt. Kippure, Dublin on 405 lines as well as using the CCIR 625-line system. The latter system is in use exclusively in the rest of the Republic.

It is thus really necessary to have a set specially adapted to receive any regularly available foreign transmissions. It is not practicable to do this with one's normal domestic set. ■

625-LINE RECEIVER

—continued from page 369

transformer and speaker arrangement. The power supply presents little problem since the output stage naturally operates under class A conditions. Separate decoupling and smoothing for the audio section is provided by R3 and C1b.

Audio from the f.m. discriminator is applied to the volume control VR9. The audio signal from the wiper of the control is coupled to the grid of V8a by C37. Grid current biasing is developed across R57. The main sound h.t. supply is further decoupled by R60 and C38 before feeding V8a anode via its load resistor R59 and the screen grid of V8b. The triode V8a amplifier raises the audio signal to a level to drive the output section of V8b. The signal is coupled by capacitor C39 to the grid end of resistor R61. V8b uses conventional cathode biasing (a wire-wound resistor is used here since cathode resistors have the unhappy habit of becoming low-resistance after a while). The cathode resistor is bypassed by C40.

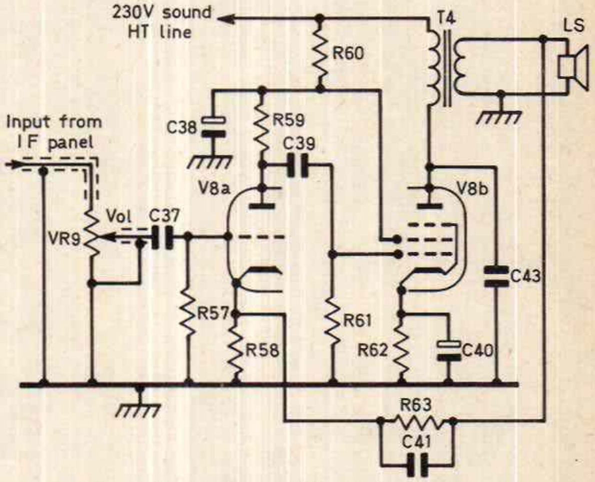


Fig. 8: The audio amplifier and output stages.

Negative feedback from the secondary of the audio output transformer T4 is applied via the network C41, R63 and R58 to the cathode of V8a. This feedback improves the audio quality at the expense of overall gain. To prevent possible h.f. instability the anode of V8b is decoupled to chassis by C43 (0·0047μF not 0·047μF as shown in the components list).

The audio output will match a 3Ω loudspeaker and an extension speaker socket can be fitted if desired to the secondary of the output transformer. Also earphones or a deaf-aid earpiece may be connected with complete safety *provided the chassis is earthed as recommended.*

Note that the leads to and from the volume control should be screened. The audio output transformer is mounted between the speaker and the mains transformer, the leads passing through the hole in the chassis which also carries leads from the mains transformer and r.f. sections.

We shall deal with the i.f. and tuner sections of the receiver next month.

TO BE CONTINUED

UNDERNEATH THE DIPOLE

"IF winter comes, can spring be far behind?" was an optimistic question often quoted fifty years ago. Winter gloom, leafless trees, concrete structural horrors, strikes, taxation, concentrated protein pills (in lieu of juicy steaks) all make up the modern world. Thank goodness that colour television features shot in summer about the countryside, animals, history, beautiful architecture and similar refreshing presentations are kept in deep freeze for winter viewing, particularly by the BBC. Subjects like *Civilisation,* acclaimed all round the world, are antidotes as are also some much smaller (almost insignificant by comparison) colour features from regional ITV stations. Iconos (and I'm sure all viewers) asks the BBC and all the ITV major and regionals to preserve some of the 1970 summer on film and tape for serving up in the gloomy days of winter.

FINE ARTS

Will radio and television ever be regarded as "fine arts", in the way the arts of painting, sculpture, engraving and music were considered a couple of centuries ago? These were esteemed as the products of "good taste, elegance, refinement and delicacy" the aesthetic appreciation of which was a matter of understanding the classic rules of the particular fine art concerned.

"Rules are made to be broken" is a commonplace (but inaccurate) saying. But rules are as essential in broadcasting communication as is the punctuation of the written word. In music hall terms, the comedian hopes his act will end with the audience wanting more. The stage actor, playright and producer crave for applause. But what reaction does the television producer want or for that matter the organisation that employs him?

It is indeed difficult to find a logical reason for televising to the public material which they find offensive and which they can (and frequently do) switch off. After seeing about ten minutes of BBC-1's *The Dance of the Seven Veils* I switched off and resolved not to mention that nasty presentation in this column until I spoke to ten regular television viewers on the following day. Nine of them had switched their sets off or turned over to ITV. The tenth (who was a film director) held on to the end because he said he "couldn't believe such rubbish possible". The newspaper TV critics usually applaud avant-garde rule-breaking trends; but they didn't think much of it either. The only people who benefit from this kind of product from the BBC are the ITV companies to whose programmes the offended viewers flee.

COMMERCIALS

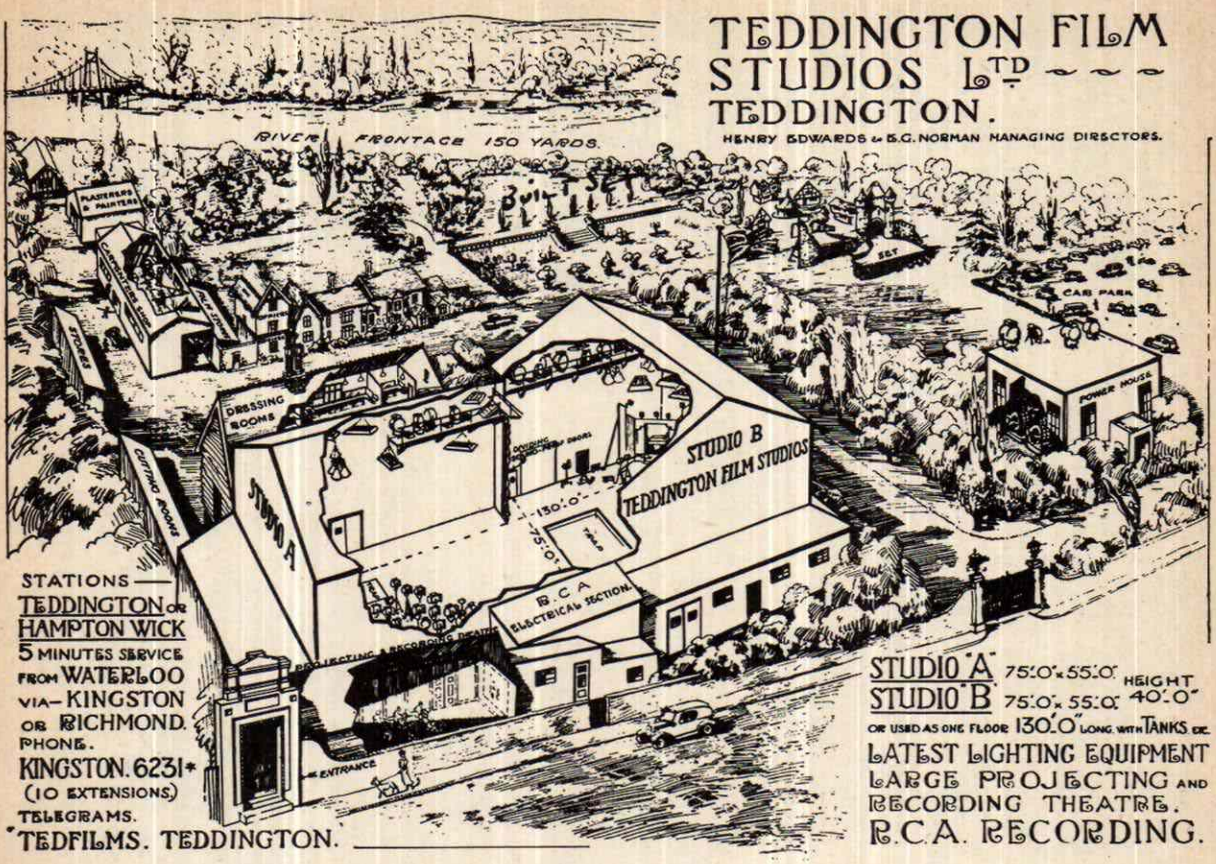
There is no doubt that colour has put a new dimension into TV commercials—excepting when they are made with videotape. This is usually because videotaping is the only way to make a commercial quickly—because of a rush, because of topicality or because it is cheaper. Tape editing can involve transfers from one videotape machine to another; A and B roll transfers to a third machine; sequential overlaying; guillotining or simple skilled use of a pair of non-magnetic scissors in precisely the right place (when it can be located!). Though the long-established use of 35mm. film with its optically introduced dissolves, wipes and superimpositions will always continue, especially for commercials, the sophisticated use of new technical tricks in video is gaining ground. The extremely high capital outlay of such equipment leads to very high charges per hour for its use. The high speed with which such complicated operations can be carried out could justify the "high cost to low utilisation time" ratio—if the human element, the editor, could do it.

2 EMMA TOC WRITTLE TUESDAY EVEN!

Curiosity always gets the better of me when I see bundles of dusty books in dimly lit junk shops or at jumble sales. Recently I found an almost mint copy of *Broadcasting from Within* by C. A. Lewis ("Caractacus") and published in 1925(?) by George Newnes. It is an unofficial history of the British Broadcasting Company's first year of operations but it also talks of the pre-2LO days—of Captain P. P. Eckersley's tiny 250W transmitting station at Writtle with its call sign 2 EMMA TOC. This station sent out a half-hour programme every Tuesday to the growing number of wireless "hams", beginning operations in February 1921 and discontinuing early in 1923. 2 EMMA TOC transmitted the first wireless play in the United Kingdom—a scene from *Cyrano de Bergerac*—so the Tuesday play came before the Wednesday Play or Saturday Night Theatre!

C. A. Lewis, or "Uncle Caractacus" as he was known to thousands of children via the early Children's Hour programme, wrote a fascinating book—and the "B.O.P." and "Harry Wharton" atmosphere of those pioneer days comes out in such passages as this about the engineer at a concert broadcast: ". . . a crackle begins to develop. The concert becomes hopelessly distorted. The engineer leaps to the telephone and asks them to hold the concert up. He then looks quickly over the set . . . the insulation has broken down in one of the condensers. Off goes the current while a spare condenser seized from the store is quickly connected in place of the dud one. In goes the switch, the generators hum up to their load and the engineer telephones through to the studio 'Carry on, quite O.K.' The station was out of action for perhaps three minutes. Indeed during the total transmission time of the last year the breakdown period was $\frac{1}{4}$%!" That was the time when BBC HQ were at Savoy Hill, when *every* programme was broadcast from one studio and one microphone.

Broadcasting from Within told us that "the cost of a transmission station complete is estimated at £8,000" and suggested to aspiring singers that "It's



worthwhile to be singing for the BBC. Think it over." A few years later the writer of this column designed a new-fangled "dramatic control panel" which controlled the outputs from several studio sources, with artificial echo and group mixing from five volume controls on each side of a central knob. It was unused for nearly a year before a producer summoned up courage to use it. The producer was "Uncle Caractacus".

In a chapter entitled *A Glance Ahead* Mr. Lewis wrote of "stereoscopic broadcasting" and Captain Round's (the Independent Research Department Chief of the Marconi Company) idea that "two transmitters would be kept working on their respective wavelengths, each connected to a microphone in the same studio . . . the listener fortunate enough to have two sets (two crystal sets don't cost *so* much) would tune to each of the two wavelengths respectively and get the stereoscopic effect."

THAMES TELEVISION STUDIO'S ORIGIN

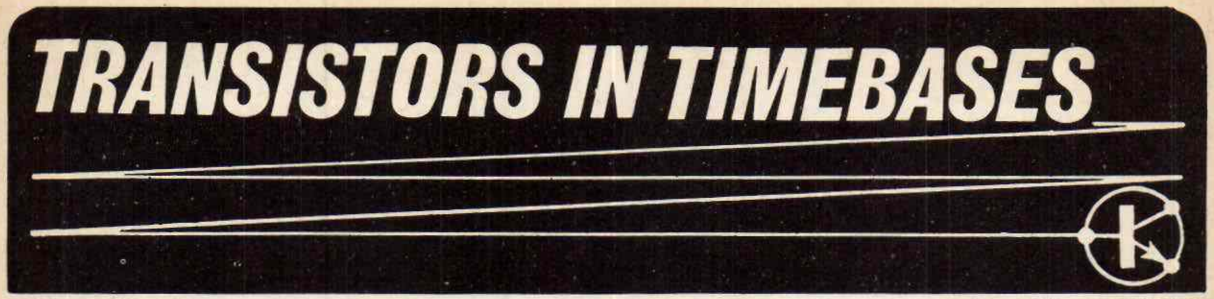
Teddington is a pleasant riverside suburb of London famous for its lock, footbridge and weir. Close to the weir on the Middlesex side was the secluded mansion Weir House, with stables, coach house, well laid out gardens and river banks ideal for anglers. Except for the noise of the water cascading down the weir and the occasional husky hoot of a passing steamer all was peace and quiet—that was until 1915 when a film company moved in, producing "Ecko" comedies with the inevitable chases and ultimate splashing watery endings. Interior settings were erected in the grounds on a revolving platform to face the sun. Later a glass-house studio was built, shown in our illustration as Studio A, to which Studio B was later added.

At this time, in 1932, it was soundproofed for talking pictures, using the RCA Photophone system, under the direction of Henry Edwards. Warner Brothers of the USA leased it for two years and then bought it, adding a new large stage, two theatres, cutting rooms etc. It was bombed in the last war but afterwards restored. It was an ideal site for a studio for big-scale television productions and ABC Television, then with the weekend Birmingham and Manchester ITV franchises, took it over. This was a courageous step, taken when commercial television was losing millions during its first two-three years.

It has now become the main production centre for Thames Television, formed from ABC and Associated Rediffusion, with a second smaller studio complex near Euston. The perspective sketch was kindly lent by Mrs. Henry Edwards (formerly known as Chrissie White the British silent-screen film star). From the earliest days of silent comic policemen—played by Charles Austin, Lupino Lane, Billy Merson and other early crazy-gangers—it was locally referred to as "Weird House". Still in show business it retains that nickname.

Iconos

TRANSISTORS IN TIMEBASES



PART 7 FIELD OSCILLATORS

H. W. HELLYER

FIELD timebases develop a lot of power. We can expect the deflection circuits to dissipate some 8W, even for a black-and-white receiver, while for colour reception it may be necessary to allow for half as much again. This has caused the development of fully transistorised field timebases to lag and in the hybrid set we usually find that the field output stage at least is designed around a well-tried valve. In the early days of transistorised television receivers there was a lot of talk about the impossibility of getting rid of the output inductor, and the oscillator-driver part of the circuit was largely taken for granted. Nowadays design concepts take the field timebase as a whole, regarding the oscillator as a switching device and part of a flyback switch.

BASIC DIRECT-COUPLED CIRCUIT

Figure 1 shows in simplified form the basic arrangement commonly used. This is a direct-coupled sawtooth generator using three transistors, the first being shown as a switch. The main action of the circuit is to discharge capacitor C through

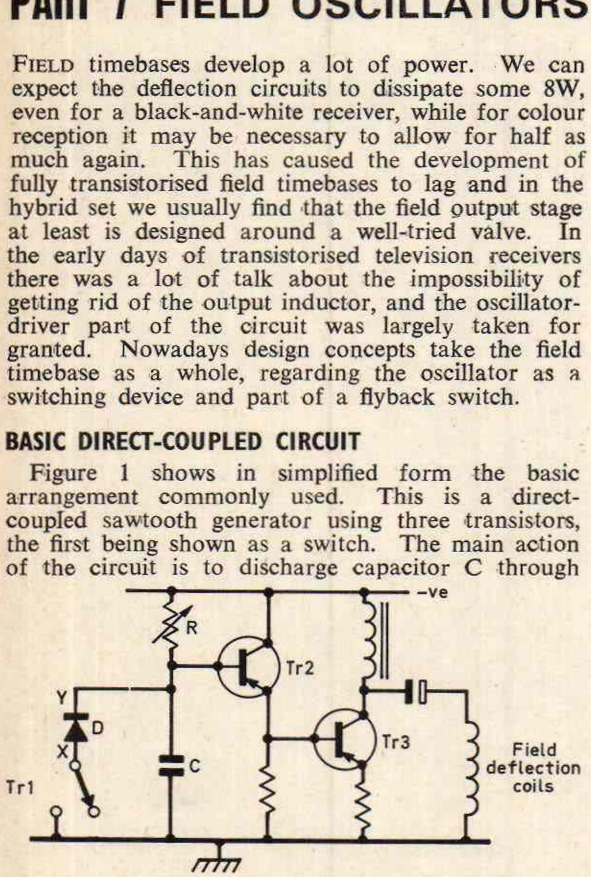


Fig. 1: Basic direct-coupled sawtooth-generator field timebase circuit with oscillator stage Tr1 shown as a switch.

diode D at regular intervals. C charges exponentially depending on the values of C, the variable control R and the supply voltage to provide the sawtooth waveform. When "Tr1" conducts point X will be at nearly ground potential, D will conduct and when C has discharged via D and "Tr1" point Y will be at near ground potential as well. When "Tr1" is cut off again C charges and the sawtooth signal is fed via the emitter-follower Tr2 to the base of the output transistor Tr3. In most practical circuits to date the switching action provided by "Tr1" is achieved by the use of a blocking oscillator circuit.

This basic arrangement provides a good waveform but because of the inductive loading caused by the presence of the choke in the collector circuit of the output transistor the sawtooth waveform requires modification. This is generally done by adding a

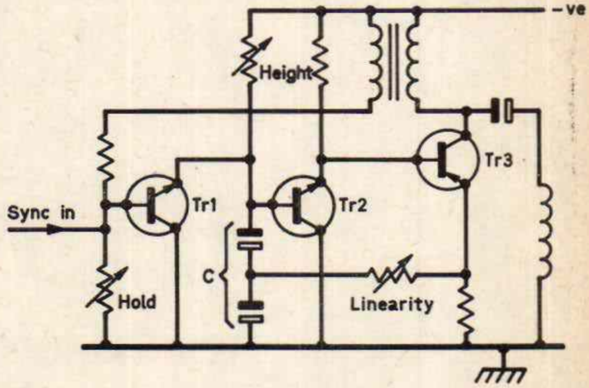


Fig. 2: Self-oscillating timebase circuit in which the flyback pulse caused by the collapse of the field around the deflection coils at the end of the scan is applied to the oscillator via a winding linked to the output inductor and drives the oscillator Tr1 hard on to discharge the scan charging capacitors. Note the introduction of a linearity feedback loop.

parabolic waveform to the sawtooth. A widely used method is shown in Fig. 2 where the charging capacitor C consists of two series-connected capacitors to the junction of which a parabolic waveform is applied from the emitter circuit of the output transistor. This is a self-oscillating circuit in which feedback from the output transformer drives Tr1 hard on so that C is rapidly discharged. The circuit is however for several reasons not a practical proposition. A practical circuit devised by B. E. Attwood, a Mullard engineer, is shown in Fig. 3. This uses an OC81 transistor in a blocking oscillator circuit to provide the switching action.

BLOCKING OSCILLATOR CIRCUITS

We mentioned earlier that points X and Y (Fig. 1) are taken *nearly* to ground. The reason for this is that small leakage currents prevent full bottoming of the switching transistor. The circuit in Fig. 3 allows for this: an overwinding is provided on the collector winding of the blocking oscillator transformer T1 and the positive voltage produced across this winding backs off the voltage drop across the transistor and OA10 diode. This reduces the standing current in the output transistor. By adjusting the

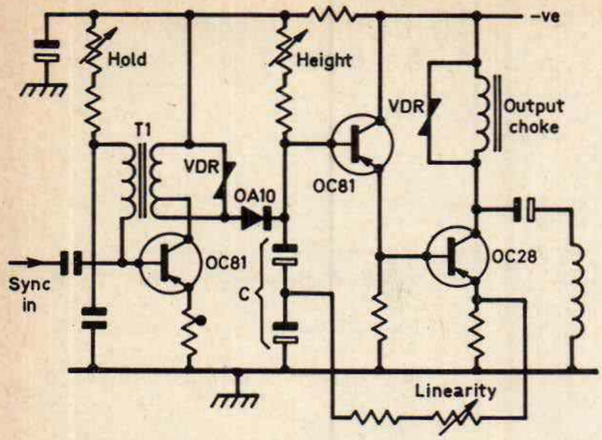


Fig. 3: Practical field timebase circuit using a blocking oscillator stage. Note the tapping on T1 primary, explained in the text.

height control the rate of charge of the C pair of capacitors is varied whilst in the feedback loop a linearity control gives parabolic waveform correction. This basic field generator scheme has been widely used and is to be found for example in the early Pye Model TT1, the Perdio Portarama and the BRC 2000 and Pye group dual-standard colour chassis.

PHILIPS T-Vette CIRCUIT

An example of "the same thing with a difference" is the circuit used in the Philips T-Vette and shown in Fig. 4. Here Tr1 is the blocking oscillator transistor and the sync pulses are applied to a tertiary winding on the blocking oscillator transformer T1. The speed is set by C1, R1 (the hold control) and R2. Tr1 is again used to discharge the charging capacitors C2 and C3 and since the discharge current flows through Tr1 and the collector winding on T1 in series we again get the problem that the potential across the collector circuit prevents the full discharge of C2 and C3 during the flyback period. In this circuit this problem is overcome by the feedback winding on T2 which provides the necessary backing-off voltage.

TRANSISTOR MULTIVIBRATOR

Until recently the blocking oscillator has reigned supreme in transistorised field oscillator circuits. However with the recently introduced BRC 3000 single-standard colour chassis we come upon the first use of a multivibrator circuit in this position—and a somewhat unusual one at that, as Fig. 5 shows. At first sight this looks like a triggered monostable circuit, since we have an *RC* time-constant network as one cross-coupling whilst the other cross-coupling network is resistive. However it is free-running, which is in fact necessary if the field is not to collapse every time we change channels or pull the aerial lead out. Let's look at the circuit operation in detail. The operation is of course controlled by the time-constant network R2, C1, R3, R4 and R5. Suppose that Tr1 is cut off. Its collector voltage will be at almost h.t. potential and C1 will charge rapidly to almost h.t. The positive potential at Tr2 base will drive it hard on, but as C1 charges negatively with respect to Tr2 base Tr2 will be rapidly cut off. With Tr2 off its collector voltage will rise to the rail voltage and because of the resistive cross-coupling via R6 Tr1 will be turned on and its collector voltage will fall. When this occurs C1 will begin to discharge so that the voltage at the base of Tr2 is positive-going. Eventually Tr2 base will be sufficiently positive for it to conduct and the sequence of operations will be repeated, the fall in Tr2 collector voltage driving Tr1 towards cut off and C1 rapidly charging to the h.t. potential. The negative-going sync pulses applied to Tr1 base assist the action in driving Tr1 off. Tr2 conducts for only a brief period each cycle so that the output from it is as shown a series of negative-going pulses at field frequency. These pulses are in fact the discharge current of the charging capacitors C2 and C3 as they discharge via D2 and Tr2. The resistance in series with the charging capacitors trims the start of the scan (top of the picture) and the term "sit-up" adjustment is applied to this.

SILICON CONTROLLED SWITCH CIRCUIT

For something quite new in timebases we return to Mullard who have developed (B. E. Attwood again and B. J. Simpson) a field generator circuit

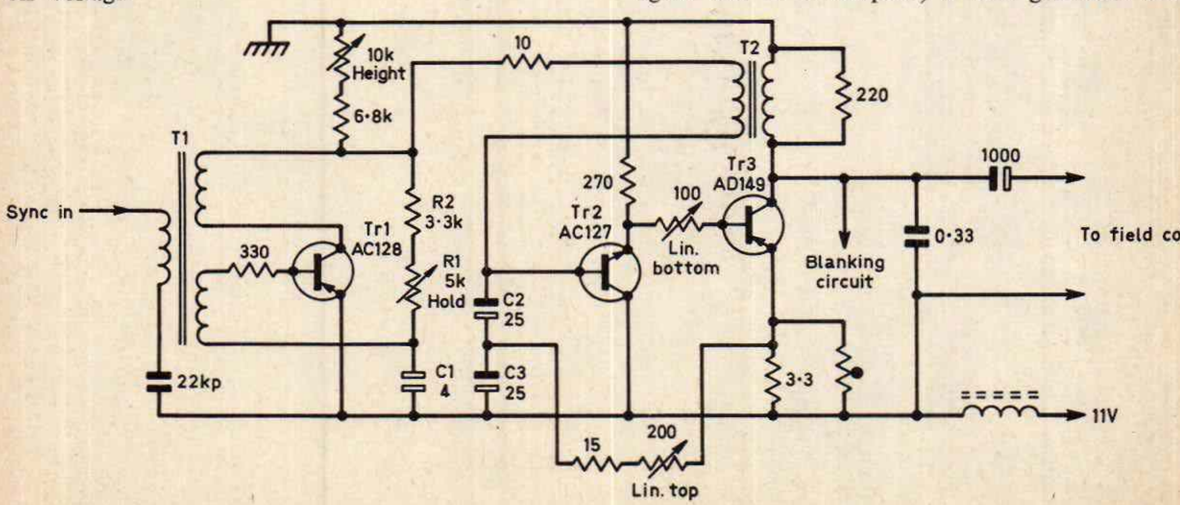


Fig. 4: A further practical blocking oscillator example, as used in the Philips portable T-Vette.

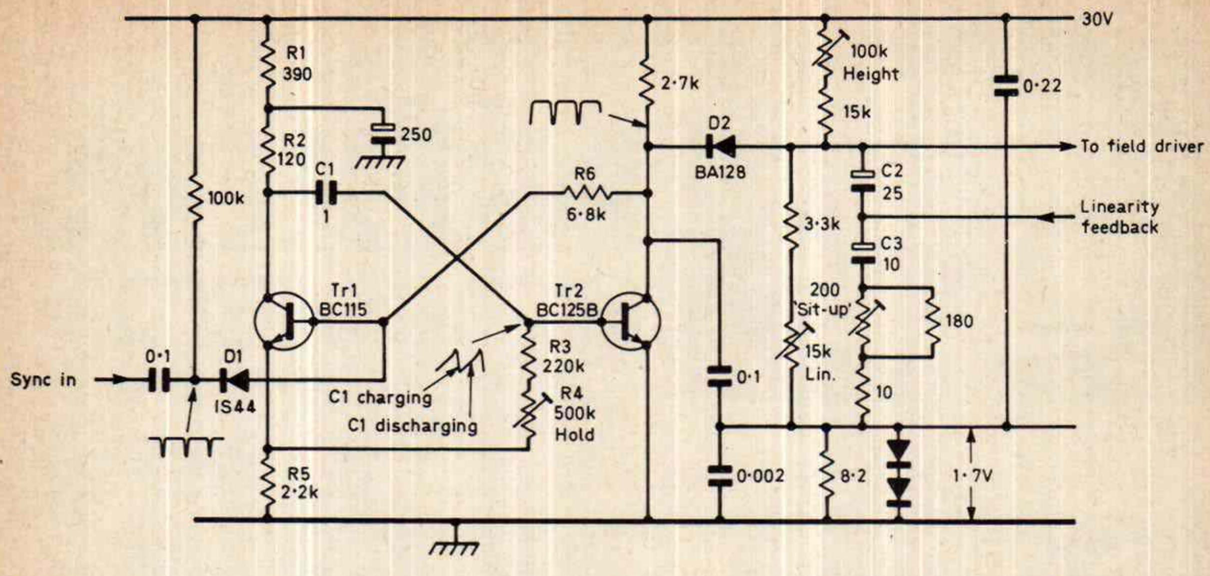


Fig. 5: The first transistorised multivibrator timebase oscillator stage to be used in the UK, from the BRC 3000 single-standard colour chassis.

using a new device, the silicon controlled switch (s.c.s. for short). This device is similar to the thyristor which we dealt with pretty thoroughly in the February issue of PRACTICAL TELEVISION. There are four layers and three pn junctions, but in this device all four layers are available for connection to the external circuit. We saw that the thyristor can be triggered into its low-impedance (fully conducting) state by applying a positive pulse to the gate so that the gate is positive with respect to the cathode. Remembering the two-transistor analogy of the operation of four-layer devices, it will be appreciated that in addition the s.c.s. can be triggered on by making its anode gate negative with respect to the anode.

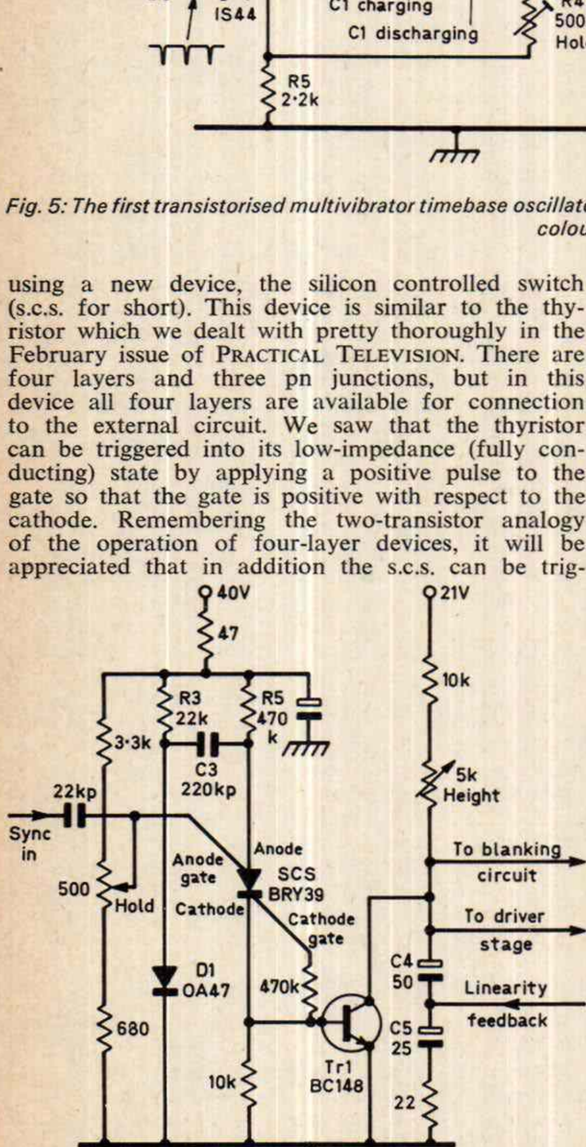


Fig. 6: Field oscillator stage using a new component, the silicon controlled switch, to provide the switching action required to discharge the scan charging capacitors C4 and C5 via Tr1 at the end of the scan period.

The Mullard s.c.s. field oscillator circuit is shown in Fig. 6. The timing capacitor whose charging and discharging controls the operation of the circuit is C3. Diode D1 is normally forward biased so that the junction of R3, C3 is effectively at chassis potential and C3 charges via R5. Eventually the point is reached where the anode of the s.c.s. is positive with respect to its anode gate. The s.c.s. then fires, C3 is discharged and Tr1 driven hard on so that the charging capacitors C4 and C5 are also discharged. Once the anode potential of the s.c.s. is below the hold-on value it reverts to its high-impedance state and the sequence of events is repeated. In earlier versions of the circuit a simple discharge resistance in series with C3 was used, giving an exponential current decay. The use of the combination R3, D1 results in an almost constant discharge current in C3, the s.c.s. and Tr1 during flyback.

In a d.c.-coupled field timebase the "sit-up" current in the output stage is dependent on the oscillator flyback period, because the charge (and thus the degree of "sit-up") remaining on the charge capacitors at the end of the flyback period is determined by the discharge time. Since the "sit-up" current should remain within close limits the oscillator flyback time must also be kept within close limits.

In the circuit shown in Fig. 6 negative-going sync pulses are fed to the anode gate of the s.c.s. Amongst the advantages of the circuit are the low and consistent voltage drop across the transistor at the end of the flyback period, ensuring a very constant working point for the output stage, the independence of the height and hold controls, the avoidance of wound components and the easy synchronisation and good triggering stability.

In Part 8 we shall be taking a detailed look at the output side of the field timebase.

TO BE CONTINUED

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 379 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

EKCO T344

After about half-an-hour the lower part of the picture becomes inverted to a depth of 3-4in. The rest of the picture is OK. The inverted band can only be removed by switching off and giving the set a considerable while to cool down.—A. Corbett (Oldham).

Try changing the field output valve—testing it won't show up a heat-induced fault. This is the most probable trouble. If the valve proves to be OK check the following components: 50μF cathode decoupler; 22kΩ resistor in series with an 0·05μF capacitor across the primary of the field output transformer; 150kΩ feedback resistor; VA1033 thermistor in series with the field scan coils.

HMV 2700 COLOUR RECEIVER

After ten months' operation two of the convergence controls (R27 blue amplitude and R23 blue tilt—625) became ineffective due to overheating. They were replaced with identical components but after a similar interval there are again signs of breakdown.—A. S. Ball (London SW2).

Component overheating is certainly not general with the BRC colour chassis. The two controls are driven by a d.c. signal from the line timebase circuit to control the horizontal position of the blue raster. If the raster is badly out-of-centre there would be a higher than usual voltage across these controls. If this is not the case component failure must be assumed. The things to check would be the static clamp transistor W2 (AC153), C6 (0·22μF), the flying lead from PL16/2 to the timebase panel and on the timebase panel itself diodes W6 and W7 (BA148), electrolytics C26, C27, C28 and C29 and resistors R23 and R24. Also ensure that the winding these components are fed from is not open-circuit on one side.

PYE V200

After approximately 15 minutes a white line appears at the bottom of the screen and slowly widens to 2in., developing into a foldover leaving two inches under the picture black. I have replaced the PCL82, also C74, C60 and C58.—J. Denniss (Yorkshire).

We advise you to check the PCL82 cathode components C62, R81 and also the screen grid feed resistor R85. Make sure that the boost volts at the upper end of R70 are correct.

MURPHY 625 VIDICON CAMERA

I have two Murphy 625-line cameras—one behaves perfectly but the other in addition to having spots on the screen produces a moving background. This is a shading effect more apparent in poor illumination and also seems to affect the camera line scan. Interlace is non-existent.—D. Bridger (Kent).

The spots on the screen of your faulty Murphy vidicon camera are caused by particles of dust which fall on to the photoconductive material inside the tube and make the particular spots on which they fall non-conductive to the electron beam. The dust sticks to the layer and so the only solution is replacement of the tube itself. For this reason it is a rule with all types of camera tube that they are not carried face-down and that they are not operated with a declination angle of more than about 60 degrees.

We feel that the second fault is almost certainly due to the lack of interlace causing target redistribution effects and causing the video clamps to give incorrect reference levels. This lack of interlace could be a fault almost anywhere in the pulse generation circuitry and should not be difficult to find using a scope and the waveforms given in the manufacturers' handbook. What to look for is the point where the field train loses a pulse timing, either by having insufficient number or too many broad pulses or equalising pulses.

FERGUSON 546T

This receiver has lines expanded from the middle of the screen to the top but crushed in to the bottom. The problem does not seem to be curable by the height control or by centring the picture. I have replaced several valves but the fault persists.—J. Campbell (N. Ireland).

The trouble is associated with the lower PCL82 valve (near the PY32). Check this valve, the electrolytic capacitor and bias resistor associated with pin 2 and the 0·01μF feedback capacitor from the linearity control.

EKCO T433

The set works OK most times but if knocked the sound is distorted with a high-pitched whistle appearing. I have cleaned the push-button switch but the results are still the same. The whistle sometimes comes on when the set has not been knocked.—J. Alvey (Bordon, Hants).

The way in which the fault appears suggests a mechanical error rather than a component fault. Check connections in the receiver for dry-joints, broken resistors, poor earth connections etc. To cause a whistle, the fault is most likely to be in the r.f./oscillator section.

PHILIPS 23TG152A

For about one-third of the picture at the top of the screen the lines are more widely spread apart, giving the impression of double lines. This is on ITV and BBC-1. The field hold and line hold have been troublesome and I have changed valves ECL80 and PCL85. I switched over the two ECC82s and this put things right for one night's viewing.—E. Brooks (Eccles).

Check the PCL85 valve and the two cathode "drop-off" resistors (ensure that there are two). Also check the cathode electrolytic (100μF), then check the smaller field output stage capacitors. Check the resistors on pins 6 and 8 of the ECL80, and the video stage PL83 and its associated components.

BUSH TV76

The fault with this receiver is lack of width. Recently I replaced all the valves except the e.h.t. rectifier and the ECC83 in the timebase unit. At the same time the height control inside the set was adjusted to give full picture height with the preset control for external setting at its fullest. The width control is at maximum but there is still a margin on either side of the screen, measuring approximately 1in. All valves are giving full emission and there is a good fat spark on the e.h.t. connector to the tube. There is also an annoying hum present which can be temporarily removed by adjusting the fine tuner control—this returns after a few minutes though.—T. Griffin-Thomas (Glamorgan).

We suggest you replace the h.t. rectifier on the lower-right side. Use an exact replacement or a silicon diode (BY100) in series with a surge resistor of about 25Ω (wire-wound 10W).

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PRACTICAL TELEVISION, MAY 1970

TEST CASE

90

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.

? *No brightness could be obtained on a Ferguson Model 3639 so the first check made was for tube bias. This was found to be reasonably correct (cathode and grid relative to chassis) and the effective grid-cathode bias was normally adjustable over the range of the brightness control.*

With the aerial removed a very weak line whistle could be heard as the line hold control was rotated, but lack of line drive was discounted because the line output valve showed no signs of overload. The valve remained at a fairly normal (hot) temperature even during protracted periods of testing. If there is no line drive this valve generally gets very hot, its anode glowing red.

Voltage tests revealed abnormally low voltage at the screen grid of the line output valve (PL81A) and at the two anodes of the oscillator valve (6/30L2), but subsequent tests of the feed resistors showed these to be of the correct values.

What important component was overlooked? See next month's Practical Television *for the answer to this problem and for a further Test Case item.*

SOLUTION TO TEST CASE 89
Page 331 (last month)

After correcting the low width and low boost voltage symptoms the technician should have investigated the cause of the overbright heaters. Had a service sheet or manual been available it would have been seen that in the KB VC11 chassis a BY100 rectifier is employed in series with the heater circuit as a mains dropper. This works by rectifying the a.c. which reduces its effective "heating power" so far as the valve heaters are concerned. In this way the heater current is cut to a value equal to the heater requirements, and because this type of silicon rectifier is very efficient hardly any heat is generated in the voltage-dropping process.

The voltage at the junction of the heater chain and a series VA1015 varistor should have been 89V but instead the technician read a value of a little over 200V. Removing the BY100 and checking the current through it both ways (this can be done with an ordinary ohmmeter) indicated clearly that the junction was shorting. There should be a very high resistance one way and a virtual short-circuit the other way. Rectifier replacement solved the problem.

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