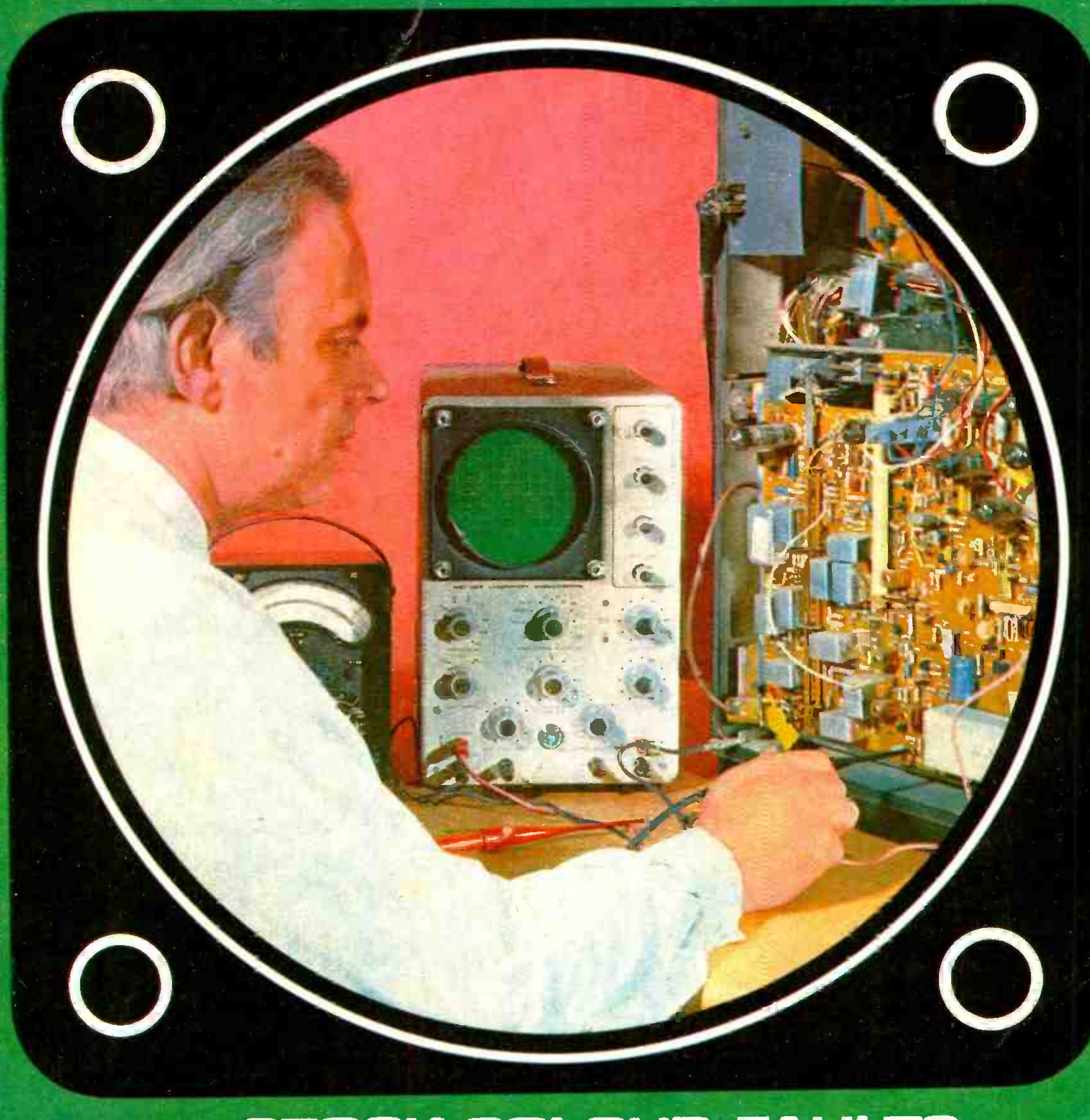
TELEVISION

17½p (3/6)

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

APRIL 1971

Using the OSCILLOSCOPE



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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 21 No 6
ISSUE 246

APRIL 1971

We visited the ITA Television Gallery—which houses a splendid collection of vintage television equipment—recently to see a demonstration of television playback from a disc (a subject in the news recently), the twist being that the disc was bought from a London store in 1935 and the playback machine was a 30-line Baird "Televisor" of 1929 vintage. Although the engineers cheated a little by converting a second Televisor into a slide scanner and using a taped copy of the original disc (very fragile and precious) it was nevertheless a fascinating step back into the beginnings of television. (The November 1934 issue of *Practical Television* carried an article on how to make your own television recordings!)

Watching the flickering images brought home to us the astonishing progress which has since been made and the rate at which it is increasing. After a decade of mechanical scanning came the first high-definition electronic system which, due to the interruption of the war, ran for only three years before the restarting in 1946. The point at which acceleration really began was the move to 625-line u.h.f. in 1964: only three years later colour came on the scene. Receiving equipment, fairly static in design for years, then suddenly started to develop, notably in the direction of solid-state circuitry—first humble transistors then integrated circuits. Parallel developments in the fields of video recording, studio equipment and transmission (*vide* microwave links and satellites) are other parts of the story.

The changes in the past few years have been fundamental and far reaching. It was thus instructive to see within a few days the whole history of practical television telescoped into two events—first the Baird Televisor in action and secondly televised scenes from the lunar landscape in the home via satellite!

W. N. STEVENS, *Editor*

PRICE INCREASE

Owing to the rising costs of production the price of TELEVISION will be increased to 20p (4s. 0d.) with effect from the May issue. Much as we regret this increase it has been made inevitable by the hard economic facts of publishing in these days of spiraling prices. Existing subscriptions will not be affected, but new subscriptions will be £2·65 per annum.

THIS MONTH

THE NEXT ISSUE DATED MAY WILL BE PUBLISHED APRIL 22

TELETOPICS

GERMAN BAND VI TV TESTS

As we reported in this column in September, 1969, tests of the feasibility of local ground-to-ground s.h.f. TV transmissions in the 12GHz band (Band VI) have been carried out at Munich, West Germany by the Federal Post Office. The results have now been assessed and it has been concluded that the technical problems and the costs of suitable s.h.f.-u.h.f. converters make the scheme impractical at the present time.

A high-gain parabolic aerial with built-in frequency converter would be necessary, the gain needed being very high because of the large free-space attenuation at s.h.f., the fact that high-gain transmitter aerials cannot normally be used because of the local radiation pattern necessary, and because a large input signal is needed to obtain a reasonable signal-to-noise ratio in an inexpensive input stage with its inevitable high noise figure. Wind loading would necessitate an expensive aerial support, permissible aerial attitude fluctuations as a result of wind being much smaller at s.h.f. A suitable compromise is considered to be a 60-70cm. diameter parabolic aerial with a gain of 34-36dB and half-value beam width of 3-2·5°. The local oscillator frequency is about 11·34GHz and filters should be incorporated to avoid oscillator radiation. A crystal oscillator would be necessary operating at as high a frequency as possible to reduce the number of multiplying stages required—the frequency of an ordinary oscillator stage at these frequencies could fluctuate by as much as 120MHz, which is totally unacceptable.

TRANSMITTER NEWS

Two further BBC u.h.f. relay stations have come into operation. **Todmorden** is transmitting BBC-1 on ch. 39 and BBC-2 on ch. 45 while **Weardale** (Co. Durham) is transmitting BBC-2 on ch. 44. Group B receiving aerials are required for both stations and the polarisation is vertical.

The ITA has announced that it hopes to start trade transmissions this month from its two main S.W. England u.h.f. transmitters—**Caradon Hill** in East Cornwall and **Redruth** in West Cornwall. These stations will be followed a few months later by **Stockland Hill,** Devon.

NEW FORM OF IMAGE INTENSIFIER

In a recent issue of *Mullard Technical Communications* (November, 1970), A. J. Guest of the Mullard Research Laboratories reports on a form of image intensifier using a plate consisting of an array of channel electron multipliers. The channel electron multiplier itself consists of a glass tube coated on the inside with a layer of material having good secondary electron emission characteristics. Electrons—from a photocathode for example—entering the tube are accelerated along it by the potential applied between each end of the tube but also move across the tube with the transverse component of their emission velocity. Secondary emission thus occurs many times along the channel and a gain is obtained depending on the voltage applied, the characteristics of the tube's inner coating and the length-diameter ratio of the tube. By using fibre-optic techniques the channels can be scaled down in size (diameters of 40μm., 100μm. and 200μm. have been studied) enabling them to be assembled in close-packed arrays of parallel channels. This gives the device known as a "channel plate" which provides amplification while preserving an optical image.

NEW VTR FROM RANK NIVICO

Top Rank Television have introduced a new ½in. helical-scan videotape recorder, the Rank Nivico Model KV810, with electronic editing and slow-motion facilities. The price is claimed to be a third that of previous machines offering such facilities. An internal sync pulse generator provides sync pulses for external cameras or other picture sources permitting electronic editing to be used in the assembly of composite recordings. Slow-motion at 1/12th normal speed assists entry into the stop-frame mode at the desired moment while reproduction in the stop-frame

The Rank Nivico KV810 videotape recorder.

mode is particularly steady because of the presence of the internally generated sync pulses. The new recorder uses the same format as others in the range enabling tapes made on the standard KV820 to be edited or displayed in slow-motion on the KV810. Top Rank Television, PO Box 70, Great West Road, Brentford, Middx.

"WRITER-PHONE" SYSTEM

Mitsubishi of Japan have developed a system—called the "writer-phone"—to enable characters to be written down and displayed at the receiving end using a conventional telephone line (videophone systems which enable callers to see each other require a far wider bandwidth). The new system uses a bandwidth of 0·3-3·4kHz, with sound in the 0·3-2kHz range and the display data in the 2-3·4kHz range. The characters to be transmitted are written on a special pad which provides an electrical signal indicating the position of the pen on the pad. At the receiving end a storage tube memorises the pen's position which is read out by its scanning system and then displayed on a picture tube.

DESOLDERING I.C.s

Solderstat Ltd. (PO Box 10, Bush Fair, Harlow, Essex) have introduced a new soldering accessory for simultaneous desoldering to enable standard dual in-line i.c.s to be removed within a few seconds. The device is a desoldering head which can be simply pushed on to a standard HMS series miniature soldering iron in place of the standard copper bit. Models are available for both 14- and 16-pin packs.

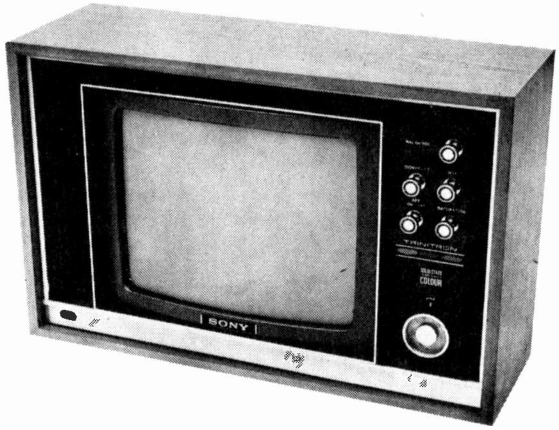
1970 TRADE RESULTS

According to The British Radio Equipment Manufacturers Association more than two million TV receivers were delivered by UK setmakers during 1970. It is the first time since 1959 that this total has been reached. Actual figures were 2,145,000 sets of which 469,000 were colour receivers. The proportion of colour receivers jumped from 8% in 1969 to 22% in 1970. During December 50,000 colour and 135,000 monochrome sets were delivered. More record players—547,000—were delivered than in any previous year but radio receivers registered a fall of 7% compared with 1969 and radiograms a slight fall.

A new consolette colour model with hinged fold-away doors has been added to the **Ekco** range. This, Model CT111, has a recommended price of £310 and is fitted with the 691 single-standard chassis.

SONY COLOUR SET AT UNDER £200

Sony have announced that they intend to introduce a 13in. colour receiver, Model KV1320UB, on the UK market at the competitive price of £199·75. The set is fitted with their Trinitron aperture-grille type tube which was described in our September, 1970, issue. Sony claim it is not necessary for them to apply for a PAL licence (recently obtained by Hitachi who say that an initial batch of 10,000 PAL-type receivers are on their way to the UK) and although they talk about "entirely new concepts for the reception of the British color TV broadcasting standard" they will still have to find some way of carrying out PAL switching to alternate the R-Y component of the chroma signal on alternate lines of



The Sony Model KV1320UB colour receiver.

the picture. The only definite information from Sony is that their set incorporates a hue control—the type of control featured in US NTSC type receivers in which it is necessary for the viewer to be able to adjust the phase of the reference oscillator in order to obtain correct picture colours when—as they do—phase shifts in the transmission path occur. The PAL system was of course devised to overcome this problem. We await with interest further information on those "entirely new concepts".

MODULAR ETV SYSTEM

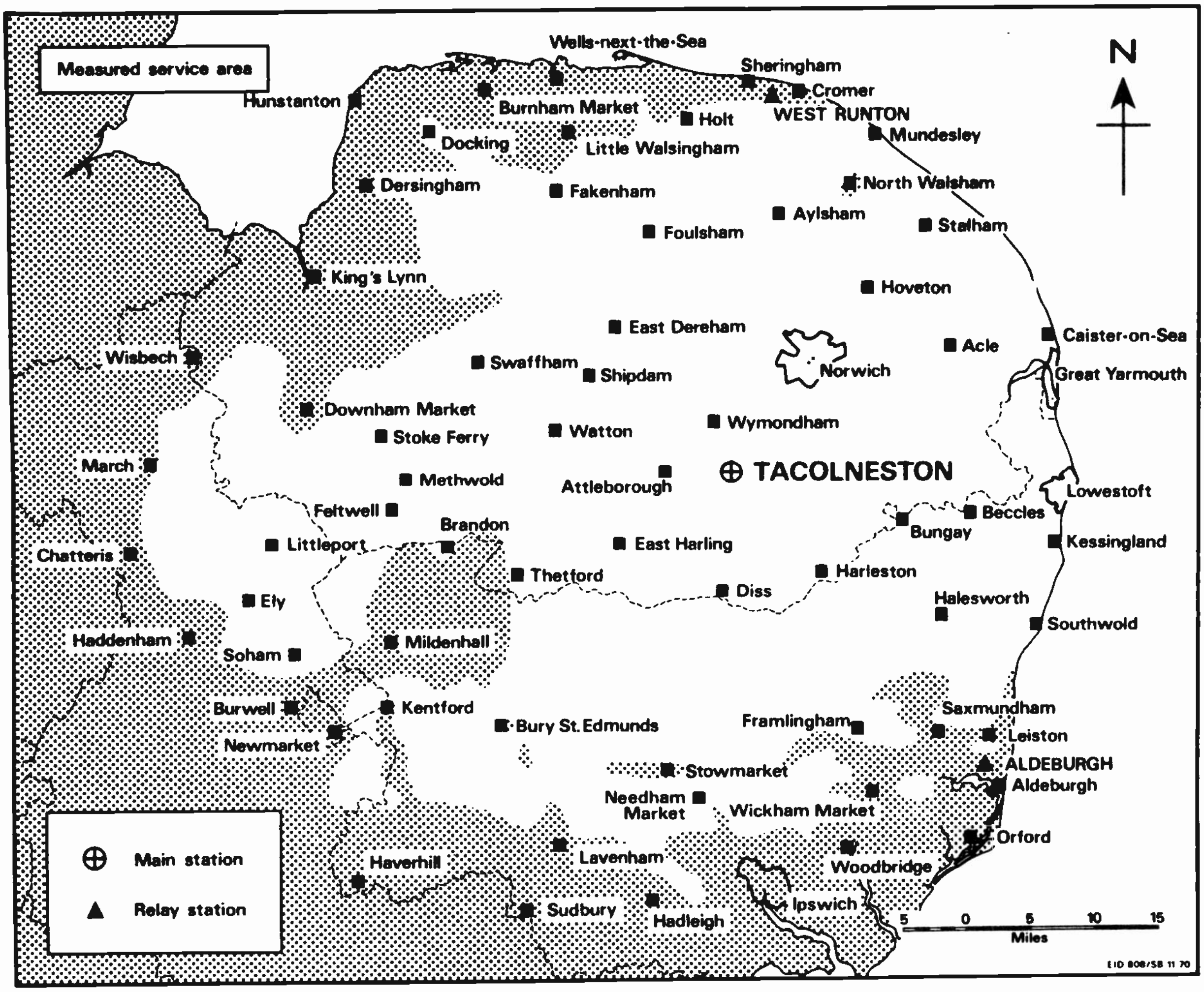
Teletron have introduced a modular educational TV system developed in collaboration with the TV Research and Training Unit of Goldsmiths College, London. A simple one-camera studio costs £2,000 and the system can be built up to a complex installation with three cameras costing nearly £7,000. A feature is the use of mirrors above, below and to the side of the instructor to provide alternative camera angles without the need for extra cameras (reverse line switching in the cameras compensates for the image inversion of the mirrors). The functions of producer, vision and sound mixer, camera operator, telecine and caption projectionist can all be performed by a single operator from a portable console on the studio floor while studio lighting is carried on a lightweight "space-frame" which is claimed to provide flexibility and can support such items as blackboards, backing curtains, acoustic soundboards, etc.

UNIVERSAL MULTIMETER

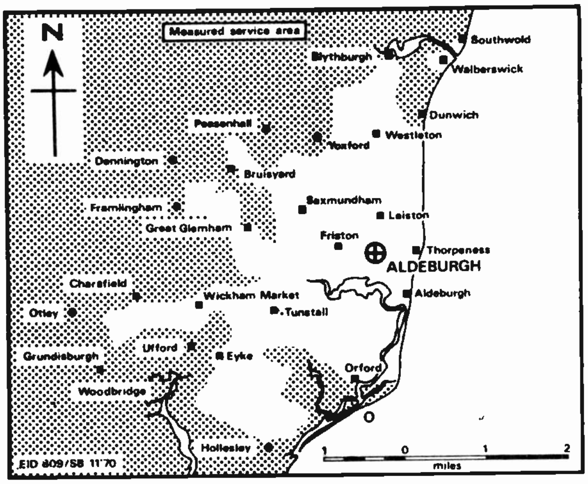
A compact universal multimeter at £23 has been introduced by ITT Electronic Services, Harlow. The meter, type MX202B, measures direct and alternating voltages and currents, resistance and light intensity and has a sensitivity of 40,000Ω/volt. Optional extras include a photocell unit, shunts, a.c. and d.c. high-voltage probes, clip-on 1 : 1,000 transformer, ohm-meter adaptor and filtering probe.

A further addition is an electronic voltmeter, type VX208A, which will measure the average value of an a.c. voltage in the range 10Hz to 10MHz and is thus suitable for video and TV applications. A preamplifier and attenuator give a high input impedance (10MΩ shunted by 30pF) and low noise factor. Twelve ranges cover 1-300mV and 1-300V.

UHF SERVICES—TACOLNESTON AND RELAYS

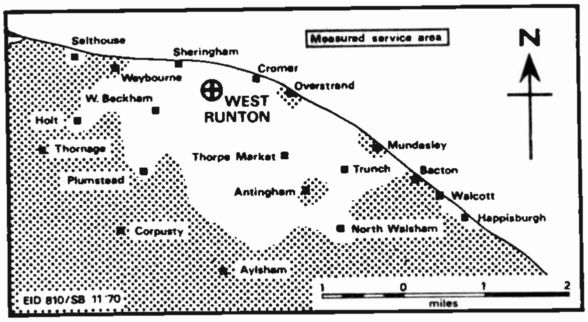


ALDEBURGH



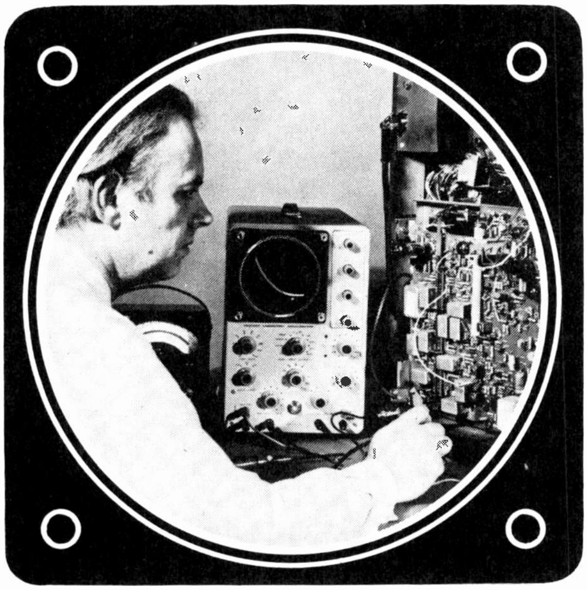
Channels: BBC-2 55; ITV 59; BBC-1 62. Horizontal polarisation, receiving aerial group C. Maximum vision e.r.p. 250kW.
These BBC Engineering Information Service maps indicate the approximate service areas: pockets of poor reception too small to be shown may be experienced.

WEST RUNTON



For both relay stations the channels are ITV 23; BBC-2 26; BBC-1 33. Vertical polarisation, receiving aerial group A. Aldeburgh maximum vision e.r.p. 10kW, West Runton 600W.

using the Oscilloscope



PART 1

KEITH CUMMINS

THE oscilloscope is an increasingly important tool in servicing now that the number of colour receivers is rapidly increasing and with a whole range of video-cassette devices soon to appear on the consumer-electronics market. It is therefore an appropriate time to get to know the oscilloscope and its uses—the purpose of this new series.

While the oscilloscope has been accepted in industry and development labs for many years as an essential tool, service workshops—for a variety of reasons—have not been so likely to possess one. The reasons for this are several. In the first instance the cost of a respectable oscilloscope can be daunting so that the small shop owner feels he cannot economically justify its purchase. Similarly, larger organisations have sometimes regarded the purchase of test equipment as a necessary evil—the oscilloscope being the greatest evil of all. The current situation, however, dictates that anyone seriously involved in the servicing of electronic apparatus, industrial or domestic, must be versed in the use of the oscilloscope.

The 'Scope in Fault-Finding

This situation has arisen simply because the use of Avo meters and signal generators can no longer provide an adequate picture of what is going on inside much modern equipment. Thus it can no longer be said that the oscilloscope is a gimmicky device that any engineer worth his salt can do without. So we come to the final point—namely that some people are rather worried by the oscilloscope and are not quite sure what to do with it. In these articles we shall cover the groundwork on oscilloscopes so that the reader will feel at ease with the instrument.

To begin with it should not be assumed that the oscilloscope is a wonder device which supersedes all other equipment. The oscilloscope instead provides an extension of our facilities for finding out what is happening inside the equipment. Our senses are all called in to use when we service a piece of equipment which has broken down. We do not always, however, consciously realise this fact until an instance is cited.

Imagine a television set which has been brought in for service. As sometimes happens it is brought to the workshop by an owner's friend who knows nothing of the fault except that the set has broken down. We first switch on and after a short time an unpleasant smell emerges from the set accompanied by wisps of smoke. Using our senses of smell and sight we conclude that something is burning up. We switch off quickly and look in the back. Slight crackling noises in one corner lead us to a burnt-looking resistor. Holding the back of a hand close to this component we sense the heat from the resistor. So we have used all our senses except taste without really thinking about them. We know that the resistor is burning up and turn directly to the Avo meter to measure its resistance.

At this particular point we have called in help from test equipment and the Avo meter reveals that a direct short-circuit exists from one side of the resistor to earth. Checking the circuit we then find that an electrolytic capacitor has gone short-circuit. Our senses told us that the resistor was feeling unhappy but we needed the Avo meter to check that the capacitor had failed. Physically it looked sound and the Avo meter was necessary to prove quickly that it was defective.

So we prove the point that our own senses can take us part of the way towards locating the fault, but sooner or later test equipment is necessary to determine exactly what the fault condition is. Measuring zero ohms with the Avo meter, we knew that the capacitor was defective: the Avo meter formed the interface between the fault we wanted to find and our own senses.

We know that the Avo meter will measure current, voltage and resistance and this tells us much about the operating conditions within the apparatus being checked. The majority of faults in servicing can be located using an Avo meter alone, but in the same way that the Avo meter took over from our direct senses, the oscilloscope has to take over from the Avo meter. Thus by this reasoning process the reader will realise that the oscilloscope provides us with a further improved kind of information. To appreciate this improvement in the transmission of information we must think about the word "oscilloscope".

Basic Oscilloscope Action

An oscillator produces repetitive identical changes in its condition, the number of changes per second being referred to as the frequency. The frequency used to be measured in cycles per second but the current term is Hertz. The word "scope" means "to

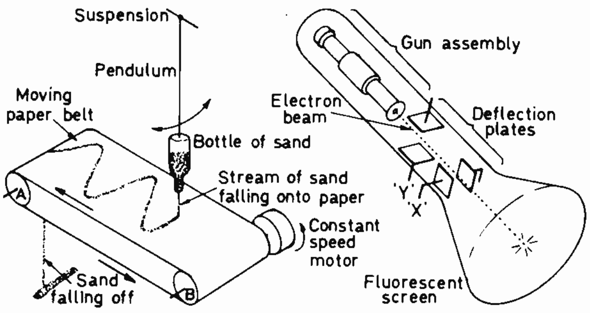


Fig. 1 (left): A mechanical analogy of the operation of an oscilloscope.
Fig. 2 (right): Simplified sketch of the instrument type c.r.t. used in a typical oscilloscope.

see", so the oscilloscope is a device which enables us to view a repetitive signal. The process is of course electronic, but we shall first examine a mechanical system for displaying an oscillation. Fig. 1 shows a pendulum swinging from a suspension at right angles to a moving paper strip which passes over rollers A and B. Attached to the pendulum is a bottle of sand, upside down, functioning like the top half of an hour glass. As the pendulum swings to and fro, the sand falls from the bottle in a thin stream on to the paper which moves from right to left. A pattern of sand is thus traced out on the paper and if the speed of the paper is constant the sand trace forms a graph of the amplitude of the pendulum swing plotted against time. As the paper passes over the roller A the sand falls off and clean paper reappears over roller B.

If this experiment is carried out it is found that the motion of the pendulum is simple harmonic motion which when plotted graphically forms the sinewave with which we are all familiar. If instead of our bottle of sand being attached to a pendulum someone had held it in his hand and moved it about we would of course have seen a constantly changing random trace of sand on the paper instead of a repetitive pattern.

The oscilloscope is the electronic equivalent of the bottle of sand, paper and constant speed mechanism. When the oscilloscope's function is fully understood it will be realised that the comparison is not quite exact, but it is sufficiently accurate for the moment.

The heart of the oscilloscope is its display device, a cathode-ray tube. This differs from the type used in a television receiver. The television tube's electron beam is deflected by magnetic fields applied by coils outside the neck of the tube. An instrument cathode-ray tube employs electrostatic deflection plates instead, mounted inside the tube as shown in Fig. 2.

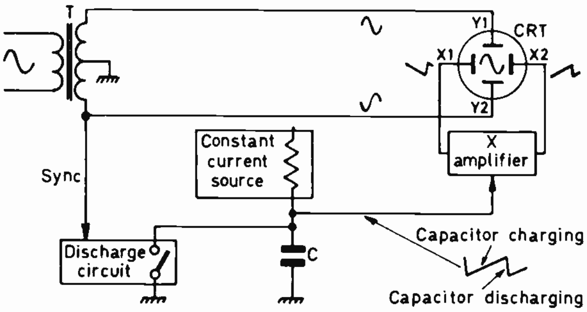


Fig. 3: The basic oscilloscope principle.

The deflection plates have voltages applied to them to deflect the electron beam. As there are two sets of plates at right angles to each other it is possible to deflect the beam to any part of the tube screen by an appropriate combination of voltages applied to the plates. The plates which deflect the beam *vertically* are called the Y plates while the *horizontal* deflection plates are referred to as the X plates.

The *average* potential of all the plates is normally the same as that of the final anode of the tube, and the plates operate differentially, i.e. if to deflect the beam the potential on one plate of a pair is increased the potential on its companion is decreased by the same amount. This is known as push-pull deflection and is essential to avoid geometrical distortion of the trace. With equal voltages on all the plates the beam remains undeflected.

Displaying Waveforms

We shall next consider what has to be done to display one complete cycle of the mains alternating current on the face of our cathode-ray tube. Fig. 3 shows a very basic block diagram of the arrangement used to achieve this. Transformer T applies the 50 Hz mains signal to the Y plates of the c.r.t. —in push-pull because of the centre-tapping on the transformer secondary winding. If we imagine our trace initially deflected to the extreme left in the X direction it should start to move to the right at the same time as our waveform applied to the Y plates commences. This X deflection is achieved by charging a capacitor C from a constant-current source so that there is a linear increase of voltage with time across it. The change in voltage across C is amplified and applied to the c.r.t. X plates so as to move the beam linearly to the right—the X amplifier once again providing a push-pull output. If our timing (i.e. charging rate of C) is correct the beam will have been moved from the left- to the right-hand side of the tube in exactly the time of one cycle of the mains supply. The beam, which of course is virtually weightless and thus has no inertia, will have been moved in both the X and Y directions during this period and one cycle of the mains supply will have been traced. At the end of the scan a synchronising circuit discharges C, so "emptying the bucket" which has to start filling again. In this way the same trace can be repeated indefinitely at 50Hz. The speed is sufficient for the eye's persistance of vision to integrate the repetitive traces into a stationary fixed pattern on the face on the tube.

This simple system is given only as an example. A proper oscilloscope contains a Y amplifier and an X timebase (which can sometimes be used as another amplifier). In addition there are the power supplies for the c.r.t. and the amplifier circuits.

It is naturally very useful to be able to examine high-frequency signals and it is in this area that the most striking progress has been made in oscilloscope technique in the last few years. A Y amplifier bandwidth of d.c. to 5MHz must now be considered commonplace, whereas originally 50Hz to 300kHz was normal. Naturally if the upper limit of Y frequency response is increased, the X timebase speed must be increased correspondingly if display of a few cycles of the Y signal on the screen is to be achieved. Obviously if one cycle of a 1MHz signal is to be displayed the X timebase speed must be equal to the time for one cycle, i.e. the timebase forward action must be completed in 1μsec.

Oscilloscope Block Diagram

A basic oscilloscope block diagram is shown in Fig. 4. The Y input, that is the signal we wish to examine, is passed directly to a calibrated attenuator. Modern oscilloscopes all use this technique in connection with a ruled graticule placed over the face of the tube. The graticule divides the c.r.t. face area into one centimetre squares, the vertical lines measuring amplitude and the horizontal ones time. The oscilloscope has a preset variable gain control which allows the amplifier gain to be adjusted so that with no attenuation an input signal amplitude of (typically) 100mV produces a deflection of 1cm.

The calibrated attenuator reduces the input applied to the Y amplifier by precise factors at each switch position so that for example sensitivities of 100mV, 1V, 5V, 25V, 100V, 250V per cm. are available. Some instruments include a "calibration" output which is usually a stabilised 1V peak-to-peak squarewave. This is connected to the Y input, the sensitivity switched to 1V/cm. and the preset gain adjusted so that the square wave measures 1cm. peak-to-peak on the graticule.

Some oscilloscopes have selected sensitivity and bandwidth so that by reducing the bandwidth the sensitivity is increased. As one has to assume that the gain-bandwidth product will be constant, operating a sensitivity "×10" control will usually reduce the bandwidth by the same factor, i.e. a 5MHz bandwidth will be reduced to 500kHz.

Modern oscilloscope design allows d.c. coupling through the Y amplifier. If, however, we wish to examine an a.c. component standing on a large d.c. offset voltage the d.c. component needs to be removed. For this purpose an a.c.-d.c. input switch is included. This introduces a d.c. blocking capacitor between the input terminal and the attenuator in the a.c. position.

Occasion often arises when we wish to examine part of a waveform in detail, for example distortion at the top of a sinewave. A Y shift control is included which enables the whole trace to be moved up or down. This does not impair the measuring facility of the oscilloscope relatively from one point to another on the tube face, but one must be careful to remember that if a d.c. level is being preserved movement of the Y shift control will move the zero datum line as well. This will be dealt with in more detail later.

The Timebase

To complete the general picture we must now turn to the X side of things. We shall consider the X circuits as two basic parts, the timebase generator and the horizontal deflection amplifier. These two items together produce the horizontal trace or "base line" which most people have seen on an oscilloscope at some time or another. Our X controls are calibrated as in the case of Y but in time instead of amplitude. The velocity (speed) control is calibrated in time per centimetre. 1msec/cm. for example means that the beam takes 1msec (i.e. 1/1,000 sec) to move a distance of 1cm. across the tube face. If we examine a waveform and find that it consists of five sinewaves

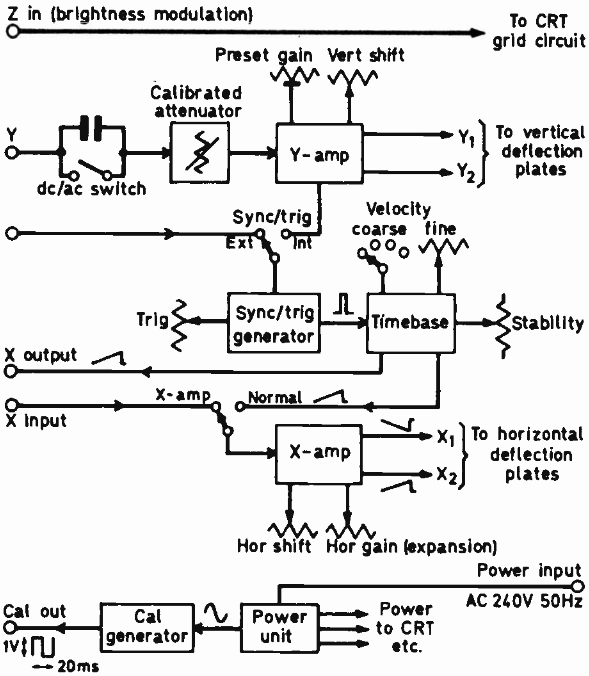


Fig. 4: Block diagram of the elements of a typical oscilloscope.

occupying five squares at a velocity of 1msec/cm. we know that each sinewave is traced in a period of 1msec so that 1,000 will be traced in one second. Thus we know that the frequency is 1kHz. By using the calibrated Y facility we can measure the amplitude of this 1kHz sinewave signal.

In the same way that Y shift is available to move the trace vertically, X shift is used to move the trace horizontally. This facility is useful, particularly if one wishes to examine the end of the trace. Expansion of the trace is also usually available. The expansion control increases the gain of the X amplifier and in effect makes the trace longer horizontally. This means that the tube is over-scanned, generally up to a factor of about 5 to 1, so that only 20% of the trace is visible on the tube face. The X shift control is then used to move the trace so that we can examine a part of the waveform we wish to study in magnified detail.

The use of expansion obviously upsets the velocity calibration, which is normally accurate only at the minimum setting of the control. At this setting the trace is usually about 0·5 cm. short of each side of the tube, fitting five graticule spaces. The factor of five enables easy calculations to be carried out in terms of velocity. While a short trace 4cm. long would still allow sensible scaling, a 6cm. trace would produce some very tedious calculations (try dividing 6 into 10!).

Synchronisation and Triggering

So far we have said little about synchronising and trigger arrangements. It is obvious that the horizontal timebase action must be related to the frequency of the signal to be displayed. This is illustrated in Fig. 5 which shows waveforms at different points in the oscilloscope. At (a) is shown the incoming waveform to be displayed. The scanning voltage generated by the X timebase is shown at (b).

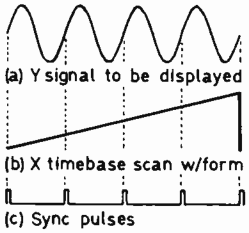
It is obviously necessary to generate a synchronising signal from waveform (a) and this is illustrated at (c). Every time the input waveform crosses its zero point in the positive-going direction the sync generator circuit produces a pulse. These pulses are applied to the X timebase to synchronise it to the Y waveform. Unless the timebase is almost at the end of its sweep however the pulses have no effect. The timebase becomes sensitive to sync near the end of its cycle, and if a pulse arrives at this time it initiates the flyback. Dependent upon the velocity setting therefore there will be a number of cycles of the Y waveform displayed.

We do not however always wish to examine a continuously repetitive event such as a sinewave. Sometimes we need to observe a very fast event which occurs at a relatively large interval, for example a 10μsec pulse which recurs once every 10msec. In this case we need to use our timebase in its triggered mode: that is, it does not start its trace until triggered and then completes only one sweep after which it remains in its resting state, needing triggering again to produce its next sweep. The leading edge of the pulse to be examined is used to trigger the timebase which can then be adjusted to a suitable velocity. After the pulse has finished a relatively long wait occurs before the next one arrives.

During this time the timebase is inactive and if the oscilloscope has a "bright-up" facility, which turns on the brilliance only during the active sweep of the timebase, the screen will be blank. Because of the long period of inactivity it is necessary to turn the brilliance control well up so that we shall be able to observe the pulse when it occurs. If the timebase is not triggered but synchronised instead, the "dead time" between pulses will be filled by useless horizontal scanning. This produces an intensely bright line which could easily damage the tube, apart from completely swamping the event we wish to observe.

Most general-purpose oscilloscopes in use today have a continuously variable control which sets the threshold of timebase operation so that it is either free-running and needing synchronisation or stalled and requiring a trigger pulse. The operating point of the timebase can thus be adjusted to suit the sync or trigger pulses available. This is particularly useful if external trigger or sync is being used and the internal sync facility is thus inoperative. This mode of operation would for example be used where video information is being examined. The line sync pulses from the TV set's sync separator are used to lock the timebase in preference to using the oscilloscope's own internal circuits which can become somewhat jittery when confronted with a complex video signal. To obviate this difficulty some oscilloscopes include TV line and field sync separator facilities which can be brought into use by a trigger selection control.

While on the subject of triggered timebase operation it is worth noting that the brilliance of a triggered trace varies with the velocity setting, sometimes necessitating readjustment of the brilliance control. This effect is brought about because with low "mark-to-space" ratio signals the trace is only present for a very short time. Varying the sweep velocity will increase this time, a slower sweep speed allowing more electrons to hit the screen for a given brilliance setting before the sweep ends. Thus the slower the sweep the greater the apparent brilliance becomes.



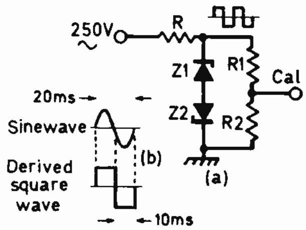


Fig. 5 (left): Relationship between the displayed signal, the timebase waveform and the sync pulses.
Fig. 6 (right): Generating a calibration waveform.

This effect is normal and illustrates the need for very high-intensity tubes to display fast waveforms adequately.

Calibration Generator

We have not so far discussed the calibration generator shown in the block diagram, Fig. 4. Where fitted it consists in its simplest form of a back-to-back zener diode arrangement as shown in Fig. 6(a). 250V a.c. is applied via the high resistance R to the two zener diodes Z1 and Z2. The voltage is clamped at the zener voltage equally above and below earth potential. A zener voltage of around 5V is least dependent on device temperature and the voltage across the zeners is finally potted down by the close-tolerance resistors R1 and R2 to 1V peak-to-peak. The 250V supply used is derived from the mains transformer directly and as the mains frequency is 50Hz the duration of one cycle is 1,000/50=20msec.

As can be seen from Fig 6(b) each flat top of the square-wave calibration signal thus produced has a duration of 10msec. The timebase is set up to 10msec/cm. and adjusted with its preset calibration so that the flat top of the squarewave is exactly 1cm. long.

Z Input and Power Supplies

Other points worth mentioning in Fig. 4 are the Z input and power supply. The Z input, for intensity modulation, is applied to the grid of the c.r.t. This facility is included for blanking and certain frequency measuring techniques which we shall mention later.

The power supply produces the e.h.t. for the c.r.t. as well as the normal supplies for the valves and transistors. Because d.c. coupling is used between the amplifiers and deflection plates and the deflection plates must be held at the same potential as the final anode of the tube, the e.h.t. supply is negative. This enables the amplifier and deflection plates to be operated at around +250 to +350V with the tube cathode circuit operated at typically −1·5kV. Thus the e.h.t. supply feeds the tube cathode circuit and not, as in a television receiver, its anode. The brightness control is necessarily at e.h.t. potential and needs adequate insulation from the control knob and surrounding objects. The tube heater is fed from a separate well-insulated winding on the mains transformer. The c.r.t. is electrostatically focused and a user control is generally available for this purpose.

Next month we shall among other things deal with setting up the oscilloscope, viewing lissajous figures, PDA tubes and double-beam oscilloscope applications besides having a look at some 'scope circuitry in detail.

DYNAMIC TV PICTURES

NORMAN McLEOD

It is only recently that much attention has been paid to the problems of maintaining the brightness and contrast of a TV picture at reasonable levels for the type of scene broadcast. Sets with a d.c. restoration circuit of some sort can hold the brightness correctly if the appropriate control is accurately set, but the a.g.c. system in these sets often destroys most of the benefit gained from a black-level clamping circuit by flattening out variations in the overall tube brightness to a considerable extent. The effects that sets with different a.g.c. and brightness control circuits have on the picture are illustrated by the tables below.

Effects on Display

Sets A, B and C are representative of virtually all the receivers on the market today. Set A represents the majority, having no black-level clamp. Set B has a black-level clamp but a form of a.g.c. that does not do full justice to this device. Set C has the video amplifier and a.g.c. circuit described in this article.

	Set A	*Set B*	*Set C*
Signal: blank screen			
Overall brightness	medium	zero	zero
Gain	high	high-medium	low
Peak white level	—	—	—
Darkest level	medium	zero	zero
Signal: low-key			
Overall brightness	medium	medium-low	low
Gain	high	high-medium	low
Peak white level	very high	very high	medium
Darkest level	zero-medium	zero	zero
Signal: high-key			
Overall brightness	medium	medium	high
Gain	medium	low-medium	high
Peak white level	high	medium	very high
Darkest level	below or at zero	zero	zero
Signal: white screen			
Overall brightness	medium	medium	very high
Gain	low	low-medium	very high
Peak white level	medium	low	very high
Darkest level	—	—	—

Study of these effects reveals that the overall brightness varies little with set A, somewhat more with set B and very considerably with set C. This might lead one to suppose that set C would impose excessive demands on its e.h.t. system, causing changes in picture size with brightness, damage to the picture tube or even to the line output stage. Provided however the contrast is set to a reasonable level the demands are easily met by an ordinary timebase even without the v.d.r. stabilising circuit used in modern circuits.

The sort of picture displayed on set A is well known (turn to page 59 of the November, 1969, Practical Television for a beautiful description). Set B gives dazzling white-on-black captions and nice dark low-key scenes with not-so-nice glaring highlights, but goes a watery gray when the soap powder commercials come on. Set C on the other hand gives low-key scenes a gentle range of contrast (as is usually encountered in the gloom) while making a dazzling spectacle of bright scenes. The video circuit used in set C is shown in Fig. 1.

Conversion

The circuit comprises a complete video amplifier and a.g.c. feed system for use with a *valve 625-line i.f. panel.* If your set is suitable for this conversion and you intend to try it, it is a great advantage to have the manufacturer's service sheet or at least a circuit diagram before starting.

First if the detector diode is not connected as shown in Fig. 1 reverse it (it will probably be inside the final i.f. transformer screening can), but *take care.* It is no joke to find that you have damaged a coil critical to the operation of the i.f. strip when you remove a resistor no longer needed in the new circuit. And on no account operate on the domestic telly unless you are skilled at repairing and constructing TV circuitry! Note that after conversion the set will be suitable for 625-line operation only, since the detector must give a positive-going output for the circuit to work. Most parts of the country however are now served by three u.h.f. channels.

Circuit Description

The positive-going signal from the detector diode D1 drives transistor Tr1, type BFY50 or BFY51. This transistor amplifies both the d.c. and a.c. components of the signal and boosts the frequencies above 1MHz due to the reduction of negative feedback across R4 caused by C4 at the higher frequencies. This com-

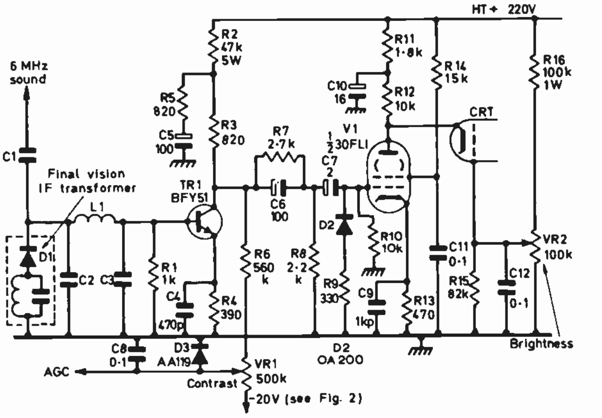


Fig. 1: The suggested video amplifier and a.g.c. circuit. A 6MHz rejector should be included in series with the grid or cathode of V1.

★ Components required

Resistors:

R1	1kΩ	
R2	47kΩ	5W W.W.
R3	820Ω	
R4	390Ω	
R5	820Ω	
R6	560kΩ	
R7	2·7kΩ	
R8	2·2kΩ	
R9	330Ω	
R10	10kΩ	
R11	1·8kΩ	1W
R12	10kΩ	5W W.W.
R13	470Ω	
R14	15kΩ	2W
R15	82kΩ	
R16	100kΩ	1W

Capacitors:

C1-C3. Part of the original detector circuit. These or their counterparts should be left well alone.

C4	470pF ceramic
C5	100 μF 50V electrolytic
C6	100 μF 25V electrolytic
C7	2 μF 25V electrolytic
C8	0·1 μF ceramic or polyester
C9	1,000pF polystyrene
C10	16 μF 350V electrolytic
C11	0·1 μF 350V polyester or paper
C12	0·1 μF 150V polyester or paper

Semiconductors:

Tr1	BFY50 or BFY51
D1	AA119, OA90 etc. (original detector)
D2	OA200
D3	AA119 or OA90

Valves:

V1 30FL1. Any other video valve should do provided the cathode components are changed if necessary. CRT AW43-80 used in prototype. Circuit can be used with all c.r.t.s but R16 may require slight alteration.

pensates for losses incurred later in the valve output stage V1. Note that the transistor is fed direct from the h.t. line of the receiver but that R2, R3, R7 and R8 prevent the collector voltage rising above 30V. C7 prevents the voltage at the junction of R7 and R8 reaching the valve. A d.c. component is immediately reintroduced following C7 by the OA200 d.c. restorer diode D2. This d.c. component is preserved by the d.c. coupling from the valve (beam-tetrode section of a 30FL1) to the tube cathode.

AGC System

The original d.c. component of the signal, varying with the brightness of the picture and the signal strength received, is fed to the contrast conrol via R6. With a negatively-modulated signal—as is broadcast on our 625-line system—the weaker the signal the brighter the picture. On weak signals the voltage at the base of the transistor falls, its collector voltage rises and both ends of R6 become more positive. The gain as a result of the a.g.c. action rises and so does the contrast. The black level however is kept firmly in check by the OA200 diode and R11 while the gain of the i.f. stages varies up and down as the picture content changes.

Construction

How you build this circuit is largely dictated by the set into which it is to be incorporated. Do however site the transistor as close as possible to the i.f. can from which the video signal comes. The video output stage itself should need no physical alteration. Check that there is no *RC* combination between the valve anode and the tube base and short it out if one is found. If there is only a.c. coupling between the valve and the tube, disconnect the biasing resistors on the tube cathode and connect it directly to the video output valve anode. Then rewire the grid and brightness control circuit as shown in Fig 1. No blanking is required as the flyback occurs below or at black level.

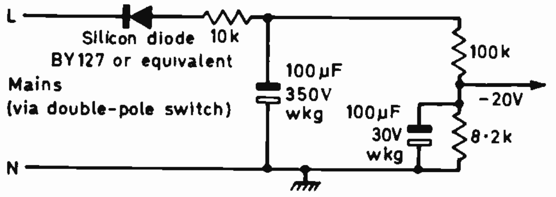


Fig. 2: Obtaining the —20V supply for the contrast control circuit.

Negative Supply

The −20V supply shown on the diagram can be obtained by rectifying the mains supply to the set as shown in Fig. 2. Any other source may be used provided it is independent of signal strength and has a source impedance preferably less than 200kΩ.

In Conclusion

It is to be hoped that manufacturers use this form of mean-level a.g.c. together with black-level clamping to obtain an increased "dynamic range" on the TV screens of their sets. It would be possible for the broadcasting authorities to arrange for the gain of their amplifiers to be varied with picture content to take greater advantage of this system. Programmes such as *Top of the Pops* come over very well indeed —when a spotlight shines on the camera you are dazzled by it as well as the cameraman! The arrangement has a counterpart in sound in the Dolby system of noise reduction in which the signals are compressed in dynamic range before being recorded and are subsequently expanded again. Perhaps a system could be evolved for TV with all signals being transmitted at a high contrast and the strength of the sound carrier (f.m. remember) determining how much amplification should be applied to reconstitute the original levels. This might reduce the mushiness of night and fog scenes for those with poor reception. Readers suggestions on this idea would be welcomed. ■

LOW-LEAKAGE DIODE

Mullard have introduced a new silicon diode, type BAV45, with the extremely low leakage curent of 10pA at a junction temperature of 25°C and with 20V reverse bias. Its capacitance is only 1·3pF, maximum reverse voltage rating 20V and maximum forward current 50mA. It is intended for clamping and holding circuits and other applications where it is important to avoid unwanted signal paths and current leaks.

COLOUR RECEIVER CIRCUITS

GORDON J. KING

DETECTOR AND LUMINANCE PREAMPLIFIER CIRCUITS

THE techniques of using two separate detectors for the luminance and chroma signals, with the intercarrier signal derived from one or the other, were investigated in the previous instalment. Before dealing with the circuits through which the various detector output signals pass however mention must be made of the detector techniques adopted by Bush-Murphy in their single-standard, all-transistor chassis.

This chassis employs two detectors, but the chroma detector in this circuit is fed from a tap-off point in the common i.f. channel via a two-stage chroma i.f. channel as shown in block form in Fig. 1. The first stage in the chroma i.f. channel provides for both manual and automatic (a.c.c.) chroma signal level regulation. The main i.f. channel then goes on to feed the vision (luminance) detector which also yields the intercarrier signal.

The printed circuit panel for the i.f. channels carries easily replaceable screened modules for various circuit sections, there being one for the controlled chroma i.f. amplifier, another for the luminance detector and another for the final chroma i.f. amplifier and chroma detector (taking in also the chroma signal 4·43MHz bandpass amplifier, a section which has not so far been looked at in this series). There are also other modules for the selectivity and gain of the main i.f. channel.

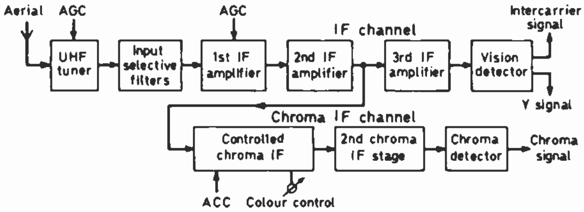


Fig. 1: Block diagram of the i.f. and detector sections of the all-transistor Rank-Bush-Murphy single-standard chassis.

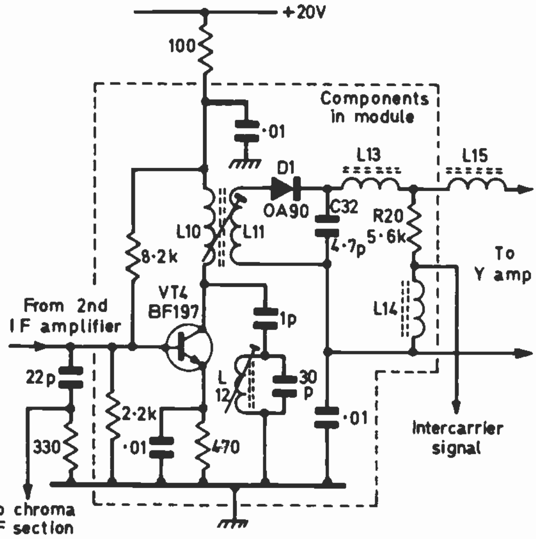


Fig. 2: The third i.f. amplifier and luminance detector stages of the Bush-Murphy single-standard circuit.

Vision Detector

Figure 2 shows the circuit of the vision detector module. Correct base coupling impedance from the preceding stage is secured from a capacitance-divider in that stage, while the transformer L10/11 is bifilar-wound to give tight coupling to the detector diode D1, the transformer being tuned towards the middle of the i.f. passband. The detector load is R20 and the associated reservoir capacitor C32. L13 and L15 are merely stopper chokes for attenuating residual i.f. signal. The intercarrier signal is developed across L14, while L12 is tuned to 32·5MHz to clear the response of spurious beats.

Controlled Chroma Stage

Figure 3 shows the circuit of the controlled chroma i.f. amplifier module. The i.f. transistor is VT8 while VT7 is concerned with the actual chroma level control. VT8 base receives the i.f. signal from a capacitive coupling (see Fig. 2) at the output of the second i.f. amplifier stage which, incidentally, is a two-transistor cascode stage, and the amplified signal is loaded across L17 in the collector circuit. A bandpass pair is formed by this and L18, with the 5·6pF capacitor giving top-end coupling. The signal from L18 is then

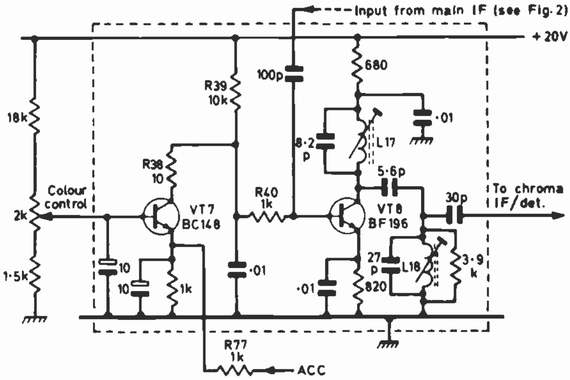


Fig. 3: Circuit of the controlled chroma i.f. amplifier stage in the Bush-Murphy single-standard chassis. Manual colour and automatic chroma control are applied via transistor VT7.

fed to the input of the chroma detector i.f. drive transistor (see Fig. 4 later).

The gain of VT8 is a function of the bias at its base, and this bias is obtained from VT7. The basic source of bias is the voltage drop across resistors R38 and R39 due to VT7 collector current, this bias being applied to VT8 base via R40. Since VT7 collector voltage depends on its conduction it follows that by varying the emitter-base current (i.e. its base bias) the base bias of VT8 is also varied. Manual variation of VT7 base bias is effected by the 2kΩ colour control across the supply line, padded by the 18kΩ and 1·5kΩ resistors.

It is more usual to include the colour control in the chroma signal bandpass amplifier circuits which follow the chroma detector. Since however VT8 (Fig. 3) feeds via the second chroma i.f. amplifier the chroma detector, which then feeds the chroma bandpass amplifier, the method of gain regulation just described is equally suitable. The control stage VT7 can also be used to apply the a.c.c. bias, and in fact this is fed to VT7 emitter circuit, via R77. The a.c.c. bias adjusts the biasing of the transistor in a similar manner to the potentiometer in its base circuit, but while the potentiometer provides manual control the a.c.c. action provides automatic control from a potential derived from the rectified burst signal.

Chroma Detector

The next part of the circuit (Fig. 4) consists of a chroma i.f. stage feeding the chroma detector and the detector itself. The i.f. signal from the 30pF capacitor in Fig. 3 is fed to VT9 base. The amplified signal in the collector circuit is developed across the single-tuned transformer L19/20, the latter winding feeding signal to the chroma detector D5. R48 is the detector load and C53 the reservoir capacitor, L21 serving as a stopper choke and L22 as a video compensating device.

The chroma signal proper from D5 is fed to the input of the chroma bandpass amplifier, which is also a part of this particular module though not shown in Fig. 4: I shall be dealing with the chroma stages in a later instalment.

As mentioned in previous instalments the advantage of two detectors is that the one dealing with the chroma signal can be arranged to combat quadrature distortion and heavy modulation levels. Distortion in the Bush-Murphy design is essentially minimised by the nature of the i.f. response charactersistic of the circuits feeding the chroma detector. The signal is tailored by the combined effects of L17 and L18 in Fig. 3 and L19/20 in Fig. 4. The response is arranged

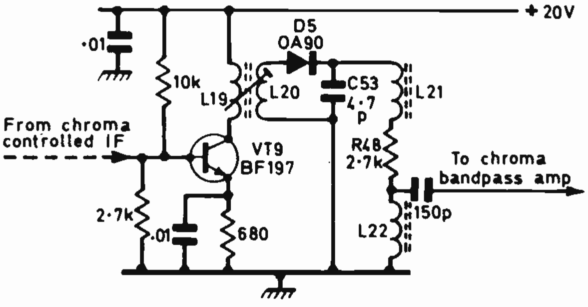


Fig. 4: The second chroma i.f. stage and chroma detector, Bush-Murphy single-standard chassis.

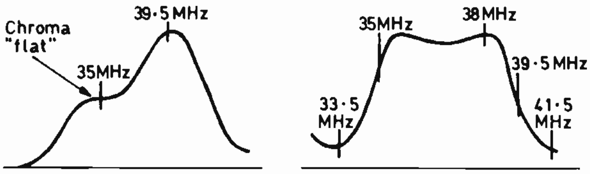


Fig. 5 (left): Chroma i.f. response characteristic.
Fig. 6 (right): Luminance i.f. response characteristic.

so that the vision carrier appears towards the top while the chroma frequency position falls upon a flat down the sloping side of the curve. The flat permits a small degree of mistuning without significant colour display impairment. The idea is shown in Fig. 5 while Fig. 6 shows the response characteristic at the luminance detector.

On to the Luminance Circuits

Having obtained a fair idea of the front-end, i.f. and detector sections of contemporary colour receivers, we must next venture into the video circuits fed from the detector(s) (we will leave the intercarrier and sound circuits until later). Leaving the intercarrier signal for the time being then there are two video channels, the brightness or luminance signal channel (which provides the picture detail) and the chroma channel which amplifies the chroma component of the composite luminance-plus-chrominance received signal. Filtering is adopted to remove the respective unwanted signals in the two channels. Let us start with the luminance channel which is the less complex of the two.

The luminance channel in fact does a similar job to the video channel in monochrome sets. That is, it lifts the level of the detector output signal sufficiently to drive the picture tube; it also commonly provides some sort of compensation in terms of both amplitude and phase of the luminance signal over the passband.

Tube Drive Techniques

At this juncture however mention must be made of the two types of picture tube drive currently in use in colour sets. The primary-colour information required by the three guns (red, green and blue) of the picture tube is obtained either by feeding the colour-difference signals separately to the grids of the guns and the luminance (Y) signal to the cathodes or by first combining the colour-difference and luminance signals so as to obtain the primary-colour signals and then feeding these to the cathodes of the guns. The first technique is called colour-difference drive and the second primary-colour (or RGB) drive. In the first system the tube guns themselves matrix the colour-difference and the Y signals to obtain the primary-colour signals as seen by the guns. In the second system the primary-colour signal matrixing is performed by the tube drive stages, one being required for each primary colour: each stage is fed with the Y signal and its own particular colour-difference signal.

I shall be dealing separately with colour-difference and primary-colour circuits later in the series. Mention of the two schemes was however necessary at this stage since they lead to differences in the luminance circuits. Let us first look at some luminance circuits used with the colour-difference drive system.

Luminance for Colour-difference Drive

The luminance channel is more complex than the video channel of a monochrome set. This is mainly because a preamplifier section is required prior to the output stage. A valve is commonly used for the luminance output stage and transistors for the preamplifier section. The Y channel has to provide filtering to remove the chroma components of the signal and sometimes the intercarrier signal, as well as incorporating contrast and brightness control facilities. It also has to provide the sync and possibly the a.g.c. feed. And because the luminance channel bandwith is significantly greater than that of the chroma stages, a signal delaying device must be incorporated to ensure that the Y and colour-difference signals arrive at the picture tube at exactly the same instant in time. Signals pass more rapidly through a wideband channel so that without a delay the luminance signal would reach the tube cathodes fractionally before the colour-difference signals reach the tube grids. This would cause the brightness components of a display to appear displaced horizontally from the colouring components.

Luminance Preamplifier Circuits

Figure 7 shows the basic circuit (i.e. simplified to bring out the fundamental actions) of the luminance preamplifier stages of the dual-standard Bang and Olufsen 3000 colour chassis. There are four stages and it will be seen that d.c. coupling is used throughout. This is in order to retain the correct black level from the detector all the way through to the luminance output valve (see later) and then to the picture tube cathodes.

Tr1 is arranged as an emitter-follower which feeds the base of Tr2 from the emitter of which are taken the feeds to the sync and a.g.c. circuits. The collector of Tr2 feeds the Y signal to the base of Tr3 via the contrast control. This control is arranged as a potentiometer and is in this particular chassis ganged to the colour control in the chroma amplifier to provide correct tracking between the contrast and colour saturation controls.

Tr3 collector feeds the base of the final transistor Tr4 which is connected as an emitter-follower so that the Y output is fed to the Y amplifier valve from a relatively low-impedance source. This is desirable from the frequency response point of view.

The luminance delay line is included between Tr3

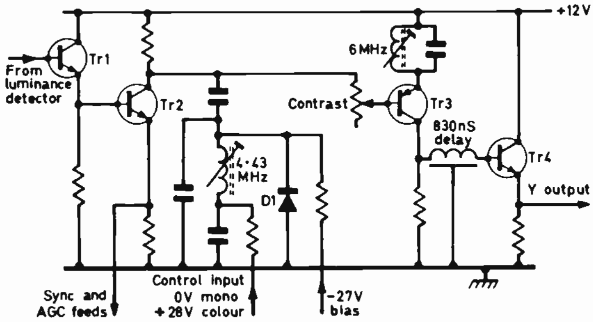


Fig. 7: Simplified circuit of the luminance preamplifier stages of the Bang and Olufsen 3000 chassis.

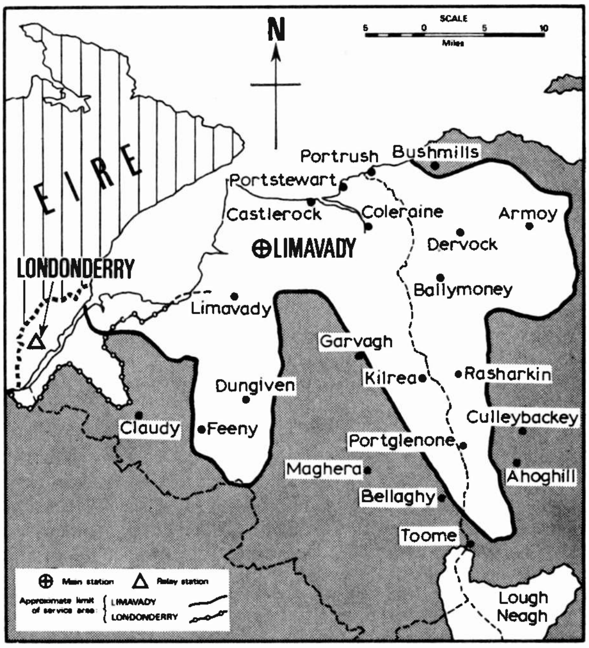
and Tr4. The delay required by the different bandwidths of the chroma and Y channels works out in this design at 830nS ($0{\cdot}83\mu S$)—it differs of course in receivers of different make and design.

The intercarrier component of the signal is rejected by the tuned circuit in the emitter lead of Tr3 while the unwanted chroma components are rejected by the 4·43MHz tuned circuit at the collector of Tr2. Diode D1 is used to disable the 4·43MHz rejector during monochrome transmissions to make maximum use of the black-and-white signal bandwidth. The diode cathode is biased by about −27V relative to chassis. On monochrome the control input (derived from the colour-killer bias) contributes near 0V—via the coil—so that the diode is heavily conducting and the resulting low impedance appears in shunt with the 4·43MHz rejector thereby muting it. On colour however a bias of about 28V appears at the control input. This cancels the effect of the −27V bias and thus switches the diode off, the rejector then becoming operative.

Next month I shall continue this exploration into the luminance circuits.

CONTINUED NEXT MONTH

UHF TV SERVICES FROM LIMAVADY AND LONDONDERRY



The above map indicates the expected service areas of the Limavady and Londonderry transmitters: small pockets of poor reception too small to be shown may be experienced.

For **Limavady** the channels are BBC-1 55; ITV 59; BBC-2 62. Horizontal polarisation, aerial group C.

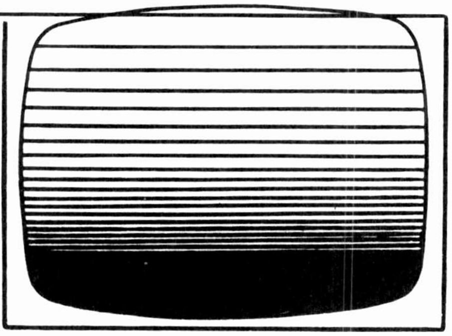
For **Londonderry** the channels are ITV 41; BBC-2 44; BBC-1 51. Vertical polarisation, aerial group B.

N. LONDON CES BRANCH MOVES

Combined Electronic Services, the Pye-Philips service organisation, has moved its North London branch to 6 Chase Road, Park Royal, London NW10 (01-965 0041).

TRACING FIELD LINEARITY FAULTS

VIVIAN CAPEL



In most sections of a television receiver the usual effect of a fault is to remove the picture or make it unwatchable. The one exception to this is the field circuits. Apart from complete field collapse, faults are often tolerated for long periods by the owner and in some cases are not even noticed. In most cases such faults have the effect of producing a non-linear scan, and quite frequently the service engineer will find a linearity fault on a set that has been brought into the workshop because of some other complaint.

Whether he deals with it or not will depend on its severity and the age and condition of the set. Slight non-linearity on an ancient receiver may well prove uneconomic to deal with and things are often best left as they are. Quite often there will be more than one fault affecting the linearity and it is not unknown for one to partially balance the effect of another. Thus curing one of the faults can actually make matters worse. The home experimenter is not so tied to economic considerations as the professional engineer —especially over time and labour costs—so he may well decide to try to winkle out all the bugs in his own or any other set passing through his hands. At least he should be more critical of the result than the average viewer!

Different components in the field circuit produce different effects on the scan when they are faulty while sometimes the same component can give different effects according to its condition, e.g. a capacitor being either leaky or open-circuit. We will first classify the different effects and then see what could be the possible causes, paying particular attention to those that experience has shown to be the most common ones.

Bottom Cramping

Cramping of the bottom of the scan is without a doubt the most commonly encountered fault. Scan over the upper portions of the picture can be quite linear but in the bottom few inches it gets progressively restricted giving the familiar "short legs" effect. While this—along with other non-linear effects—can best be seen on a test card, a close examination of the scanning lines quickly reveals the difference in spacing between those in the affected area and elsewhere on the raster. Sometimes the bottom cramping is slight and often adjustment of the main linearity control will correct it. At other times the cramping can be severe and the bottom few lines actually superimposed.

As the bottom of the scan comes at the end of the scanning stroke cramping here signifies a failure of the output stage to provide enough power to complete the scan, either because the valve is operating on the curved portion of its characteristic or for some other reason.

Low-emission Valve

The most common cause is the valve itself. A low-emission cathode restricts the power available, giving the effect described. Another fault is a low-resistance heater. When operated in a series chain as is the general practice this will reduce the voltage across the heater and so prevent it attaining its full operating temperature. Cathode emission will thus be adversely affected. It is often found that after the set has been on for a while the linearity improves and the bottom stretches out to almost normal linearity. The overall height may also increase. This is because temperature increase improves the emission, so such an effect can almost certainly be taken as a sign of a defective valve.

Not all low-emission valves behave in this way. Some remain low even after being run for several hours. The obvious certain diagnosis is to change the valve. Sometimes it may be found that the sound valve is of the same type and so a change over can be made as a test. It is not conclusive however as the sound valve may be as bad if not worse, its effect on the sound passing unnoticed

A word of warning is appropriate here. Some bargain-priced valves offered for sale are quite good in many applications but for field output stages it is wise to obtain one of a reputable make. Some of the bargain type are of slightly low emission so that one may be no better off than with the original valve.

Changing the valve is the first move for the engineer as it is quick, easy and very likely to cure the fault. The experimenter however may not have a spare to hand and may wish to eliminate some other common possibilities before obtaining a replacement.

Bypass Capacitor

A very likely culprit for bottom cramping is the cathode bypass capacitor. Low capacitance here, or a complete open-circuit, will give rise to current negative feedback over the cathode resistor, restricting the power available. Usual values are from 25 to 100μF and the working voltage is anything up to 50V.

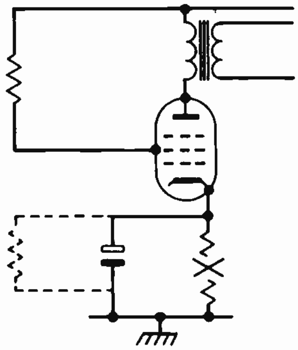


Fig. 1: If a cathode bias resistor goes open-circuit the full h.t. then appearing across the bypass capacitor will break it down forming a leakage path. This will act as a "bias resistor" but of the wrong value, resulting in bottom cramping.

Almost any electrolytic except the lower values can be used as a test so it is very likely that there will be something suitable in the spares box.

Bridging the old capacitor will correct the linearity if it is at fault but here again a word of caution: even if the old capacitor is not faulty bridging it with another will nearly always drop the bottom of the raster slightly. This is because of the increase of capacitance in the cathode circuit. When the old capacitor is removed and a replacement made it may then be found that there is no difference and the cramping remains. Shunting the test capacitor across the existing one must produce a *marked* improvement before the old one can be condemned as faulty and replaced. With older sets however it may prove beneficial to the linearity to replace the capacitor with one of a much higher value. The values which are commonplace today were unobtainable in compact form in the early days.

Feedback can also take place over an unbypassed screen resistor, so the bypass capacitor here should be checked in similar manner. Not all screen grids are bypassed however, a certain amount of feedback being purposely introduced by leaving the screen grid without a bypass capacitor.

Cathode Bias

The actual amount of cathode bias has a considerable effect on the linearity as it is by this means that the linear portion of the valve characteristic is selected. Too much bias will move the operating point farther along the characteristic on to the curved portion and at the same time reduce the anode current and limit the power available. Thus the symptom will be similar to the other faults we have described, cramping at the bottom part of the picture.

Too much bias will be obtained should the cathode resistor go high in value. It should be stated though that this does not often happen. It is more likely to go low and this in some circuits can also produce bottom cramping. What can also happen (see Fig. 1) is for the resistor to go open-circuit, possibly through an internal leak in the valve causing excessive current and thus burning out the resistor. The cathode now has the full h.t. potential on it because no current is flowing. The bypass capacitor, being rated at up to 50V maximum, then takes objection to this and promptly develops a partial short-circuit. Current flows once again but this time through the leaky capacitor. The ohmic value of the leak will therefore determine the amount of cathode bias and it is often higher than the correct cathode resistor value. Leaks of around 500-1,000Ω are not uncommon whereas the most usual resistor value is 330Ω. Thus there is too much bias and as a result bottom cramping. Often in such cases it is necessary to replace the resistor, the capacitor and the valve.

Charging Capacitor

Another cause of bottom cramping is the field charging capacitor (C1 in Fig. 2) which in most circuits is connected between the anode of the generator valve and the cathode of the output stage. It is obvious that if this is leaky an extra positive voltage will be placed on the cathode from the preceding anode. Thus the effect of too much bias will be obtained. If it is low-capacitance the same symptom will be produced. This means that bridging the capacitor is of little use as this would only give a check on the low-capacitance state, any leak in the original still being present. One end of the old capacitor must be disconnected and a replacement of the same or near value connected in circuit.

Some circuits employ a capacitor from the feedback network to the cathode and this too could be either open-circuit or short-circuit and give a similar effect. Substitution of this one also involves the disconnection of one end of the original.

Feedback Network

This brings us to the feedback network itself and the associated linearity controls. The linearity control will have been tried at the start in an attempt to rectify the poor linearity. Observing the effect it produces can help in pinning down any fault in the feedback circuit.

If it behaves normally, producing a change of linearity over the whole picture, particularly the middle and bottom, even though not fully correcting the fault condition, the chances are that this part of the circuit is in order and the trouble is elsewhere. It may however have no effect over part of its travel and then suddenly at one point cause a jump of linearity. This indicates a break in the control itself, the jump occurring when the wiper passes over the break.

Should there be little or no difference over the whole range of the control then it may either be open-circuit at one end of the track or have an open-circuit wiper or one of the associated feedback components could be faulty, probably short-circuited. An open-circuit feedback path means that there is no feedback applied to the grid circuit and hence there will be excessive height. It may not be possible to reduce the height sufficiently to come within the mask even with the height control at its minimum position. This then provides a valuable clue: if there is too much height or the height control must be set towards minimum, there is almost certainly a fault in the feedback network.

Bottom Foldover

From bottom cramping we next come to a related fault, bottom foldover. Here as the description implies the bottom part of the picture is folded back up to be superimposed on the previous part of the scan. Although apparently similar to bottom cramping it is generally due to an opposite cause, that is, too little bias.

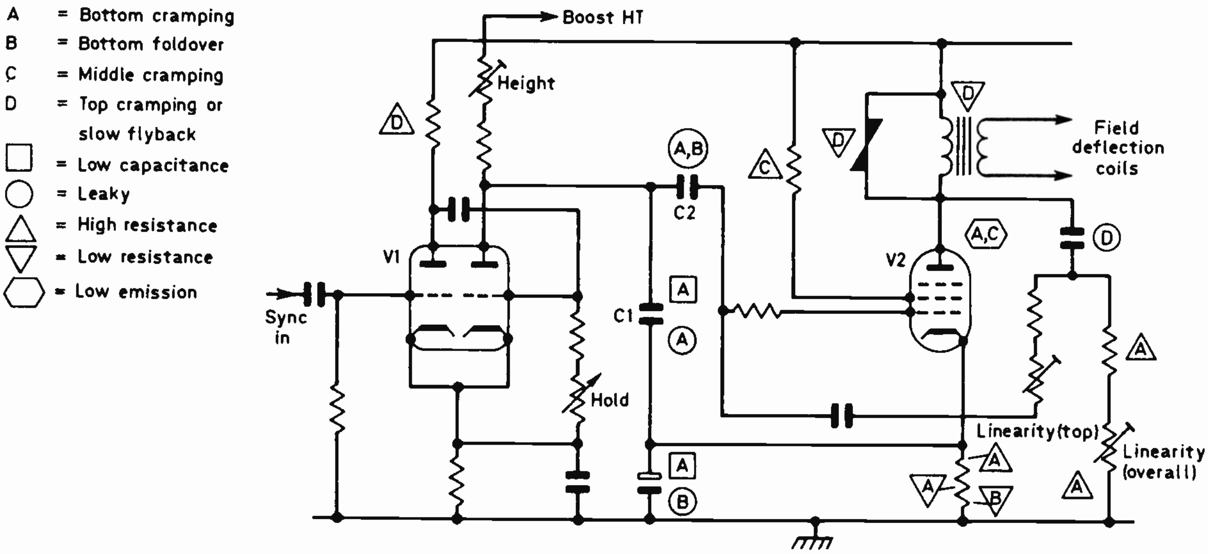


Fig. 2: Circuit of a representative field generator and output stage showing likely component defects and their effects on linearity.

The most common cause is a decrease in value of the cathode bias resistor, due probably to becoming overheated through passing excess current as noted before. A quick measurement with the ohmmeter will determine whether this is the case. Another possibility is an open-circuit cathode resistor with a d.c. path being established through the associated bypass capacitor as previously described, only this time the leakage is less than that with the correct resistor value. It maybe too that the capacitor has developed a short-circuit and the resistor is perfectly all right. A few quick checks with the meter will soon run the fault to earth.

Another way by which insufficient bias may be applied to the output valve is when a positive voltage is leaked on to the control grid. Remembering that bias is really applied between grid and cathode (positive cathode bias being the same as making the grid negative), any positive potential on the grid will subtract from the bias developed across the cathode resistor. Insufficient bias will not only move the operation off the linear portion of the characteristic but will over-run the valve, causing it to reach saturation point in extreme cases and hence give the foldover effect.

Faulty Coupler

A positive grid voltage is usually due to a leak in the coupling capacitor from the anode of the generator stage (C2 in Fig. 2) and this can be confirmed by disconnecting the grid end of the capacitor and measuring with an ohmmeter across it. If no leak can be measured it may be due to the fact that the leak only appears when there is a high voltage across the capacitor, a quite common occurrence, and this can be checked by measuring for voltage at the free

Fig. 3: (a) Waveform of linear scanning current. (b) Waveform giving bottom cramping, (c) bottom foldover, (d) middle cramping, (e) top cramping.

end of the capacitor with the set switched on. Be careful though to turn the brilliance control right down as otherwise the collapsed field due to the disconnected coupling capacitor could burn a line across the face of the c.r.t.

If a positive voltage can be so measured then the capacitor is obviously faulty and must be replaced. If there is no sign of a reading, try for voltage on the grid pin of the valve. If a positive voltage is indeed present then there is an internal leak, possibly between the control grid and screen, and the valve must be replaced. When run for even a short time with insufficient bias due to any of the above mentioned causes the valve will get much hotter than normal, so care must be taken when attempting to withdraw it from its socket. Allow time for it to cool and use a cloth to handle it.

Middle Cramping

From the bottom of the picture we now direct our attention to the middle, or more accurately to about a third from the top. Cramping at this point sometimes occurs when the height control is set to just overscan the tube area. When the height is reduced so that a black area appears at the top and bottom of the picture the scan becomes more or less linear again. This effect is due to the output stage being unable to handle the full signal applied to it from the field generator so that it overloads. When the height is reduced the input signal is reduced to a level that the output stage can manage so that it then produces good linearity.

The cause of the trouble can be anything which reduces the signal handling capacity of the output valve. It could well be the valve itself and in fact this is the most likely possibility. Before obtaining a new valve however—if one is not to hand—take a few voltage checks. In some sets low h.t. could be responsible but in most cases this would also affect the line circuits leading to low e.h.t. and an increase in the deflection sensitivity of the tube. Thus the mask could still be filled vertically with the reduced field scanning power. However it is worth trying, and if it is found to be low then the general performance is bound to improve by putting this right quite apart from its possible effect on the field scan.

Low screen voltage on the output valve is another likelihood. The screen resistor going high in value is a probable cause of this. Another is a partial short-circuit in the screen decoupling capacitor. If these checks prove unfruitful it can be assumed that the valve is at fault and a new one obtained. The professional engineer will have tried this first, having replacements available.

Top Cramping

At the top of the picture various fault conditions can once again produce a cramping effect. Cramping here is produced by a slow rate of scanning current change at the start of scanning stroke. As a general rule this effect arises from mismatching in the anode circuit due to some fault condition reducing the value of the anode load by forming a shunt path across it.

In occasional cases a series capacitor and resistor are to be found across the output transformer primary winding. A leak in the capacitor will produce the symptom. Another component commonly found across the primary is a v.d.r. This is included to suppress the high-voltage pulses that appear across the winding during the flyback period. Its resistance is high at the relatively low voltage dropped across the winding during the normal scan, hence its effect on the circuit is negligible. During the flyback however the high-voltage pulse lowers the resistance of the v.d.r. which therefore conducts and damps the pulse. It follows that a breakdown in the v.d.r. will shunt the primary during the scan and will produce the same effect. Many chassis use an ordinary resistor to provide this damping: if it goes low-resistance it will also have the same effect.

The feedback circuit to provide control of linearity is taken directly from the anode so if any of the capacitors involved go leaky this too could cause top cramping, though the effect may not be so marked because of the fairly high-value resistors in series with them. It should be noted that if any capacitors are replaced in this section of the receiver, particularly that across the transformer primary, ones with high-voltage ratings should be used as replacements—1,000V working if available—because of the high pulse voltage present during flyback.

Some sets have a second linearity control, usually labelled "lin. 2" or similar. This one always affects the top of the picture, the main one affecting the middle and bottom mainly (see Fig. 2). The effect of operating this control can be noted as with the overall one. Any irregularities such as a sudden jump or failure to have any effect at all will point to the control or its associated components being at fault

Field Output Transformer

If all these checks fail to produce the culprit and the components tested appear to be in order we are left with the field output transformer. Short-circuited turns will impose a heavy load and give a mismatch and in most cases the result is to affect the linearity at the top of the picture—accompanied possibly with an overall reduction in height. This will depend on the amount of "spare" field amplitude available before the fault occurred and the number of turns that are shorted.

Unfortunately there is no easy method of positively testing the transformer as d.c. and resistance readings will be little affected. Transformer testers are available which measure the damping imposed on an oscillatory wavetrain. These are very useful but not entirely foolproof as different types and makes of transformer give different readings and a reject reading for one could be the same as a good reading for another. The only sure way is to compare readings with a good transformer of the same type. While this is true of readings that are slightly below the good range and hence leave room for doubt, a reading well down into the reject area would be quite conclusive.

Although professional workshops are likely to be equipped with such an instrument the home experimenter will probably not. As the transformer is the most expensive and least readily available component—especially for older models—it is necessary to eliminate all other possibilities before condemning it.

Slow Flyback

A fault which at first may not be associated with linearity troubles but which in fact is closely tied in with them is slow flyback. Pulses are radiated on some transmissions during the field sync period. These take the form of a white line then a dot followed by another white line. The second line may be at various amplitudes and so will be reproduced as a particular shade of grey. Where the flyback is reasonably fast—as on a normal set—these pulses occur after the flyback but before the start of the next field scan. Thus they are out of the way above the top of the picture. If the height is reduced or the vertical hold allowed to slip the pulses can be observed in the black bar between fields.

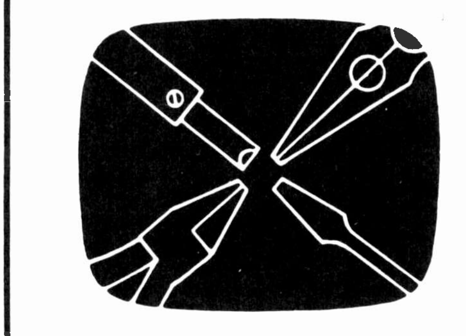
In cases of slow flyback however the pulses will occur before the spot has reached the top of the screen and so will be visible on the picture. Very likely there will be two sets of lines and dots one under the other: this is due to the pulses in one field not occurring at exactly the same time as those in the corresponding field of the same frame. In severe cases the video signal will start before the spot has reached its starting point at the top of the scan, giving rise to foldover at the top, but in less severe cases only the lines and dots appear.

Fig. 4: Slow flyback and top cramping or foldover are often due to related causes: the same part of the scanning cycle is affected.

The pulses are not radiated on all transmissions. In fact at the present time they are only transmitted during the afternoon programmes. As the majority of viewers watch only the evening transmissions it may well be that this fault may cause no trouble to the viewer. If it is known however that the owner views in the afternoons then it may be necessary to pursue the fault and cure it. As with other minor faults, individual circumstances will decide. Top foldover will of course have to be tackled.

The faults and conditions which give rise to top cramping can also cause slow flyback, the two being

—continued on page 278



SERVICING television receivers

L. LAWRY-JOHNS

DECCA DR100 SERIES—*cont.*

Vision Circuits

The presence of valve diodes in the detector, d.c. restorer and vision interference limiter circuits should be noted. These can develop heater-cathode shorts leading to severe hum bars on the picture or a complete loss of picture with the screen being divided into black and white—black top and white bottom or reversed.

The video amplifier is a PCF80 with the triode section used as a cathode-follower. This is fairly reliable except for a slow loss of contrast as the valve emission falls off—which sometimes gives the impression that the tube is failing.

The vision i.f. circuits are often neglected when the fault of poor contrast or a grainy picture is being traced. This is probably because of years of faithful service given by the EF80 type of valve. Frame-grid valves of the EF183 and EF184 type are however much more likely to give trouble due to their closer tolerances. There may be loss of emission causing loss of contrast or a grainy picture; complete loss of signal due to an internal short, often resulting in the feed resistors being burnt out (check the decoupling capacitors with this one); or excessive contrast with smearing due to grid-cathode leakage cancelling the a.g.c. action, with the added possibility of sound-on-vision or vision-on-sound thrown in for good measure. With all these symptoms check the system switch to ensure proper connection before condemning the valves.

The same remarks can be applied to the sound i.f. stage which uses an EF184.

Sound Circuits

For u.h.f. an EB91 ratio detector is used whilst for v.h.f. an OA79 detector diode is used. A further OA81 diode functions as a noise limiter on v.h.f. and its load resistor R80 (1·5MΩ) is a common cause of distortion when its value rises above 4MΩ (note that this distortion is confined to v.h.f. only, the u.h.f. not being affected). The switched output of the detector stages is taken via the red plug to the volume control, the wiper of which is taken back via the blue plug to the PCL82 control grid (this is where you get the hum if the plug is not a snug fit).

The triode section of the PCL82 deserves some comment. It is loaded by R85 (220kΩ). When this resistor goes high the sound is reduced with a clipping action which distorts the "Ss". There is also a degree of negative feedback from the output stage fed back to the triode cathode. This feedback is effective across the 270Ω section (R83) of the total cathode bias

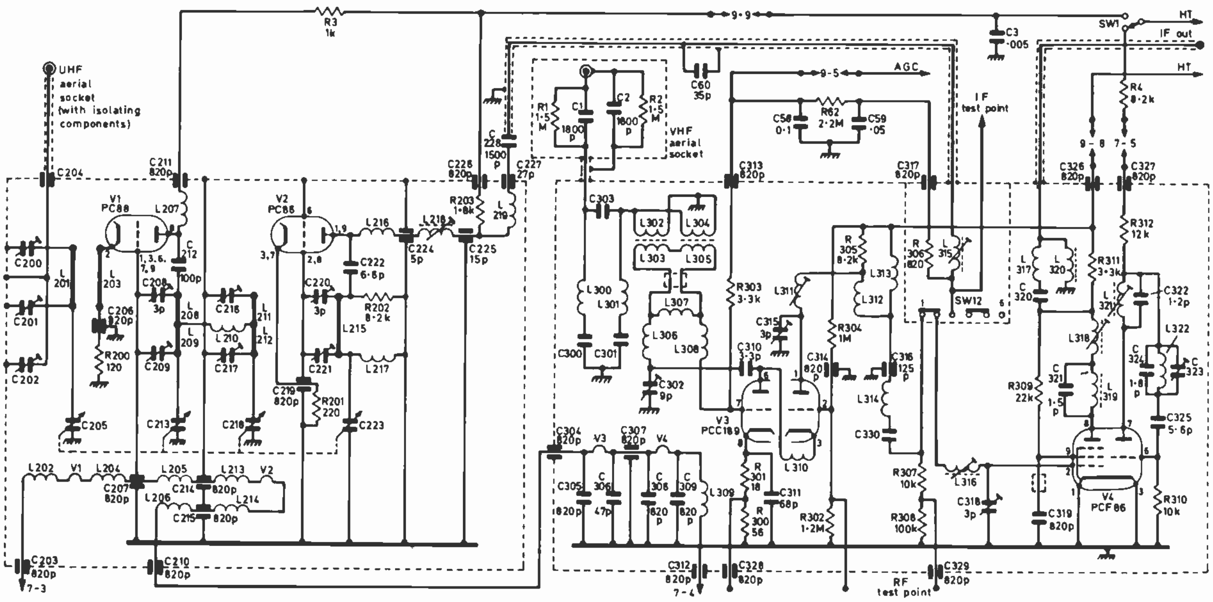


Fig. 4: Circuit diagram of the u.h.f. and v.h.f. tuner units.

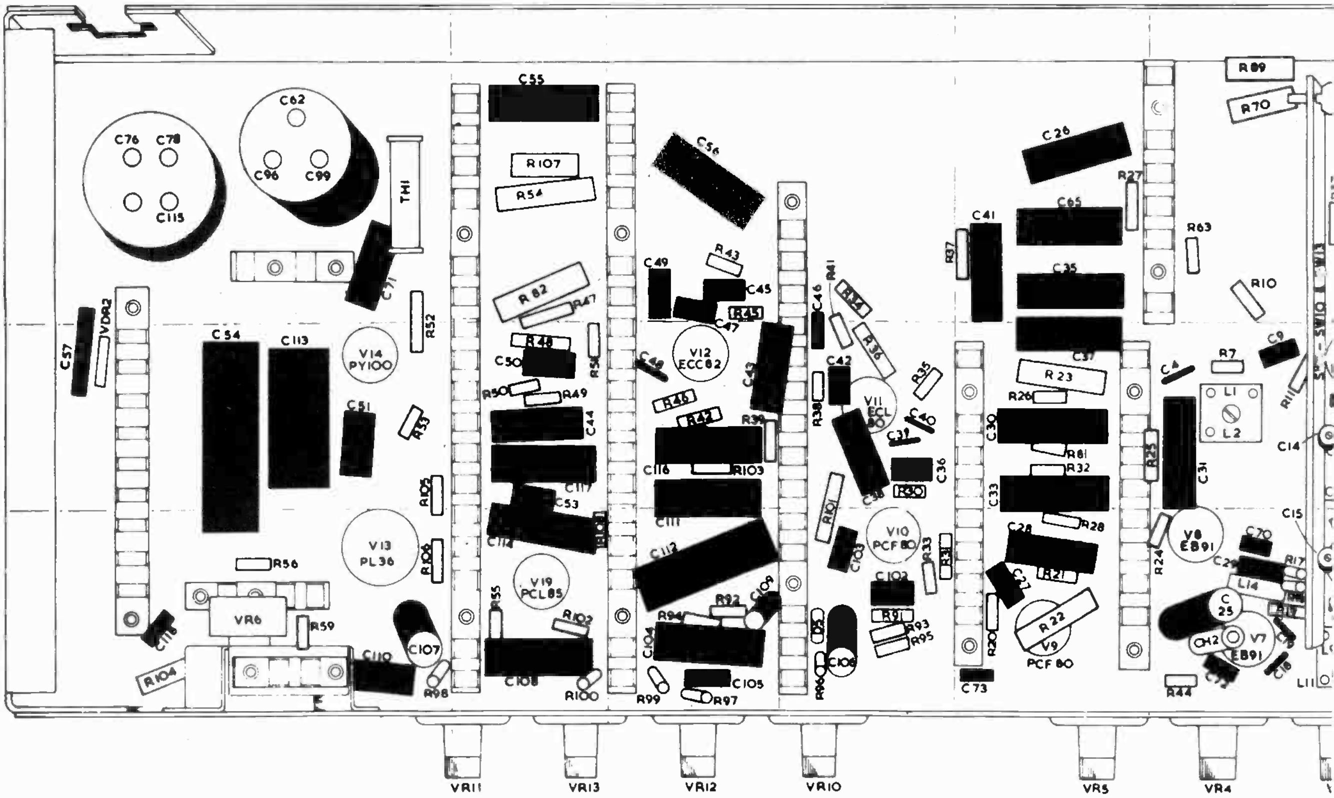


Fig. 5: Underchassis layout.

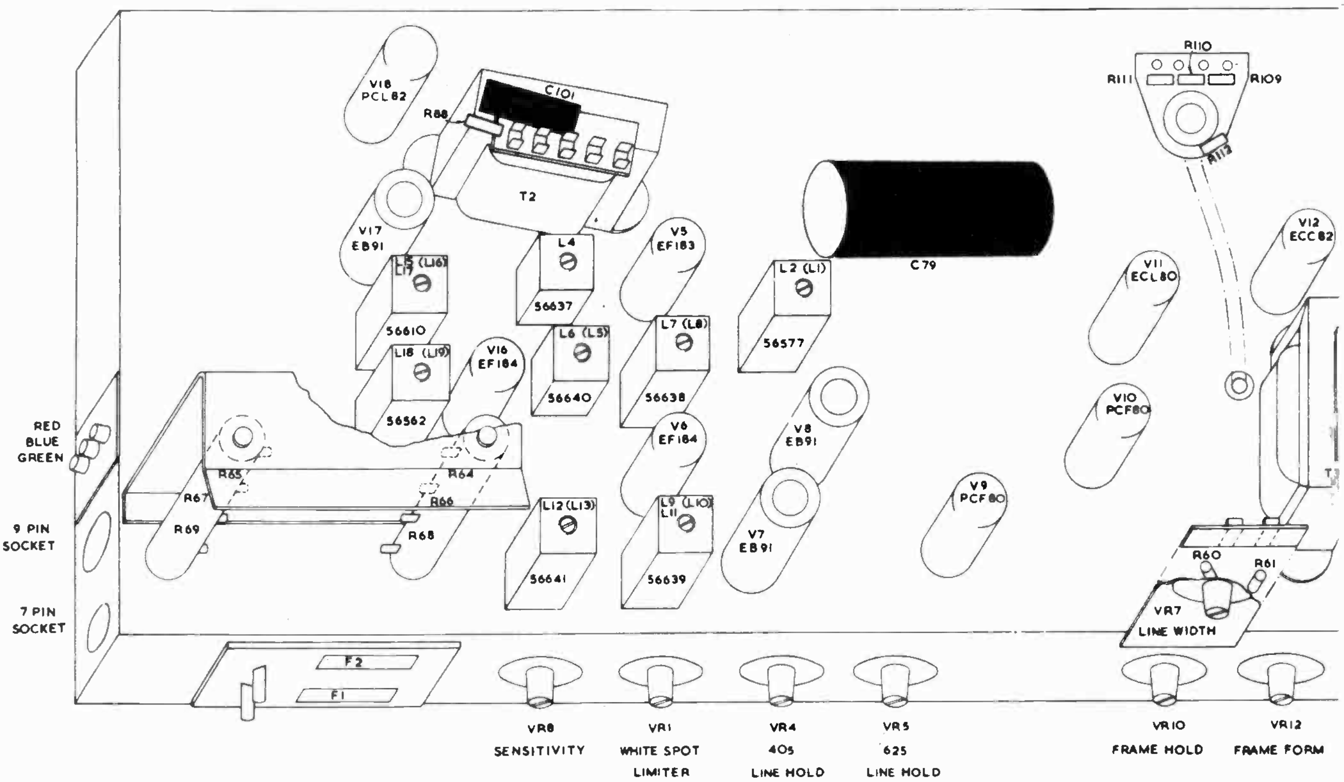
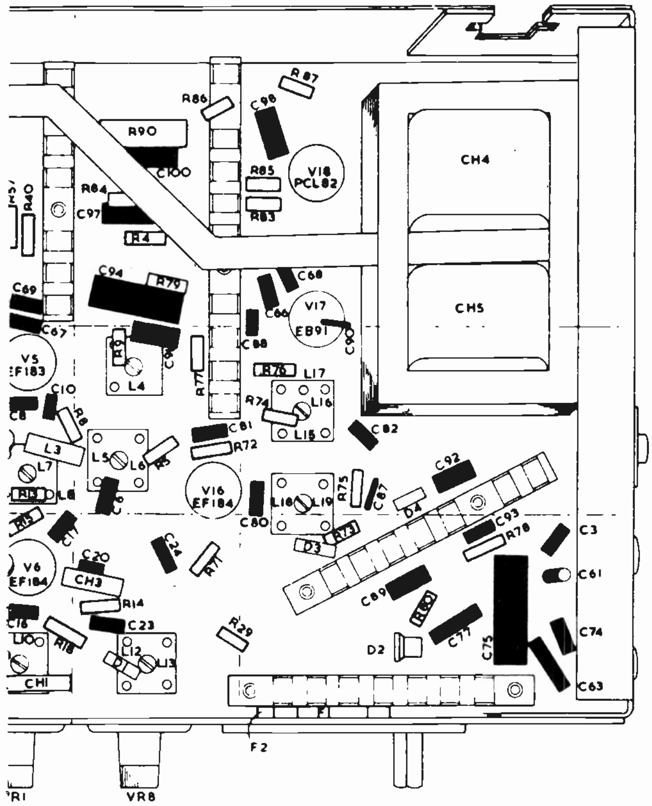
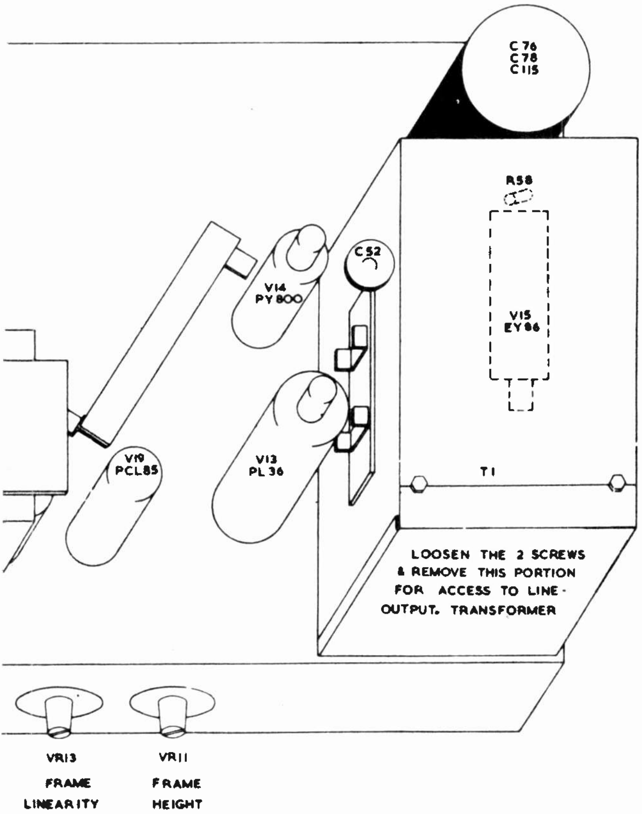


Fig. 6: Above chassis layout.





network. The main bias is developed across the 3·9kΩ resistor (R84) which is decoupled by C97 25μF. Now if this capacitor should become open-circuit the total feedback becomes excessive and the sound, although wonderfully pure, becomes hardly audible!

The output stage is a common source of distortion and the PCL82 may be seen to be overheating. This can be due to the valve running into grid current, the coupling capacitor C98 leaking, R90 being the wrong value or a combination of all three. Usually the valve is at fault with the possibility of the 270Ω resistor being damaged due to overheating.

Loss of Sync

Loss of sync implies that the timebase locking pulses are arriving with insufficient amplitude to hold a picture or are not getting through at all. This may affect both the line and field timebases or only one (usually the field). Sync pulses can be considerably weakened in the video circuit if the partial cathode bypass C28 (100μF) becomes open-circuit. Complete loss can occur in the sync separator stage when the valve (V10, PCF80) fails or when its screen feed is impaired. This happens when R31 goes high-value or when C38 shorts. If this capacitor becomes open-circuit the field pulses will be mainly affected. The interlace diode D5 (OA81) should not be overlooked when loss of field sync is experienced. If a reverse resistance test shows this diode to be in order check the associated resistors, particularly R91.

Power Supply Circuits

The troubles to be expected in the power supply circuits are open-circuit dropper sections or shorted capacitors. As far as the droppers are concerned it is the h.t. sections which are likely to be the source of trouble. These are the right-hand droppers of the pair on the left side. They consist of three 20Ω sections (R64, R66, R68) and it is a simple matter to locate a suspected break (assuming the valves are alight but there is no h.t.) by applying the ever handy neon to each tag in turn in order to locate the defective section. It is then a matter of fitting a replacement section across the break. The value is not too critical between 14-25Ω but please don't short out!

The same remarks apply to the left-hand heater sections when the fault is one of no heaters glowing. The probability here however is that it is a valve heater which is open-circuit rather than a dropper section, and all tags of the dropper may therefore be fully alive to a neon tester. The dropper sections on the left have a value of 67Ω each and the Radiospares 66Ω sections may be used for bridging.

A blown mains fuse should be examined to gauge the severity of the overload. If it is blackened with the wire disintegrated the strong possibility is that a capacitor has shorted and C64 is the strongest suspect (even though it shows virginal innocence on a resistance test).

If the h.t. fuse blows check C75, the BY100 D2 (back-to-front reading) and the h.t. line generally. Because of the large number of electrolytics used in this receiver tracing which one is shorted is largely a matter of comparing the resistance reading (if any) with the circuit and disconnecting the suspects in turn in order to check them.

NEXT MONTH: PHILIPS STYLE 70 SERIES

Receiving ORTF

ROGER BUNNEY

EARLY last year I was approached for suggestions as to the possibilities of receiving French television (ORTF) at a location to the South East of Salisbury, Wilts on a fairly regular basis. The following account gives a general idea of the problems encountered and their solution, and should provide sufficient information for any reader suitably situated on the South Coast to enable him to investigate similar reception possibilities. At this point it should be stressed that the initial experiments were to determine whether such reception was possible; the information that follows outlines the general approach followed rather than specifying particular equipment for any site to make daily reception possible.

Initial Investigation

Initially a survey of the location was made. John, farmer and owner of the site and house, had already been receiving indifferent reception from ORTF Rennes but wished to improve the somewhat inconsistent signals received. The site was found to be ideal, about 440ft. above sea level, with a clear take-off to the horizon due South. From West to East through North the house is in a slight depression, some 40ft. below the height of the surrounding hill range which runs East-West. Being some miles from a main road and any other housing electrical interference was at a very low level.

Of the higher power ORTF transmitters in North France within about 200 miles range two lay to the South. One was Rennes ch. F5 in Band III, some 210 miles away. Due to the distance and the frequency this seemed rather optimistic, especially as interference was received at times from a nearby radio transmitting site carrying various mobile services. The other transmitter which seemed the most likely candidate was Caen ch. F2, with sound at 41·25MHz and vision at 52·4MHz. Being in Band I and only 140 miles away success seemed assured!

Having decided on this transmitter, which has an e.r.p. of 50kW and uses horizontal polarisation, a review of the likely reception problems was made. In this age of low-noise transistor preamplifiers the weak signals were less of a problem than the likely adjacent and co-channel interference. The sound channel on 41·25MHz could possibly suffer with pick-up from Crystal Palace sound on ch. B1 at 41·5MHz. The vision channel could suffer from ch. B2 vision pick-up from North Hessary Tor on Dartmoor and the Oxford relay, also on B2 at 51·75MHz. Another known source of interference which *would* occur was sound splatter from ch. B3 Rowridge at 53·25MHz. Rowridge is the local coverage station and from here on I will refer to it as the "local". The sound splatter would spread down to cover most of the ch. F2 vision, and with the transmitting mast being observable on a clear day at 24 miles problems were expected.

Receiver

John had a 21in. French receiver with three vision i.f. stages using EF80 valves but unfortunately the set had no form of flywheel sync. The sound take-off to the two sound i.f. stages was via a small-value capacitor after the first vision i.f. stage. The three vision i.f. stages were considerably damped to obtain the necessary wide bandwidth. I decided to split the

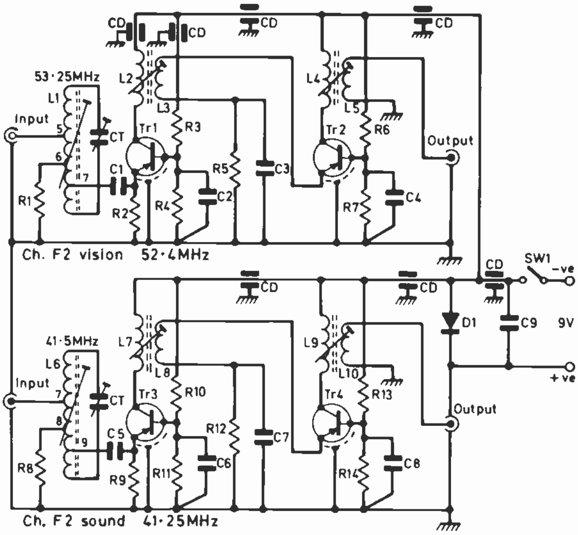
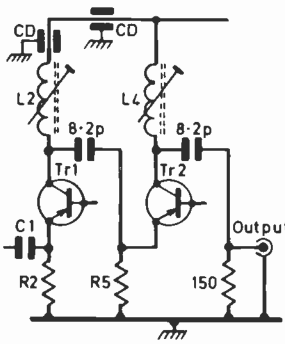


Fig. 1: Circuit diagram of the preamplifier used. The vision and sound channels are separate.



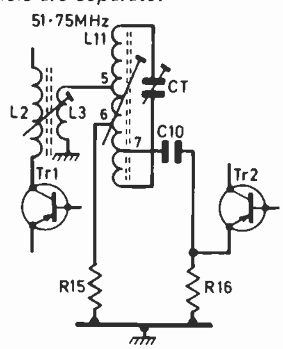


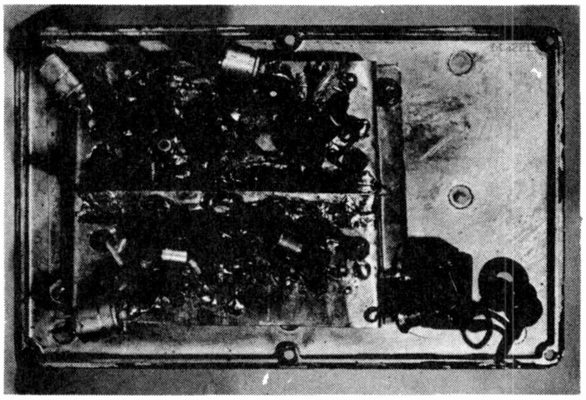
Fig. 2 (left): Alternative circuit using capacitive coupling between stages (the primary coils remain unaltered).
Fig. 3 (right): Modified circuit when using a second video notch filter.

i.f. channels entirely by fitting a second tuner and an extra sound i.f. stage and to decrease the vision i.f. bandwidth. This would have the effect on vision of higher gain and improved performance, especially on days when the signal was of marginal quality. With the reduced bandwidth some quality would of course be lost due to restricted h.f. response but in practice this was hardly noticeable. I found that the i.f. transformers were shunted by low-value resistors such as 2·2kΩ. These were increased to 4·7kΩ which seemed the best compromise. The EF80 valves were replaced with EF184 frame-grid types which increased the gain still more. All the valves were eventually replaced to give the set maximum performance. In common with most French sets a mains transformer is fitted so one can work on the receiver safely with the chassis out of the cabinet.

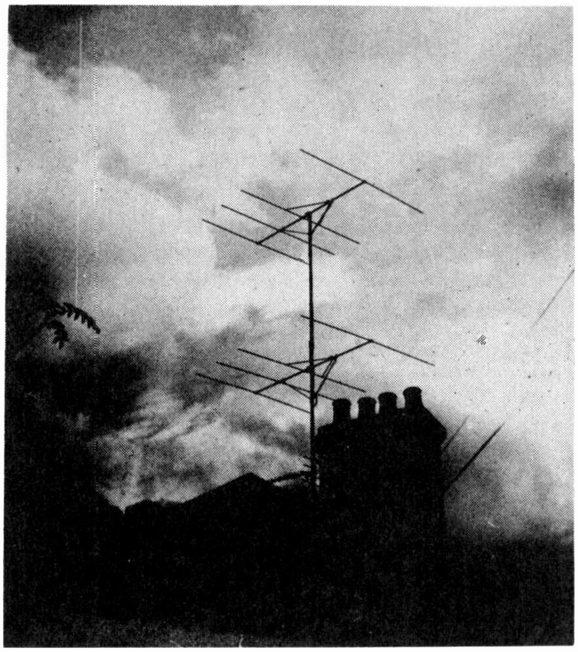
Aerials

As the receiving site was so well placed and as the whole project was in the first place an experiment too large an outlay on aerials was initially avoided. The construction of a large array was decided against and instead commercial arrays were purchased, a three-element ch. B1 array for the sound and a four-element ch. B2 array for the vision. If reasonable reception was obtained it was felt the eventual system would probably be a double-four for the vision on a 14ft. chimney mast and that a more modern French receiver with flywheel sync should be obtained.

The aerials were obtained from Telerection at Weymouth. These are delta-matched types and due to the sliding matching connections, which are marked on the aerials, an accurate match into 75Ω cable is possible. It it worthwhile checking the dimensions of the arrays to see how close they are to the frequencies required. The ch. B2 aerial was in order but the ch. B1 array was found to be cut to favour the B1 vision (frequency 45MHz) and extra inches had to be *added* together with a slight change in the delta-matching take-off points. The appropriate formulae for anyone wishing to check dimensions are as follows: director (ft.) = $450/f$, dipole (ft.) = $468/f$, reflector (ft.) = $498/f$, where f is the frequency in MHz. Any increase in dipole dimensions will necessitate alterations to the tapping points which must move away from the centre boom in the *same ratio* as the increase in dipole dimensions, compared with the distance between boom and tapping points.



Internal layout of the preamplifier.



In the final installation the double-four stacked array shown here was used for the ch. F2 vision. This was erected on an 18ft. mast and used cut down versions of ch. B2 arrays. The separate sound aerial is mounted on another chimney.

Initial aerial erection proved very easy. Low-loss air-spaced cable was used, of Aeraxial 499 type. Both sound and vision were received initially on a Bush Model TV62 used to align the aerials. The aerials had earlier been lined up in the Caen direction using a compass bearing and consequently little improvement could be obtained by slightly turning the aerials, especially bearing in mind that the forward acceptance angle for three- and four-element aerials is about 70°. Sound signals were received at once, and with the use of a notch filter to remove the local sound splatter vision was also received at fair strength with no aerial preamplifier. At this stage is was felt that little else could be achieved with the aerials installed and attention was concentrated on preamplifiers

Preamplifier

As separate tuners were being used for the two signals no problems were likely to occur with combining the two signals into one outlet. Due to the exceptionally wide bandwidth we decided to use two separate preamplifier circuits tuned to the appropriate frequencies. Notch filters could be fitted as required. The circuit of the main preamplifier is shown in Fig. 1. Two stages are used in each section, the vision channel using an AF186 first stage in order to take advantage of the low-noise performance of this transistor. Tr1 is inductively coupled to the second stage which uses an AF114 (OC171). The sound channel, on the lower frequency, has two similar AF114 (OC171) stages.

For higher gain AF102s can be used in place of the AF114s: the biasing networks required are the same. A further alternative is the use of capacitive coupling. The wiring is of course then altered slightly,

★ components list

Semiconductors:		C8	1kpF
D1	BY114	C9	1kpF
Tr1	AF186	C10	40pF
Tr2	AF114 (OC171)	All silver mica 20%	
Tr3	AF114 (OC171)	CD	1kpF feedthrough capacitors
Tr4	AF114 (OC171)	CT	3-30pF concentric trimmers
Resistors:			
R1	150Ω	**Coils:**	
R2	1kΩ	L1	11 turns tapped at 5, 6, 7
R3	10kΩ	L2	12 turns close spaced
R4	3·9kΩ	L3	3 turns p.v.c. covered over "dead" end of L2
R5	1kΩ	L4, L5	As L2, L3
R6	10kΩ	L6	15 turns, tapped at 7, 8, 9
R7	2·2kΩ	L7	16 turns close spaced
R8	150Ω	L8	4 turns p.v.c. covered over "dead" end of L7
R9	1kΩ	L9, L10	As L7, L8
R10	10kΩ	L11	As L1
R11	2·2kΩ	All wire 24 s.w.g. All coil formers ¼ in. diameter plastic	
R12	1kΩ		
R13	10kΩ	**Miscellaneous:**	
R14	2·2kΩ	SW1	S.P.S.T. on-off
R15	150Ω	4 coaxial sockets	
R16	1kΩ	Case, e.g. Eddystone P4730 die-cast	
All ¼W 10%			
Capacitors:			
C1	40pF		
C2	1kpF		
C3	1kpF		
C4	1kpF		
C5	40pF		
C6	1kpF		
C7	1kpf		

with no secondary winding being fitted and the capacitor taken straight off the "hot" end of the coil. To obtain a good match the capacitor should theoretically be tapped towards the "cold" end of the coil but the former method tends to give higher gain and a sharper bandwidth. The alternative circuit is shown in Fig. 2.

Aligning the Preamplifier

From the results obtained on completion of the preamplifier unit a notch filter (L6) for the Crystal Palace sound did not seem necessary. This was therefore disconnected from the circuit and the aerial input taken straight to C5. A v.h.f. choke could be fitted on the aerial side of C5 to allow a discharge path for static build-up and to prevent radio breakthrough if the site is adjacent to a high-power transmitter. The sound stages were peaked for maximum gain at 41·25MHz and have performed well.

As expected, on the vision side sound splatter from the local station was most troublesome. Adjustment of the notch circuit L1 removed this completely, however. The notch filter alignment is simple: screw in the dust-core half-way then adjust Ct until the splatter disappears. *This adjustment is extremely critical.* When the amplifier case lid is fitted slight detuning may occur and the core can be adjusted to compensate via a suitable hole in the amplifier case. No interference was experienced from ch. B2 vision and the B2 notch filter (Fig. 3) remained on the chassis but out of circuit. It is advisable to mount all the notch filters on the chassis and to connect them or otherwise as necessary. If the expected interference does not occur always remove them from circuit as each notch will introduce a small loss. It is also most important to achieve accurate spacing of the notch coil windings. Having adjusted the notch(es), the coils can be peaked up to give maximum gain at the desired frequency. Depending on the type of case used to house the amplifier and notch filters it is suggested that appropriate holes are drilled in the case to allow fine adjustment of the notch filters. Due to the bandwidth of the collector coils the tuning of the amplifier stages is somewhat less critical.

Results

The results so far have been encouraging. Sound has been received daily and pictures also although due to the lack of flywheel sync some line tearing is experienced and is troublesome (and irritating) on fading signals. As this is a receiver deficiency a different set with flywheel sync will obviate this fault. Rapid flutter fading occurs at times on the cross-channel path and the signals fade selectively—both within the vision channel, causing change of quality and smearing, and vision fading independently of sound and vice versa. Multipath signals are received at times. Towards dusk, with the warmth from the sun removed, the rising cooler air meeting the warmer upper air produces unsettled signals for about an hour. This is most noticed during the summer. From the results obtained by our good friend Charles Rafarel on the South Coast Caen can produce a daily signal on Band I although in fairness it must be added that on some days vision reception can be a struggle.

The aerials, supplied by Telerection, were a three-element type 8DB/D (ch. B1) for sound (with the elements suitably lengthened) and a four element "Multimus" type (ch. B2) for vision. If it is desired to stack the aerials it is most important that exactly identical lengths and types of 75Ω coaxial cable are used. To stack the aerials, assuming that ch. 2 arrays are being used, they must be at least 9 ft. apart and if possible more. The reason for this is that to obtain maximum gain from stacked arrays the capture area of each array should not overlap but just touch. With a stacked array of four elements each array should be about 0·75λ apart and for eight elements they should be 2λ apart. It will be noticed that the capture area is a function of aerial gain: the higher gain the wider the capture area. Identical lengths of cable should be connected to the appropriate dipole connections and then connected together—ensuring that the joint is making good contact and soldered—for connection to the single coaxial downlead. Telerection can supply the aerials mentioned in the text, or they can be obtained from any aerial dealer or indeed any television dealer. ■

RESTORERS AND CLAMPS

TELEGENIC

ONE of the least understood and worst explained areas of television theory is the d.c. restorer or clamp. Least understood perhaps because it involves a slightly different notion to most experienced in television, and worst explained because textbooks seem to regard it as self-evident.

What is the d.c. Component?

A video waveform contains frequencies from d.c. up to the bandwidth limit of the system. 625-line television for example contains large amounts of information at 50Hz the picture frequency, 15·625kHz the line frequency, and at the harmonics of these. Other components appear at frequencies up to 5·25MHz depending on the picture information being transmitted. But what d.c. component is there in such a signal? The d.c. component is the datum line of the television waveform. This is usually the black level, with everything above black level consisting of picture information and everything below black the synchronising information.

The cut-off voltage of the c.r.t. should always occur at the same voltage level as black. If it differs from this either picture information is lost (because it is below the cut-off voltage) or the whole picture is made brighter than it should be. This is commonly shown where in a picture containing only a small amount of white information—e.g. a caption—the darker areas around the small highlights "sit-up" and appear incorrectly as mid-grey. Conversely where a picture with a lot of white information "sits-down", i.e. occurs below the cut-off point of the tube, the detail in the darker areas is lost. For correct pictures therefore the d.c. component is essential.

D.C. information cannot pass through a capacitor. Fig. 1 shows at the left two video signals, one with only peak white in it and the other a saw-tooth. If both these signals are passed through an *RC* coupling circuit as shown the result is a loss of the d.c. component. The outputs take up the mean level of each signal—different in each case—and the reference black level is removed.

A.C. coupling is used between stages in television receivers and the d.c. datum of black level is thus inevitably lost. Direct coupling between stages could be used—avoiding the use of coupling capacitors—but such stages are difficult to make stable cheaply and are therefore impractical for domestic equipment. To replace the d.c. component after using *RC* coupling is relatively easier and there are two basic solutions available: (1) the d.c. restorer; (2) the clamp.

The d.c. Restorer

The basic d.c. restoration circuit is very simple. It consists only of a *RC* coupling network with a diode across the output terminals (Fig.2). The input waveform shown here contains peak white only and is the result of previous *RC* coupling. The diode *D* in the circuit will conduct only when the input level falls below earth potential. When this occurs capacitor *C* charges to the peak negative voltage of the signal, the output being held at zero volts because of the low forward impedance of the diode. As soon as the waveform goes positive again *D* ceases to conduct and the output waveform builds up from earth potential, *C* being unable to discharge through *D*. The output waveform then follows the input waveform except that the most negative point becomes earth potential at the output.

R must be included to allow the charge on *C* to change if the input level becomes smaller. Otherwise the output would again have a d.c. error. The value of *R* must be large enough to prevent *C* dis-

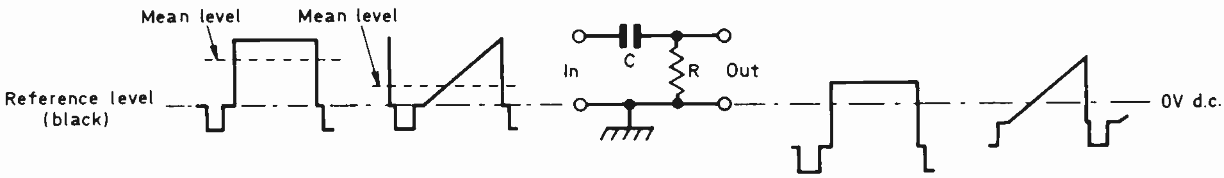


Fig. 1: The loss of the d.c. reference level that occurs when a video waveform passes through an RC coupling circuit.

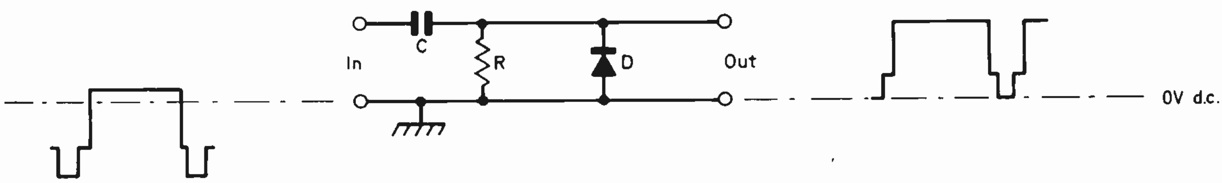
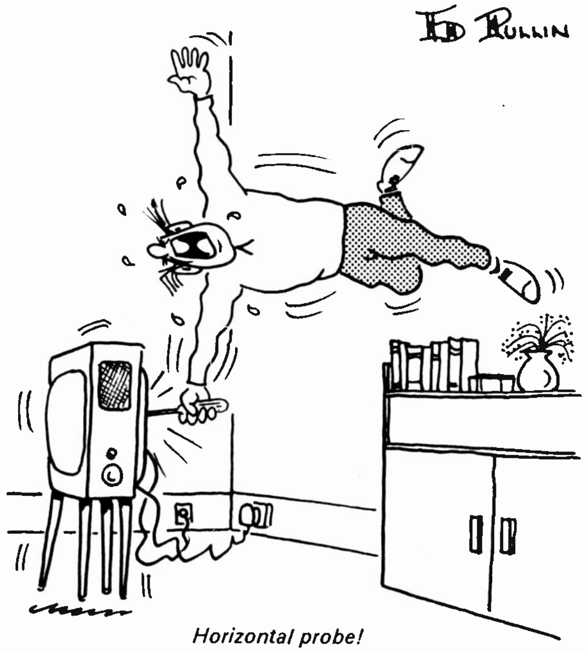


Fig. 2: The basic d.c. restorer and its effect.



Horizontal probe!

charging between lines yet it must be small enough to allow C to discharge fairly rapidly if the input level decreases. A good compromise value is usually taken so that the discharge time-constant (CR) is about 100 times the active line time of the system—i.e. about 10msec on 405 and 5msec on 625.

The output signal in this form is known as being d.c. restored to sync tips—providing a reference level for all video signals. If a video signal of opposite polarity is being d.c. restored then the polarity of the diode in the circuit must be reversed. The output will then be negative-going from earth potential with the sync tips of the waveform at the zero potential line.

The obvious place to incorporate a d.c. restoration circuit is between the output of the video amplifier and the tube or just before the video amplifier with direct coupling from this stage to the c.r.t. This latter system has been used in a number of receivers—e.g. the Philips 19TG170A/171A/173A series and its Stella, Cossor and Alba equivalents or the Decca DR1. There is however a d.c. restorer in nearly all TV receivers—the sync separator stage. A separate diode is not used here, the grid and cathode of the pentode valve itself acting as the diode. The incoming video with positive-going sync pulses is d.c. restored to sync tips to ensure that the video information is below the cut-off voltage of the stage so that it does not break through to the output of the sync separator.

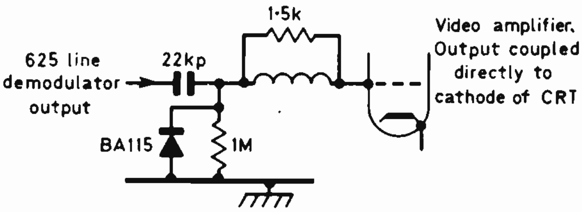


Fig. 3: The d.c. restorer used in the Philips 19TG170A series of models.

A practical video d.c. restorer circuit is shown in Fig. 3 and is from the Philips series noted above.

Simple as it is the d.c. restorer performs a useful job. It is by no means perfect however and the limitations can be appreciated in the compromise choice of value for the resistor in the circuit. If chosen incorrectly it can cause either virtually no d.c. restoration action or "shading" or "tilt" on the picture. These two effects show themselves mainly with rapidly changing pictures, particularly those from mostly black to mostly white or on a scene with a fairly even contrast ratio.

Colour Reception Conditions

The shadowmask tube has three cathodes and three signal grids. Unless RGB drive is used mixing takes place in the tube itself with the luminance signal fed to the three cathodes simultaneously and the R−Y, G−Y and B−Y colour-difference signals fed to the appropriate grids. An additive action then takes place in the tube so that the modulation of each electron beam is R, G and B. For this to be accurate however the Y and colour-difference signals must all have exactly the same d.c. component. D.C. restoration is sufficient in the luminance chain as the same signal is split to feed the three cathodes, normally through the grey-scale controls. In the colour-difference signal chains however a standard reference is required and this has led to the use of a d.c. clamp in each of these chains.

There are as always exceptions, the most important of these being the Baird 700 series of receivers in which a d.c. restorer is used in each chain. No reference level exists however on colour-difference signals—as there are no sync pulses to provide this—so a pulse is added to each signal to provide a reference level. This pulse is obtained from a winding on the line output transformer and is thus a "sync pulse" to which the d.c. restorer can work.

What is a Clamp?

The simplest way of considering the clamp is as a switch which opens and closes at regular intervals to connect the video signal to a reference potential. In the very simple circuit shown in Fig. 4 the reference potential is earth. When S closes C charges towards the anode voltage and point G is at earth potential. When S reopens C will remain charged at the anode potential for some time until it discharges through leakage. If the periods between switching are made equal to the line time the video signal will be fixed to the reference potential of earth. This is done by closing S during

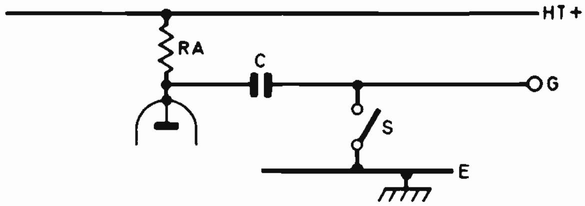


Fig. 4: Simple explanation of a clamp.

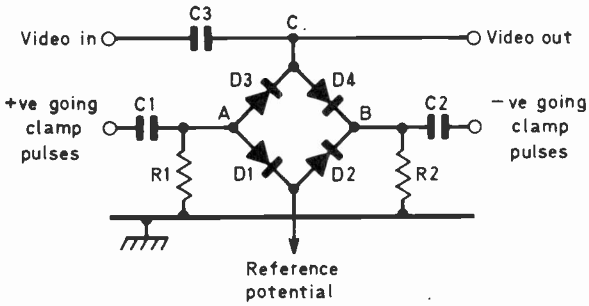


Fig. 5: The four-diode clamp circuit.

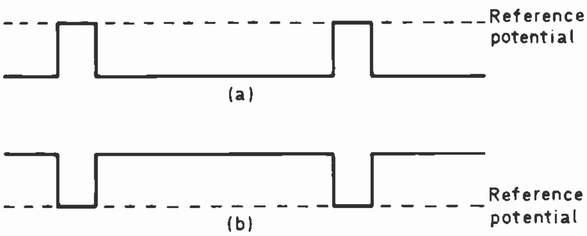


Fig. 6: D.C. restored clamp pulses, (a) at point A, (b) at point B.

each line sync period. The black level will then be kept at a fixed level above this for the rest of the line.

In a practical clamp the switch is of course replaced by an electronic switch. Through its action this line-by-line clamp reinserts the d.c. component and also reduces nearly all interference below 1kHz. The switch may make use of diodes, transistors or valves for its operation.

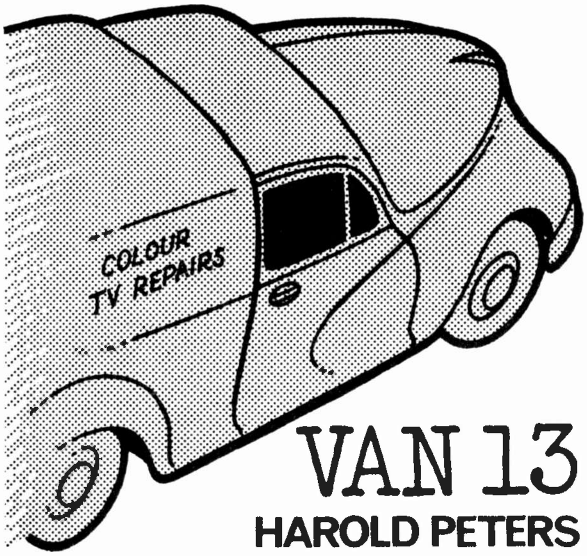
The four-diode clamp configuration consists of four diodes in a bridge circuit. Across two points of the bridge are applied the video signal and into the other two points are fed a series of clamp pulses —one set positive and one negative. The arrangement is shown in Fig. 5.

We can recognise the two formations C1, R1 and D1 and C2, R2 and D2 as being d.c. restoration circuits. Thus the pulses entering the bridge are d.c. restored to their tips. The pulses used are line sync pulses, one set being in antiphase with the other. The d.c. restored clamp pulses will appear as shown in Fig. 6.

With this arrangement diodes D1 and D3 conduct hard when positive-going pulses appear at point A and D2 and D4 conduct hard when the negative-going pulses appear at point B. Thus during the period of conduction there is a very low-impedance path between point C and the reference potential. The video signal is coupled by C3 into point C. During the time the diodes conduct the potential at point C is the reference potential and the sync pulses in the video signal are thus brought to this reference potential. Through the remainder of each line—whilst the diodes are not conducting—the reference is maintained by C3 which is charged in the same way as the capacitor in the d.c. restorer.

This type of clamp gives a line-by-line reference to the video signal in a much more accurate and faster manner than the d.c. restorer does. Its efficiency can be judged from the fact that a four-diode clamp can be built to remove 100% hum from a video signal! ■

LOGBOOK of VAN 13



HAROLD PETERS

TUCKED behind the record of hours of work in the map pocket of Van 13 is a logbook of a different kind. In this is recorded the solution to all the interesting faults that its various drivers have come across. Not all of them are stock faults by any means, neither are some of the remedies blessed by the manufacturer concerned, but since Van 13 is on the colour run (as you would expect with a number like that) the log makes interesting reading.

The filing system of the log is predictably haphazard so it is rearranged here into various manufacturing groups and further subdivided into the stage in which the trouble occurred. Most of the tips relate to dual-standard (DS) models but a few single-standard (SS) faults are included although these models are too young at the time of writing to have developed too many bad habits.

The assumption is made that the reader has a circuit diagram, a decent oscilloscope and ability to understand them both.

GENERAL FAULTS

Snowy picture: If the signal is above a millivolt suspect a faulty BF180 r.f. transistor in the tuner. If you are tempted to change it yourself don't unless (a) you are good at it and (b) you can afford to lose some r.f. gain.

Set difficult to converge: It could be what you fear most—the c.r.t.—or the deflection and convergence yoke, but first of all try tilting the convergence coils with respect to the deflector coils and start all over again.

Blue difficult to converge: Blue lateral magnet assembly incorrectly polarised.

Sudden bad convergence on one system (DS): Check system switch for sticking or bounce, also its solenoid, and solenoid limiting resistor.

Intermittent colour: 4·43MHz crystal dry-joint.

Line trouble (DS): Early line timebases tended to overheat—the odd one or two even caught fire. If conditions permit try reducing the e.h.t. from 25kV to 22kV on 25in. sets and less on 19in. sets. This has been known to prolong active life.

Eyestrain when converging blue with yellow: Turn off the green gun and converge a magenta raster.

BRC MODELS
(Ferguson, HMV, Marconiphone, Ultra)

The serviceability of these sets is extremely good. The whole chassis frame slides back for easy access and all panels are replaceable as units by plug and socket or edge connections. These latter can in fact be almost as troublesome as the circuits they hold so check interconnections thoroughly when fault-finding. Regulated supplies to all the transistor stages are provided on all models, the single-standard range using a novel chopper circuit. Protection is inbuilt, so if you accidentally brush your meter lead across a live point and you hear a splash and the set goes dead switch it off for a little while. On switching on again the protection devices will have untripped and you are back in business again. Always bear these circuits in mind, since they tend to make fault-finding difficult by cutting off whole chunks of the set at a time as soon as an overload occurs.

Tuner (DS)

Poor reset: Check that use has not loosened the plate at the rear of the push-button assembly.

Snowy picture: Faulty BF180 VT1—don't attempt replacement, send it back or performance will suffer when duplicated services arrive.

Video Board (DS)

Flashing colours: Noisy track of potentiometers R42, R61, R79, R38, R58, R75 (set video bias and gain controls).

One colour missing: Check BF178s (output transistors). These are in pairs but only one has to fail for the relevant colour to be lost.

Field Timebase (DS)

Foldover: Faulty BD124 output transistor (VT4 or VT5). See Fig. 2.

Bottom folds with increase of height: Check and adjust 55V line from regulator board.

Line Timebase (DS)

Regulator board keeps tripping: System switch jamming.

No line: C32, C33 (800pF) connected across the output transistors go short-circuit on later models, usually taking the R1039 output transistors with them.

W4 efficiency diode short-circuit—if this happens thermal runaway may occur in the output transistors as the regulator board is not always fast-tripping enough to save them.

Line jitter: Check R15 680Ω in the 55V line and

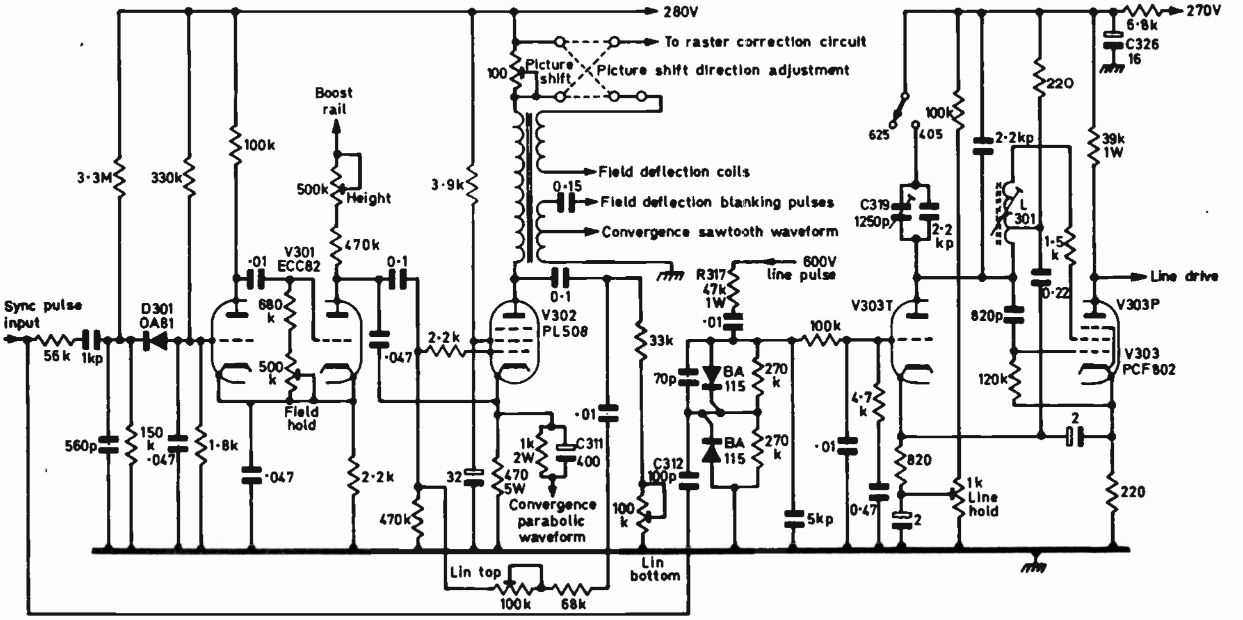


Fig. 1: Circuit of the Decca dual-standard timebase panel on which the line and field generators and field output stage are mounted. R317 47kΩ is a "favourite" in many chassis. It is 3R1 in dual-standard Rank-Bush-Murphy sets.

change for a wirewound type if necessary.

Weak line hold: W1, W2 line sync diodes unbalanced.

EHT Board (DS)

No e.h.t.: VT4 2S321 in the feedback stabilising amplifier circuit runs away despite overload protector W2. This can overdrive VT5 (2N698) and VT6 (D1693) and destroy the tripler. Worse follows: the back-e.m.f. from this lot can destroy VT7 (R1038), the e.h.t. generator.

Poor focus: Check C500, C501, C502 and C503 in the tripler unit.

Noisy focus control: Reverse the control inside the unit to utilise a new part of the track.

Focus flutters: Check c.r.t. base for flashover inside the ceramic.

DECCA
(Dual-standard)

First a timely warning if you have not dismantled a Decca CTV25 series set before: There are a number of spills beneath the chassis taking connections from one panel to another. You may be unfortunate enough to disconnect one of these as you withdraw the chassis for service and you may be further troubled by not being able to trace their home connection.

Chassis connections are made via the main framework so use chassis links if you detach panels—especially when servicing the tuner and i.f. strip as a mistake here can "pop" all the transistors on the board.

IF and Tuner

The tuner unit and i.f. strip must be correctly matched.

Ringing or instability: Suspect offtune 33·5MHz and 38·15MHz traps—tune C105, VR100.

Low gain on 625: Replace the OA47 diode D1 on the tuner a.g.c. panel with an OA81.

Brightness levels differ between systems: Adjust VR102 on 625 and VR103 on 405 (controls in a.g.c. input circuit) for 2V peak-to-peak colour bar at luminance panel video input.

Sound-on-vision: Adjust VR102/3 as above.

Convergence

Poor 625 convergence: Check for bounce on solenoid, and the switch contacts.

Convergence centre shifts with system: Check clamp diodes TR500 and TR501 (transistors diode-connected); try reversing contacts on the line output and convergence panel.

Timebases

Line out-of-lock on switch-on: Reset L310 (625) and C319 (405) preset controls. If C319 is tight in, bridge a 1000pF capacitor across it.

Bad focus: Faulty PD500 or PY500 valve.

Focus alters with width: Take focus leads out of cableform.

Low width: Replace PL509.

Height and hold vary: Try the 400μF output valve cathode bias electrolytic C311, the preset controls and the ECC82 (V301) field oscillator. Select a good specimen for best results in V301 position.

Weak field sync: Change D301 (OA81) interlace diode.

Line speed varies: Change of value of R317 (47kΩ); increase its wattage by fitting a 50kΩ wirewound type instead. This is the resistor in the reference pulse feed to the flywheel sync discriminator circuit (see Fig. 1).

Line sync varies: Check and if necessary increase the value of C312 the 100pF sync coupler.

Check C326 (16μF 275V) h.t. decoupler which gives peculiar effects if open-circuit since lock is produced from a combination of flywheel sync through the correct path and direct sync via the h.t. line.

Power Supply

Picture "breathing": This will generally be accompanied by weeping of electrolyte from beneath the 400 + 400μF smoothing block. Replace the block.

Fuseblowing: Check the h.t. rectifier and C226 mounted on the luminace panel.

Service hint: H.T. to chassis reads 8·5kΩ with red meter lead to chassis and black to the smoothing choke.

PHILIPS

The Philips group have available through their service organisation—Combined Electronic Services Ltd.—detailed fault location guides for their G6 and G8 chassis. With the aid of these charts fault location on Philips sets is reduced to its simplest form.

PYE GROUP

(Ekco, Pye, Invicta, Dynatron)

Dual- and single-standard sets follow the same layout, the main differences being in the i.f. and timebase sections. All units unplug for replacement. To change the decoder panel slide out the tray also holding the field timebase and colour-difference amplifier (CDA) panels to the extent of the leads first. On dual-standard sets mind the bowden system cable does not decapitate the ringing transformer on the decoder.

IF Panel

Pulling on whites (SS): Change R31 from 560Ω to 1,000Ω and fit a 1,000Ω resistor in place of the wire link from VT7 (sync separator) collector to PL4C.

Thin or sibilant sound (SS): Check speaker for rubbing, replace R60 (10kΩ) resistor in the detector output circuit with a 3,000pF capacitor.

Jumbled negative pictures (DS): Only top half of the i.f. system switch going over.

Green tint on 405 only: Subcarrier oscillator in decoder stopping. Add a 100pF capacitor across contacts c and a of SW2A on the i.f. panel. This feeds enough damped oscillations from the 405-line a.g.c. sync ringing transformer T3 to keep the subcarrier oscillator running.

Colour-difference Amplifier (CDA)

Screen green on left, magenta on right: Replace VT28 blanking transistor (BC107 or BC147) in luminance output pentode cathode circuit.

Patterns on channel 9: This could turn up on a nearby

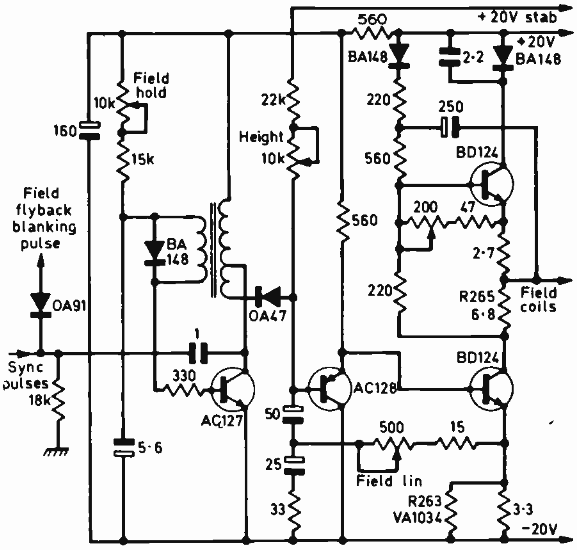


Fig. 2: The transistorised field timebase circuit used in Pye dual- and single-standard sets. The position of R263 is critical—see "Field Shrinkage" in text. The goodness of the output pair can be checked cold on the ohms range of your meter: base to collector should measure 1·2kΩ one way, infinity the other; emitter to collector 65kΩ one way, infinity the other; emitter to base 1·2kΩ one way, 65kΩ the other. A similar circuit is used in the BRC 2000 dual-standard chassis.

monochrome set also. Lay the (R−Y) red output lead running from decoder Sk9 to CDA Sk13 well down close to the metal chassis tray.

Flesh tones incorrect: Set up CDA adjustments as per manual on colour bar and finish off on site with a slight touch to the G−Y gain control (RV26).

Field Timebase

Field shrinkage: Check the position of the thermistor R263 (VA1034)—see Fig. 2. It should be suspended just over wirewound resistor R265.

Line Timebase (DS)

Picture bent at top: Change R210, C209 (grid of PCF802 triode section) from 8·2kΩ and 0·47μF to 3·3kΩ and 1μF respectively.

Excessive e.h.t.: Increase R223 (8·2MΩ) in the line output box to 10MΩ.

RANK-BUSH-MURPHY

In addition to normal service facilities, Rank-Bush-Murphy offer their dealers up-to-date information in their house magazine *Service Skill.* Also available are essential items of test gear: a crosshatch generator, inexpensive colour-bar generator, alignment sweep generator to match the Telequipment Serviscope and a complete colour course on disc and slides.

IF Panel (DS)

No signal: Check voltages around AF181 first i.f. amplifier 2VT1. If incorrect replace 2VT1.

Smeary definition: Faulty BF178 video preamplifier 2VT5.

Decoder (DS)

Colour control has restricted range: Carefully reset preset colour control 5RV4.

Weak ident, intermittent colour, colour slow to come: 6VT3 reference oscillator reluctant to start. Replace 6VT3 (BFY50).

Low reference oscillator volts: 6L10/11 oscillator transformer distorts with heat. Tune replacement for maximum reference volts and then back off a little.

Weak colour: Replace diode 5D11 OA81 by OA90.

Convergence (DS)

Intermittent field convergence: 9C1 500μF on convergence panel works loose—resolder.

Difficult to converge: You may have forgotten the balance controls 9RV27 and 9L21 on the scan coil assembly or have tackled the convergence drill in the wrong order. If all else fails twist the convergence yoke round a little and begin again.

Field Timebase

No field scan (DS): 3C33 0·0047μF short-circuit across output transformer primary. Use two 0·0022μF 1,000V capacitors connected in parallel as replacement.

The single-standard chassis uses a field output circuit of the type shown in Fig. 2 but is preceded by a silicon controlled switch oscillator stage.

Line Timebase (DS)

Wrong line speed: Replace 3R1 47kΩ by higher wattage type (resistor in reference feed path to flywheel sync discriminator circuit).

GEC GROUP
(GEC, Sobell, Masteradio)

Test points are readily available on the component side of the board. The convergence panel lifts up into two slots for adjustments. The chassis pivots to gain access to the underside (DS: disconnect system switch first). The printed circuit is on both sides of the board and connection is often made through the board on component legs. It is essential therefore that these should be soldered top and bottom.

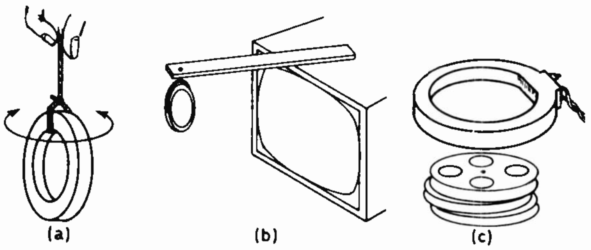


Fig. 3: Some improvised tools. (a) A focus magnet twirled on drive cord will degauss small impurities: move away from the shadowmask tube before stopping magnet rotation. (b) A 40p concave shaving mirror on a lath makes static convergence child's play. (c) Bulk tape erasure using a degaussing coil.

Table 1: Guide to the effects of colour-difference signal deficiencies.

(Courtesy Combined Electronic Services Ltd.)

Colour bar	*No R—Y*	*No B—Y*	*No G—Y*
Yellow	Lemon or too green	Badly desaturated	Too orange
Cyan	Desaturated	Too green	Too blue
Green	Lemon or too green	Greenish cyan	Too dark
Magenta	Too blue	Too red	Desaturated
Red	Too dark	Slightly magenta	Orange
Blue	Slightly magenta	Too dark	Slightly cyan

IF Panel

Moderate hum or instability (DS): Reset the preset contrast controls (625 first) for a 4V peak-to-peak signal at the base of video phase splitter TR7.

Timebases

Picture ballooning: Check that there is not too much brightness or contrast being used, then check for change of value of the 10Ω resistor R61 in the line output valve cathode circuit. Replace with a wire-wound type.

Decoder Panel

Intermittent colour, P302 (oscillator frequency) needs frequent resetting: Replace the capacitors inside L307 (oscillator coil) subassembly (i.e. C323 390pF, C324 560pF, C325 560pF, C326 180pF).

No blue: TR323 blue preamplifier (in L304 can) dry-joint to chassis return path—check both sides of board.

No colour: Short-circuit a.c.c. diode D306 OA91. C347, C348 open-circuit (L308 ident amplifier coil doesn't tune).

R−Y reversed: L308 offtune. Retune on normal colour signal for maximum reading on an Avo meter connected across C352.

Intermittent colour: C322 50pF (poly.) in crystal circuit faulty. Replace with a silver-mica type. Break in print by C304 (burst amplifier unit 333).

No colour: Also no collector voltage at burst amplifier TR324. Check T306 for open-circuit winding.

Very weak colour: C336 short-circuit (270pF). This is across L301 (chroma tuned circuit) which itself is less than 1ohm, and can be misleading. ■

CIRCUIT NOTES

H. K. HILLS

Sound Cascode IF Stage

In *Circuit Notes,* July, 1970, we covered the transistor cascode vision i.f. amplifier used in the Pye 169 single-standard chassis. Recent Sony 9in. portable models use a a cascode amplifier for sound i.f. amplification, being in addition gain-controlled by a separate a.g.c. amplifier (while a.g.c. amplifiers are virtually indispensable for the gain control of vision strips they are very seldom found in the sound section). Three transistors are employed for sound i.f. amplification in the Sony TV9-90UB circuit (Fig. 1), the first two Q401 and Q402 being the cascode pair and the following transistor Q403 a conventional common-emitter stage driving the separate v.h.f. and u.h.f. sound detectors.

It will be seen that npn transistors powered from a positive l.t. rail are used, and with the collector of Q401 connected to the emitter of Q402 the arrangement is reminiscent of the dual-valve configuration used for so many years for r.f. amplification in v.h.f. tuners. Following general practice the v.h.f. and u.h.f. i.f. transformers are series-connected in the collector output lead without the need for system switching, the disparity between the two frequencies being so great that each signal is developed across the relevant transformer. The signals appearing across the transformer secondaries are applied to the base of the third i.f. stage Q403, superimposed on the forward bias from the junction of potential divider R408, R409.

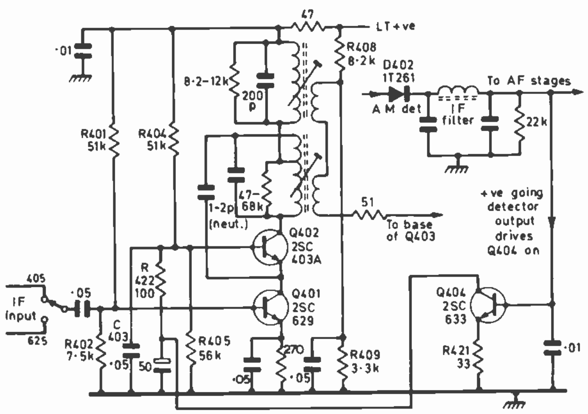


Fig. 1: Cascode sound i.f. amplifier used in the Sony Model TV9-90UB, with a.g.c. applied to Q402 base.

Reverse a.g.c. is used for television sound i.f. amplifiers as in transistor radio receivers. Thus the base bias of the controlled transistor Q402 must be negative-going to reduce its collector current and hence gain as signal strength rises. Q401 is fixed biased by potential divider R401, R402 and with the base of Q402 being earthed by C403 the i.f. signals developed across Q401 are effectively placed across Q402's base-emitter junction.

Under no-signal conditions Q402 is biased for maximum gain by the potential divider R404, R405 and although the a.g.c. amplifier Q404 in series with R421 and R422 is effectively in parallel with R405 it has no effect on circuit operation as it is then without forward bias and thus non-conductive. When however the positive-going a.m. sound detector D402 output is sufficient to turn the a.g.c. amplifier on, it in conjunction with the series limiting resistors R422 R421 then reduces the net d.c. resistance from Q402 base to chassis thereby reducing this transistor's forward bias and hence gain. As the detector output rises the a.g.c. amplifier conductance increases to proportionately reduce the overall stage gain.

Separate Intercarrier Sound Detector

Until quite recently it was the general design practice for the u.h.f. sound signal to be developed by the vision detector diode for take-off at this point or alternatively after amplification by the video output pentode. With the increasing use of transistorised i.f. strips, however, there is a growing tendency to employ a separate diode to develop the u.h.f. sound signal, thereby freeing the video detector stage from take-off circuitry. This greatly reduces the risk of patterning developing in the detector stage, the reduction of lead-out wiring making screening so much more effective.

As a typical example of this trend Fig. 2 shows the arrangement used in the Bush-Murphy TV161U-V1910U dual-standard series which except for the absence of system switching is also largely followed in the subsequent TV183S single-standard series. It will be seen that the input from the last common i.f. transformer is applied to the base of the vision-only i.f. amplifier Tr1 via a rejector tuned to the v.h.f. sound i.f. of 38·15MHz while a series acceptor takes off this signal from a rejector tapping point for feeding to the first sound i.f. amplifier. Being effectively in series with the vision signal feed to Tr1 the rejector wavetrap prevents any risk of the v.h.f. sound signal penetrating to the vision-only stage and possibly causing sound-on-vision. This particular trap is highly selective and while coil core adjustment tunes it to the unwanted frequency adjustment of the associated balance control provides optimum rejection.

The amplified output from Tr1 is developed across the primary of vision i.f. transformer T2, the secondary output being applied to the detector diode D1 in the conventional manner though it should be noted that the earthy end of its load resistor R5 is not returned to chassis but to the junction of the potential divider R9, R10. This is because the following stage, a transistor phase splitter, is d.c.

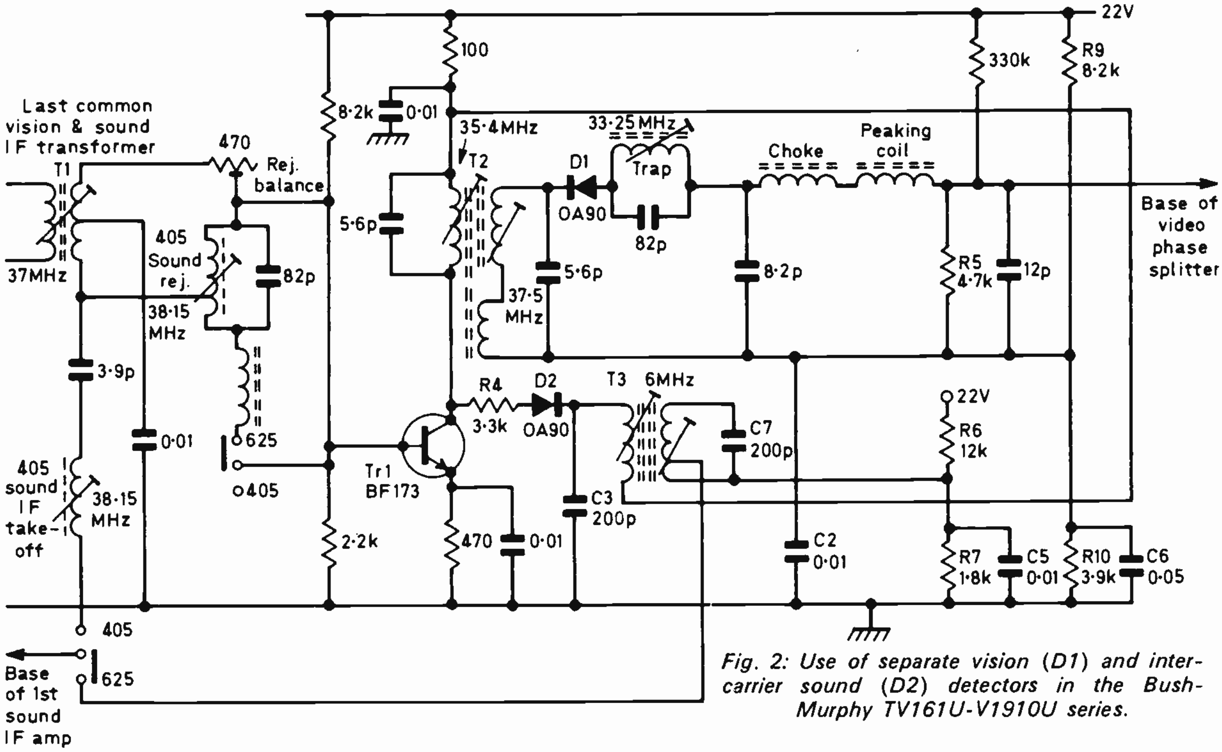


Fig. 2: Use of separate vision (D1) and intercarrier sound (D2) detectors in the Bush-Murphy TV161U-V1910U series.

coupled, the d.c. potential at the load resistor providing the forward bias required by the phase splitter stage. The negative-going detector output then reduces this forward bias. The junction of R9, R10 is decoupled to signal by C2 and C6.

The vision i.f. signal is also fed via R4 and the separate intercarrier sound detector D2 to the primary of the 6MHz i.f. transformer T3. Up to D2 the u.h.f. sound i.f. at 33·5MHz accompanies the vision i.f. signal centred at 39·5MHz. As a result of the diode non-linearity the two i.f.s produce plus and minus beats between them. Transformer T3 selects the required difference beat of 6MHz for further amplification by the two-stage sound i.f. amplifier when switched to 625. T3 primary in series with R4 and D2 is shunted across T2 primary, the 200pF capacitor C3 providing tuning capacitance similar to that given to the secondary by C7.

The secondary of T3 is linked to the junction of potential divider R6, R7 so that the 6MHz signal applied to the first sound i.f. transistor is superimposed on the junction potential which provides the required forward bias for the transistor. C5 earths one side of T3 secondary while the tapping point reduces the input loading effect of the first sound i.f. transistor maintaining selectivity at the required level. The v.h.f. sound i.f. output has no such attendant d.c. potential to forward bias the i.f. transistor because on this system forward bias is tapped from the cathode of the PCL82 a.f. triode. The potential at this point varies slightly with the mean level signal strength, introducing the a.g.c. action required on 405.

Returning to the demodulated vision signal at D1 anode this is passed via a rejector at 33·25MHz, a choke and peaking coil to the load resistor R5. As the TV161U series are dual-standard models with unswitched detector diode the detected output is applied to the base of a transistor phase splitter so that the output from this stage can be tapped from either emitter or collector to obtain correct signal phase on system change.

Can you work out from which phase splitter points the 405 and 625 signals are taken? The detector output at D1 anode is negative-going which is correct for the 625-line system. Thus to maintain this phase up to the video pentode grid the signal is on 625 lines taken from the emitter of the phase splitter. On 405 however a positive-going output is required. This is taken from the collector of the phase splitter, phase reversal taking place by normal amplifier action between the base and collector of this stage. The output from the collector is thus exactly the same as if taken from a reversed-polarity detector diode and without the disadvantages of switching and the need for extra leads in the detector screening can.

BRC 1400 405-Vision Detector

The BRC 1400 dual-standard chassis is one of those using separate vision detector diodes for 405 and 625. An unusual feature is the application of about 12V reverse bias to the 405-line detector W4 (via R35, see circuit in the December 1969 issue) on 625-line operation. This reverse bias increases the depletion region at the pn junction and thus reduces the capacitance of the diode. The aim is to reduce the capacitance to such a low level that any variation in it caused by the presence of the 625-line video signal will not affect the tuning of the final vision i.f. tuned circuit; otherwise there can on 625 be phase modulation of the final tuned circuit at video rate causing vision buzz in the f.m. sound detector.

To further minimize this effect the reverse bias is increased in later versions of this chassis to approximately 20V. This is done by taking the biasing resistor R35 to a potential divider connected across the system-switched h.t. line. This completely overcomes any effect of the capacitance of W4 on the tuning of L10.

Sync Pulse Amplifier

THERE is an increasing tendency towards amplifying the sync separator output before applying it to one or both of the timebase generators. ITT-KB for example have included a grounded-grid triode to amplify the field sync pulses in their monochrome models for some years now and in their colour receivers use a transistor (BF163) pulse amplifier operated from the main h.t. rail to boost the output from a BC116 transistor sync separator run from the +15V rail. (To obtain the required peak-to-peak pulse amplitude to control valve timebase generators directly it is usually necessary to employ a valve sync separator or when a transistor sync separator fed from the l.t. rail is used to magnify its output with a pulse amplifier run from the h.t. line.) In many GEC-Sobell and BRC receivers a d.c. amplifier is used to boost the line sync discriminator output before applying it as a control potential to the line generator.

Bush-Murphy dual-standard colour receivers employ half an ECC82 double triode to amplify the output from a BC187 sync separator—and with an uncommon method of pulse injection to the field generator. The circuit is shown in Fig. 3 and as indicated by inset waveform (a) the grid of the sync amplifier receives a 15V positive-going pulse feed from the collector of the BC187 sync separator. This triode is without a cathode resistor and is therefore

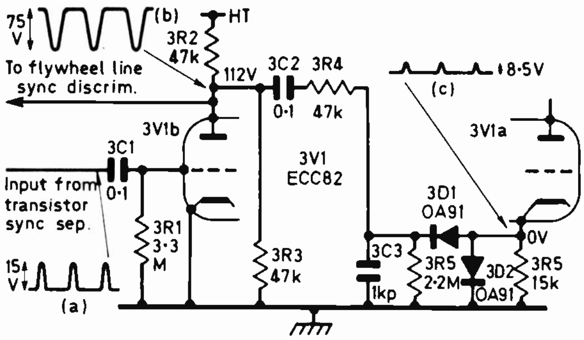


Fig. 3: Bush-Murphy triode sync pulse amplifier.

without fixed bias: it develops a negative grid voltage however because the positive excursions of the applied signal lead to grid current flow.

As the input pulse feed is positive-going the resulting increase in sync amplifier anode current causes a 75V peak-to-peak reduction in the anode voltage. This amplified 75V sync pulse is fed to a conventional double-diode line sync discriminator and via 3C2 to the integrating capacitor 3C3 which is linked to the triode section (the other half of the ECC82) of the field timebase. This capacitor is shunted by a 2·2MΩ resistor (3R5) and two OA91 diodes (3D1 and 3D2) connected anode-to-anode. The second diode is in parallel with the 15kΩ resistor in the cathode lead of 3V1a and effectively short-circuits it during the scan period so that there is then zero voltage at the cathode valve pin.

When the high-amplitude negative-going field sync pulses develop across 3C3 they conduct through 3D1 but momentarily reverse-bias 3D2. This latter diode then no longer short-circuits 3R5 and the voltage change at the valve's cathode initiates the timebase retrace.

TRACING FIELD LINEARITY FAULTS

—continued from page 262

closely connected. It can be seen from the waveform illustration (Fig. 4) that the same part of the cycle is affected in both cases. In fact we would expect a receiver that manifested top cramping to also exhibit the symptoms of slow flyback and vice versa.

Thus the various tests and cures described for top cramping will also be applicable to slow flyback. There are one or two extra ones however and these are in the field generator circuit. In the case of a cathode-coupled multivibrator (e.g. V1, Fig. 2) the anode resistor of the first triode will result in slow flyback if it is high in value. A simple resistance test will confirm this. With a blocking oscillator a similar effect will occur if there is a leakage in the insulation between the windings.

Hum

A further common cause of non-linearity in the field circuits may be overlooked because it does not originate in the field circuits at all. This is hum. When hum gets into the field timebase a sinewave is mixed with the generated sawtooth to give a region of expansion sandwiched between two regions of compression on either side. This can occur at various places on the raster, but the most common one is for the expanded section to be in about the middle of the raster.

Adjustment of either of the linearity controls may partially counteract one of the regions, leaving the others. This rather disguises the hum and makes it look like straightforward non-linearity due to component failure. Much time can be wasted trying to cure it, especially if as sometimes happens there are no noticeable hum effects on other parts of the receiver circuitry.

When the transmitted signal is not locked to the mains frequency the hum effect floats upwards or downwards over the picture. This of course helps diagnosis as it is obvious what is happening. As many engineers have found however it can also be a nuisance when trying to obtain optimum linearity on an ancient set on which it is not economically worth chasing the hum fault!

If there is no trace of hum elsewhere the most likely cause is a heater-cathode leak in one of the field valves. However there are other possible causes, and of course the smoothing circuits cannot be ruled out although one would expect trouble here to result in other signs being present.

There are then numerous causes of non-linearity in field circuits. But by noting the position of non-linearity on the raster and the effects of the various controls one can go a long way to making a quick and positive diagnosis and cure. ■

DX-TV

CHARLES RAFAREL

The SpE conditions for January 1971 here have been much the same as December 1970 except that for the first time for many months there have been some days on which no SpE reception was obtained. However the 1971 SpE season is now getting nearer: what it will bring is of course anyone's guess but let us at least be optimistic in suggesting that it could well be better than the past two seasons. We are due at least for a significant improvement. Oh for those happy days of the early 1960s with stations like Nicosia Cyprus E2 coming in!

Back to the present day however: my log for the period 1-31/1/71 for SpE is as follows:

4/1/71	USSR R1, Czechoslovakia R1.
5/1/71	Czechoslovakia R1, Austria E2a.
6/1/71	Czechoslovakia R1.
7/1/71	Czechoslovakia R1.
8/1/71	USSR R1.
11/1/71	Austria E2a.
12/1/71	Czechoslovakia R1.
13/1/71	West Germany E2.
14/1/71	USSR R1.
15/1/71	Poland R1.
16/1/71	USSR R1.
17/1/71	USSR R1, Czechoslovakia R1.
18/1/71	Poland R1.
19/1/71	West Germany E2.
20/1/71	Austria E2a.
22/1/71	Czechoslovakia R1.
24/1/71	Czechoslovakia R1, USSR R1.
26/1/71	Czechoslovakia R1.
27/1/71	USSR R1 (two stations, strong "floaters"), Czechoslovakia R1.
28/1/71	USSR R1.
29/1/71	USSR R1, Poland R1.
30/1/71	USSR R1.
31/1/71	USSR R1.

F2 AND TROPS

F2: The Russian forward-scatter network stations 38-40MHz were in evidence on January 28 and 29: this is often a sign that SpE reception will be poor.

Trops: Very poor indeed throughout the period. There were just the "local" French and Belgians here.

NEWS

Norway: The big news this month is that the "new" electronic Austrian ORF type test card is now also being used by NRK Norway on all channels. This of course accounts for reports of its reception on chs. E2 and E3 being wrongly attributed to Austria, so I must regretfully ask you to forget my recent remarks on the possible existence of a new Austrian transmitter on ch. E3. The new NRK cards carry the words "Telegrafverket NRK" at the bottom of the card, in rather small lettering I hear, and this was why we missed them before. We are indebted to Doug Bowers of Saltash for this information.

Belgium: There is something rather curious here. We have a letter from D. J. Bunyan of Sittingbourne, Kent. I quote what he says in his letter of 31/12/70: "I have this evening been looking at Belgium Ruiselede E2 and was surprised to see that it was using a test card similar or identical to the electronic card used by Austria (as shown in the August, 1970 issue). The picture was 'negative' and although not very strong the distinctive features could be seen". The point I feel to be noted here is the word "negative", and if I presume correctly that his receiver was operating on 625-lines negative it must mean that Belgium is using the Austrian type card as well. He does not say if there was any BRT-RTB lettering on it. Since receiving this report Roger Bunney and myself have been carefully checking Belgium E2 but so far we have only seen the "old" type card being transmitted. We will continue to watch and reports from other DXers would be appreciated.

Italy: Via Roger Bunney and a DX contact of his Michele Dolci of Bergamo, Italy we now have an explanation of why certain DXers have seen RAI test cards in Band I carrying the figure 8 in the corner circle. Mr. Dolci says: "You are correct when you write that the test pattern of RAI-TV bearing the 8 as identification number originates from the Roma TV station. But fifteen minutes before the programmes start *all* TV stations carry this card (which is more exactly identified by 'S8') because all are connected via cable or s.h.f. relay with the main TV centre in Roma. Consequently when no test is being made Roma operates on ch. G (Band III)."

From this it can be concluded that during the fifteen minutes directly preceding programmes a test card carrying the Rome studio identification number S8 is transmitted whilst at other times the individual transmitter number will be radiated. Thus precise station identification is still possible apart from the fifteen minutes noted above. As this is a very small percentage of the total time on test card our problems should not be very great.

DX-TV PAMPHLET

Roger Bunney and I have a project in hand that we hope will prove useful to all those interested in DX-TV. We are in the process of preparing a pamphlet outlining the basic principles of DX-TV (including propagation, European channels and systems, aerial and preamplifier design for all bands and general conversion principles for converting 405-line positive-image sets to 625-line negative-image ones for reception of Continental pictures etc.). Even more interesting we feel for all DXers will be a full selection of up-to-date test card photos.

These pamphlets will be available in due course at a small charge. More details soon I hope. Unfortunately we are having some difficulties at present as due to the postal strike we are still waiting for certain test card photos from various DX-TV friends. We hope these problems will soon be over.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by a 10p (2s.) postal order (made out to IPC Magazines Ltd.) the query coupon from page 282 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.

FERGUSON 3638

The horizontal hold control of this 12in. portable model requires frequent adjustment during a programme to restore the picture which comes back perfectly for a short time. Any slight fluctuation however makes the picture break up again. When making these adjustments there is sometimes a vertical flash in the centre of the screen.—E. Robinson (Birkenhead).

A regular cause of a sudden loss of line lock in this model is a change in value of R409 (39kΩ) or R412 (390kΩ) in the anode circuit of the flywheel sync d.c. amplifier or a short-circuit in the cable joining these two resistors together. However if the lock is never very hard check the valves concerned, the sync separator V5 PFL200, flywheel sync d.c. amplifier V401 EF80, the line oscillator V4 PCF808 and the two flywheel sync discriminator diodes W401 and W402 type SD11-7-YAG.

GEC BT302

The sound is OK but the picture has decreased in size there being a black edge all round the screen. The line timebase valves have all been tested and are OK.—J. Walker (Bletchley).

The item which is at fault is the h.t. metal rectifier which is mounted on the front of the chassis. This may be replaced with a silicon diode of the BY100 type, with a 15-25Ω wire-wound surge limiting resistor connected in series with it.

THORN 1500 CHASSIS

The vertical lines of the test card become ragged as the main contrast control (not the preset) is advanced to maximum. The waveform at the sync separator anode looks OK however and the sync separator valve and video output transistor have been replaced without improving matters. The h.t. smoothing has been checked and the components in the sync separator circuit replaced without any improvement being obtained.—L. V. Wright (Walsall).

It is quite common for the line sync to become impaired when the contrast is advanced sufficiently to overload the video stage. If however the brilliance control produces the same effect when advanced then the cause is in the e.h.t. rectifier tray which might need replacement.

GEC 2028

There is a dark and light vertical band about ½ to ¾in. from the left-hand side of the picture on this colour set, while the display is stretched and squashed. The line linearity adjustment L6 only shifts the trouble without any improvement. Also the width is about ⅜in. short at each side of the screen. The line timebase valves have been replaced.—S. Trevelyan (Crewe).

Vertical striations on the left-hand side of the screen were a common fault on earlier versions of this model and are caused by the line harmonic tuning of the line ouput transformer being incorrect. This was found to be due to inadequate damping of the red and green symmetry coil (L607). If your receiver is an earlier one fit a 390Ω resistor directly across this coil. Alternatively fit the later coil assembly which is modified. If this is not effective the line output transformer is likely to be faulty although this is not all that usual.

HMV 2624

The v.d.r. in the grid circuit of the line output valve overheated, burning a hole through the circuit board. This was apparently caused by breakdown of the flyback pulse feed capacitor C106 as this was also burnt. The board was repaired and C106 replaced. For the v.d.r. however I had to use an unmarked v.d.r. Now there is a faint raster and double-image picture lacking in width. The line output stage valves were replaced without improvement. After a time the faint raster disappeared completely and could only be observed fleetingly on increasing the brightness control setting, when it expanded and disappeared.—R. Wilton (Derby).

The type of v.d.r. used in the width stabilisation circuit is very important in order to obtain correct drive conditions for the line output valve. The type specified is the E298ZZ/05 which should be obtainable from a dealer. C106 and C105 (connected across the v.d.r.) should be 2kV pulse types—we would advise replacing C105 as well as C106. If these steps fail to cure the situation, replace the e.h.t. rectifier and R130 2·2MΩ in series with the v.d.r. If this fails to put matters right the probability is that the line output transformer is faulty.

PYE 13U

Strong interference cuts the sound volume right down and often completely off: it can be restored by switching on a light or some appliance. I've replaced the volume control because it was very noisy at low settings but the new one has developed the same fault after only a few months. There are also several vertical bars on the screen just left of centre and these show up particularly on a dark picture.—R. Hopewell (Kidderminster).

The sound problem could be due to a faulty EH90 detector/amplifier or PCL84 audio output valve, or a leaky coupling capacitor from the EH90 anode to the volume control. The striations could be due to poor mains smoothing or trouble in the boost h.t. line for which you should check the boost reservoir capacitor C97 and the capacitor C93 which smooths the feed to the field generator stage.

EKCO CT102

The focusing on this colour set is unsatisfactory. To achieve proper focus the control has to be set fully clockwise, i.e. to the non-earthy end, and this occasionally produces an interference pattern of dots on the 405 channels (monitored on another set of course) and variations in colour which are especially noticeable on flesh tones. Even with the control at this extreme setting after a couple of hours it is impossible to obtain a sharp picture.—S. J. Moore (Nottingham).

Poor focus is usually due to a low-emission line output valve or the focus control being burnt out. Check these. If the line output valve is replaced the e.h.t. should be checked and reset.

DEFIANT 902

The fault, which occurs on all transmissions both v.h.f. and u.h.f., is that the image tends to extend across the screen: if for example there is a venetian blind on the screen lines trail from it from left to right. On test card F the horizontal lines are all right but the vertical lines are wavy. There is a trail or shadow to objects with prominent features leaving lines. We checked for ghosting and there is no sign of this.—R. Manton (Sale).

The fault seems to be in the anode circuit of the PFL200 video amplifier. Check the peaking coil 2L26 wired across 2R61 (8·2kΩ), the 4μF electrolytic 2C81 coupling the signal to the high-level contrast control 2RV6 and the 0·15μF coupler connected to its slider.

EKCO T442

After running for a few minutes there is a crackle in the loudspeaker and the e.h.t. cuts off. The raster reappears after another few minutes and then the fault repeats itself. On pressing the boost diode top cap assembly the circuit functions again: it can also be made to function by lightly tapping the line output valve top cap. The line output valve, boost diode and line oscillator valve have all been replaced but the fault remains.—T. Manson (Lichfield).

Your trouble seems to be thermal, caused by a hairline crack in the printed panel or a partial short across the heater chain. The former fault can usually be detected by heating small sections of the panel with a hair dryer. The latter fault can be checked by operating the set in a darkened room when the heater affected will be seen to vary in colour.

GEC 2041

There are good colour and monochrome pictures but fine horizontal lines are also present—on both colour and monochrome. Sometimes these are very prominent but at others it is necessary to get very close to the tube to see them. Dark colours shimmer because of the presence of these lines and on highly coloured backgrounds the lines are especially apparent.—T. Dyall (Woking).

The pattern of lines appears to us to be moiré. This is an optical effect caused by interaction between the lines scanned by a very fine spot and the holes in the shadowmask. Some tubes have very fine spots and this moiré effect is then more apparent, particularly on certain colours and in certain areas of the picture. To minimise the effect you should alter the gray-scale set-up. Reduce the first anode voltage of the gun which is at the highest potential (usually the red one) and then reduce the blue and green gun first anode potentials to obtain correct gray-scale tracking. Lowering these voltages slightly defocuses the beam spot, reducing the moiré patterning. Also, always adjust the tube focus on a highlight area of the test card (e.g. white or yellow), preferably a highlight near the centre of the screen.

EKCO T434

When I switch to 625 lines there is a black stripe down the right-hand side of the screen which moves in and out causing a wave effect on the picture. This effect is not present on 405 lines.—I. Sorkin (Bolton).

Suspect the two PCL84 valves used in this chassis. The pentode section of one is the video amplifier and the triode section of the other the line oscillator. Also check the PL36 line output valve.

PYE V830A

There is intermittent field roll on this model. The field output valve has been changed without making any difference and most of the resistors and capacitors in the field timebase have been replaced without success.—T. Winfield (Folkestone).

The usual cause of weak field lock on this chassis is a faulty 50μF electrolytic (C47) connected between the emitter of the OC71 sync separator and chassis. Checking with an oscilloscope will quickly confirm.

ULTRA 6643

A u.h.f. aerial has been fitted in the loft and the picture is good on all three u.h.f. channels. On most ITV (ch. 27) adverts and live programmes however a part of the picture slips to the left, producing the same kind of effect as incorrect line linearity adjustment except only part of the picture is affected. This effect does not appear as often on the BBC channels. Also could you let me know how to discharge the e.h.t. capacitor in this and other models generally.—R. Smith (Poole).

We feel that your problem is an aerial rather than a set fault. Try adjusting the aerial not for maximum signal but for the minimum ghosting on ch. 27. To discharge the e.h.t. capacitance remove the e.h.t. cap from the side of the tube and touch it to chassis. Then connect some metal tool or a piece of wire from chassis to the e.h.t. connection of the tube, repeating this some seconds later as the charge tends to build up again.

MURPHY V789

When the brightness control is set at just about an acceptable level the picture is all right, but if the brightness is then turned up just a little more the peak whites start to explode or go out of focus. The e.h.t. was low so the e.h.t. rectifier was replaced but with very little improvement. — E. Marshall (Grimsby).

Frequent causes of this trouble are a faulty metal h.t. rectifier or low-emission 30P4 line output valve. Check these.

FERGUSON 3655

A while after switching on the sound suddenly bursts through at a much greater volume than that at which it is set. This is accompanied by a loud hum. The sound then slowly fades to the normal level and the hum slowly disappears. The picture at first appears small and slips rapidly. It then slowly fills the screen, still slipping. The slipping slowly stops and after about a minute both picture and sound are OK.—F. Bartlett (Manchester).

As far as the rolling is concerned you should change the PCL805 (PCL85) field timebase valve. The sudden change in volume level may be due to a fault in the volume control or its connection, but is more likely to be due to heater-cathode leakage in the 30PL1 audio output valve.

PYE CTM17/S

There is good sound but no raster. All the valves light up but there is no e.h.t. The PY33, EY86, PY81 and PL81 have been changed and I have tried a line output transformer from another Pye set, but without any success. A slight spark can be drawn from the PY81 top cap but at the EY86 top cap it is dead.—P. Hopkinson (Dover).

First notice whether the PL81 is overheating or not. If it is check the line oscillator (triode section of V17 PCF80) and its anode (pin 1) components. If the PL81 is not overheating check its screen feed resistor (3·9kΩ 1W to pin 8). If this is OK note the effect of removing the top cap of the PY81. If this brings the timebase to life replace the boost reservoir capacitor (C67 0·1μF).

BUSH TV135RU

There is reduced brightness giving the appearance of the tube going soft (with no picture the centre area of the tube is slightly darker than the rest). When the brightness control is turned fully up the picture is still not as bright as it was. The line output stage valves have been checked by substitution without effect.—C. Brown (Plymouth).

The fault appears to be in the tube or its first anode supply. Check the supply to pin 3 of the tube base and note the heater glow of the DY87 when the brilliance control is advanced. If this glow reduces the tube is taking too much current which could indicate an offset gun assembly. Check the line drive to the PL36 if the picture width is reduced at minimum brilliance.

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TELEVISION, APRIL, 1971

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A Pye Model V110 suffered from insufficient height and the usual tests and replacements failed to reveal the cause or correct the trouble. Tests indicated that the field output stage was working correctly both from the static and dynamic aspects, giving the impression that something was amiss in the field generator stage. The generator components all appeared to be in good order but voltage testing indicated that the potential to the generator was abnormally low. This is derived from the boosted h.t. supply and testing along this circuit showed no apparent fault although the boosted supply was only about 250V against the correct 480V. The feed resistors were of the correct values and an insulation test showed no undue leakage to chassis.

What is a likely cause of this symptom? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 99

Page 235 (last month)

Although line pulling is often caused by the presence of picture signal on the sync pulses, indicating incorrect action of the sync separator (which was disproved in the case in question), it can also be caused by trouble in the vision i.f. amplifier or video amplifier stage. It will be recalled that the i.f. channel and alignment were proved to be sound so the next test should have been in the video amplifier stage, especially since ringing was observed on the test card frequency gratings.

Any change in value or deterioration of a component in this area can cause overshoot effects and uneven frequency response, particularly those in the anode and cathode circuits. In some models the screen grid resistor and its associated decoupling capacitor are critical, and it was in fact discovered that the capacitor (10μF) decoupling the screen grid of the video valve was low in value and slightly leaky. Replacement completely cured the trouble.

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EY86/7	37p	PCL85	45p	U191	62p	30L15	70p		

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ECL80	40p	PCF808	67p	U25	75p	30C17	79p
EF80	40p	PCL82	51p	U26	75p	30F5	82p
EF85	41p	PCL83	61p	U37	75p	30FL1/2	64p
EF183/4	56p	PCL84	51p	U191	72p	30L15	76p
EH90	51p	PCL805/85	57p	U193	41p	30L17	72p
EY51	37p	PCL86	51p	U251	87p	30P12	77p
EY86/7	39p	PL36/8	75p	U301	85p	30PL1	64p
PC86/8	51p	PL81	57p	U801	£1·20	30P4MR	£1·00
PC97	41p	PL83	51p	6/30L2	77p	30P19	75p
PC900	51p	PL84	60p	6AT6	49p	30PL13	92p
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30L15	·63	ECC83	·23	PCC84	·31	U26	·63
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DAF91	·21	EF39	·22	PCF806	·58	UCL82	·34
DAF96	·35	EF80	·24	PCL82	·33	UCL83	·49
DF33	·37	EF85	·28	PCL84	·35	UF89	·30
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6BW7	0·65
6BZ6	0·33
6C6	0·19
6C9	0·73
6CD6G	1·15
6CH6	0·38
6CL6	0·43
6CW4	0·63
6D6	0·15
6F1	0·63
6F6	0·63
6F6G	0·25
6F12	0·17
6F13	0·33
6F15	0·65
6F18	0·45
6F23	0·72
6F24	0·68
6F25	0·65
6F28	0·70
6F32	0·15
6H6GT	0·15
6J5G	0·19
6J6	0·18
6J7G	0·24
6J7GT	0·38
6K7G	0·10
6K7GT	0·23
6K8G	0·20
6L1	0·98
6L6GT	0·39
6L7GT	0·63
6L18	0·45
6L19	1·38
6LD20	0·48
6N7GT	0·40
6P28	1·25
6Q7	0·43
6Q7G	0·30
6R7	0·55
6R7G	0·35
6SA7GT	0·35
6SA7M	0·35
6SC7GT	0·33
6SG7GT	0·33
6SH7	0·53
6SJ7	0·35
6SK7GT	0·23
6U4GT	0·60
6U7G	0·53
6V6G	0·18
6V6GT	0·33
6X4	0·22
6X5GT	0·25
6Y6G	0·55
6Y7G	0·63
7B6	0·58
7B7	0·35
7C6	0·30
7F8	0·88
7H7	0·28
7R7	0·65
7V7	0·25
9BW6	0·50
9D7	0·78
10C1	1·25
10C2	0·50
10D1	0·50
10D2	0·75
10F1	0·75
10F9	0·45
10F18	0·35
10LD11	0·53
10P13	0·65
10P14	1·10
10P18	0·33
12A6	0·63
12AC6	0·40
12AD6	0·40
12AE6	0·48
12AT6	0·23
12AT7	0·19
12AU6	0·24
12AU7	0·23
12AV6	0·28
12AX7	0·23
12AY7	0·68
12BA6	0·30
12BE6	0·30
12BH7	0·40
12E1	0·85
12K5	0·50
12K7GT	0·34
12Q7GT	0·28
12SA7GT	0·40
12SC7	0·35
12SG7	0·23
12SH7	0·15
12SJ7	0·23
12SK7	0·24
12SQ7GT	0·50
14H7	0·48
14S7	1·15
19AQ5	0·24
19H1	2·00
20D1	0·65
20D4	1·05
20F2	0·70
20L1	0·98
20P1	0·88
20P3	0·90
20P4	0·93
20P5	1·00
25A6G	0·29
25L6G	0·29
25Y5	0·38
25Y5G	0·43
25Z4G	0·30
25Z5	0·40
25Z6G	0·43
30C1	0·30
30C15	0·65
30C17	0·80
30C18	0·64
30F5	0·80
30FL1	0·64
30FL2	0·75
30FL12	0·80
30FL14	0·73
30L1	0·32
30L15	0·64
30L17	0·78
30P4MR	0·98
30P12	0·69
30P19/30P4	0·60
30PL1	0·69
30PL12	0·37
30PL13	0·78
30PL14	0·75
30PL15	0·98
35A3	0·50
35A5	0·75
35D5	0·70
35L6GT	0·44
35W4	0·23
35Z3	0·50
35Z4GT	0·24
35Z5GT	0·30
50B5	0·35
50C5	0·32
50CD6G	2·17
50L6GT	0·45
72	0·33
85A2	0·43
85A3	0·40
90AG	3·38
90AV	3·38
90CG	1·70
90CV	1·68
90C1	0·80
150B2	0·58
150C2	0·30
301	1·00
302	0·83
303	0·75
305	0·83
306	0·65
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7193	0·53
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AZ1	0·40
AZ31	0·48
AZ41	0·53
B36	0·33
B319	0·32
CL33	0·98
CV6	0·53
CY1C	0·53
CY31	0·38
D63	0·25
D77	0·12
DAC32	0·35
DAF91	0·22
DAF96	0·35
DCC90	1·00
DD4	0·53
DF33	0·39
DF91	0·14
DF96	0·35
DF97	0·63
DH63	0·30
DH76	0·28
DH77	0·20
DH81	0·58
DH107	0·90
DK32	0·37
DK40	0·55
DK91	0·28
DK92	0·43
DK96	0·37
DL33	0·35
DL92	0·29
DL94	0·32
DL96	0·37
DM70	0·30
DM71	0·38
DW4/350	0·38
DW/500	0·38
DY86/7	0·29
DY802	0·48
E80F	1·20
E83F	1·20
E88CC	0·60
E180F	0·95
E182CC	1·13
E1148	0·53
EA50	0·18
EA76	0·88
EABC80	0·33
EAC91	0·38
EAF42	0·50
EB34	0·20
EB41	0·50
EB91	0·12
EBC41	0·48
EBC81	0·33
EBC90	0·20
EBC91	0·30
EBF80	0·34
EBF83	0·40
EBF89	0·32
EBL21	0·60
EC54	0·50
EC70	0·24
EC86	0·63
EC88	0·60
EC92	0·35
ECC32	1·58
ECC33	1·58
ECC40	0·60
ECC81	0·19
ECC82	0·23
ECC83	0·23
ECC84	0·30
ECC85	0·28
ECC86	0·40
ECC88	0·35
ECC189	0·48
ECC804	0·58
ECC807	1·35
ECF80	0·33
ECF82	0·33
ECF86	0·65
ECF804	2·10
ECH21	0·63
ECH35	0·29
ECH42	0·64
ECH81	0·29
ECH83	0·40
ECH84	0·38
ECL80	0·35
ECL82	0·33
ECL83	0·52
ECL84	0·60
ECL85	0·55
ECL86	0·40
EF22	0·63
EF36	0·33
EF37A	0·35
EF39	0·40
EF40	0·50
EF41	0·50
EF42	0·33
EF54	0·98
EF73	0·33
EF80	0·23
EF83	0·48
EF85	0·29
EF86	0·32
EF89	0·25
EF91	0·17
EF92	0·13
EF97	0·55
EF98	0·65
EF183	0·30
EF184	0·30
EFP60	0·50
EH90	0·38
EL32	0·18
EL34	0·53
EL37	0·87
EL41	0·55
EL42	0·53
EL81	0·50
EL83	0·38
EL84	0·24
EL85	0·40
EL86	0·40
EL91	0·23
EL95	0·35
EM34	0·90
EM80	0·38
EM81	0·42
EM84	0·34
EM87	0·38
EY51	0·37
EY81	0·35
EY83	0·55
EY84	0·50
EY86/7	0·33
EY88	0·43
EY91	0·53
EZ35	0·25
EZ40	0·40
EZ41	0·43
EZ80	0·23
EZ81	0·24
EZ90	0·22
FW4/500	0·75
FW4/800	0·75
GZ30	0·35
GZ32	0·45
GZ33	0·70
GZ34	0·53
GZ37	0·75
HABC80	0·45
HL23DD	0·40
HL41DD	0·98
HL42DD	0·50
HN309	0·40
HVR2	0·53
HVR2A	0·53
IW3	0·38
IW4/350	0·38
IW4/500	0·38
KT2	0·25
KT8	1·75
KT41	0·98
KT44	1·00
KT63	0·25
KT66	0·83
KT74	0·63
KT76	0·63
KT88	1·70
KTW61	0·63
KTW62	0·63
KTW63	0·50
M8162	0·63
ME1400	0·74
MHL4	0·75
MHLD6	0·75
N78	2·05
N108	1·40
N308	0·98
N339	1·25
P61	0·50
PABC80	0·35
PC86	0·52
PC88	0·52
PC95	0·53
PC97	0·40
PC900	0·38
PCC84	0·32
PCC85	0·33
PCC88	0·49
PCC89	0·48
PCC189	0·49
PCF80	0·30
PCF82	0·33
PCF84	0·40
PCF86	0·50
PCF200	0·67
PCF801	0·35
PCF802	0·45
PCF805	0·64
PCF806	0·64
PCF808	0·73
PCH200	0·62
PCL82	0·37
PCL83	0·50
PCL84	0·38
PCL805/85	0·45
PCL86	0·43
PCL88	0·75
PEN45	0·35
PEN45DD	0·75
PEN46	0·20
PEN453DD	0·98
PENA4	0·98
PENDD 4020	0·88
PFL200	0·59
PL33	0·38
PL36	0·48
PL81	0·48
PL81A	0·63
PL82	0·33
PL83	0·33
PL84	0·33
PL302	0·60
PL500	0·68
PL504	0·68
PL505	1·44
PL508	1·40
PL509	1·44
PL802	0·75
PM84	0·39
PX4	1·18
PX25	1·18
PY32/3	0·50
PY80	0·33
PY81	0·27
PY82	0·27
PY83	0·29
PY88	0·34
PY301	0·63
PY500	1·08
PY800	0·38
PY801	0·34
PZ30	0·48
QQV03/10	1·20
QS75/20	0·63
QS150/15	0·63
QV04/7	0·63
R10	0·75
R11	0·98
R16	1·75
R17	0·88
R18	0·50
R19	0·33
R20	0·59
R52	0·38
RK34	0·38
SP42	0·75
SP61	0·33
TH4B	0·50
TH233	0·98
TP2620	0·98
UABC80	0·33
UAF42	0·52
UBC41	0·45
UBC81	0·40
UBF80	0·29
UBF89	0·34
UBL21	0·55
UC92	0·35
UCC84	0·40
UCC85	0·37
UCF80	0·42
UCH21	0·60
UCH42	0·63
UCH81	0·33
UCL82	0·35
UCL83	0·50
UF41	0·50
UF42	0·60
UF80	0·35
UF85	0·34
UF86	0·63
UF89	0·34
UL41	0·59
UL46	0·88
UL84	0·33
UM80	0·33
URIC	0·53
UU5	0·38
UU9	0·40
UU12	0·24
UY1N	0·50
UY21	0·55
UY41	0·38
UY85	0·29
U10	0·45
U12/14	0·38
U16	0·75
U17	0·35
U18/20	0·75
U19	1·73
U22	0·39
U25	0·65
U26	0·59
U31	0·30
U33	1·50
U35	0·83
U37	1·75
U45	0·78
U47	0·65
U49	0·59
U50	0·28
U76	0·24
U78	0·22
U107	0·92
U191	0·63
U251	0·73
U281	0·40
U282	0·40
U301	0·53
U403	0·33
U404	0·38
U801	0·95
U4020	0·38
VP13C	0·35
VP23	0·40
VP41	0·38
VR75	1·25
VR105	0·33
VR150	0·33
VT61A	0·35
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VU120A	0·60
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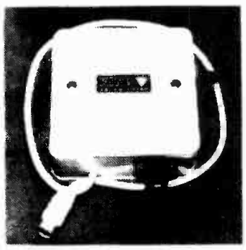

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