TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

20p

DECEMBER 1971

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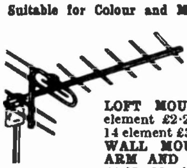

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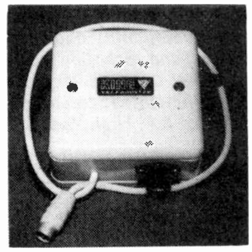

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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 22 No 2
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DECEMBER 1971

WHAT TURNS ON TR4?

THE fundamental requirement of a service manual is that it should provide the bench worker with suitably presented information to assist in quicker fault diagnosis and thus more efficient servicing. Manufacturers have succeeded in fulfilling this requirement in varying degrees over the years but unfortunately a noticeable deterioration in standards has been noted recently.

Importers, of course, are the worst offenders. The home companies are generally better but there is one common irritation which seems to be inherent in almost all manuals today—the low standard of presentation of the circuit diagrams.

Passing lightly (but with a shudder) over the "Continental style" symbols of one certain manufacturer, it is not particularly important that BSI symbols are strictly adhered to so long as one can see if a particular squiggle is a resistor, capacitor or inductor. What *does* matter is the lack of appreciation of the need to be able to easily *interpret* a circuit diagram.

Circuits should be laid out so as to indicate by the disposition of the components and wiring the function of the various components—what they do and how they are inter-related. The service engineer wants to see quickly what is going on. He wants to know where Tr1 gets its bias from, what is coupled into V6 and what turns on Tr4. Many circuits defy analysis and appear to be the work of an inebriated spider, demanding intensive study before they yield their mysteries. This disease has spread to such fundamental items as the placing of bias resistors and their associated bypass capacitors (sometimes in recent examples being quite detached on paper!), coupling and feedback components, etc. It all adds up to a mass of slipshod draughting which does not help logical fault-finding.

A few discreet enquiries elicited complaints of the lack of good technical illustrators. But the man responsible for giving his OK to drawings is usually the designer. He, however, is so familiar with his brainchild that he seems to check only for basic accuracy, rarely for clear presentation. The service engineer on the other hand, bereft of prior knowledge, has to start to puzzle things out from scratch.

The manufacturer's service manager is ultimately responsible for his department's publications and should ensure that they provide the maximum information in the most helpful way. One can pass the buck so far but there comes a time when it has to stop. We suggest it is on the desk of the maker's service manager!

W. N. STEVENS, *Editor*

THIS MONTH

THE NEXT ISSUE DATED JANUARY WILL BE PUBLISHED DECEMBER 22

Cover: The colour triangle featured on our cover this month is from a still in the Mullard Educational Service's filmstrip No. E61, "Introduction to Colour Television". Grateful acknowledgements are due to Mullard Ltd. for permission to reproduce this.

TELETOPICS

VIDEO DISCS, TAPES, ETC.

Video recording and playback systems were one of the main features of the recent Berlin Radio Show, with Philips showing their videocassette recorder (VCR), Teldec demonstrating for the first time a colour prototype of their video disc system, EVR players on show and a new system, the Nordmende CCS Super-8 system, being demonstrated for the first time. There is no further news of the RCA Selectavision system.

Nordmende's new CCS system is being developed to enable 8mm. films to be shown on an ordinary colour television set. Like the EVR system it uses a flying spot scanner to convert the film frames to an electrical signal for feeding to the TV set. Nordmende called their CCS player the Spectra Colorvision and a player using the same system was also being shown by Bosch. The players are expected to cost about £320 and be available some time next year. 8mm. film cassettes giving about an hour's playing time would cost between £10 and £25 depending on the material recorded. Home movies can apparently also be made.

Colour VCR machines were being shown by Grundig (Model VR2000), Loewe Opta (Optacord 700) and Nordmende in addition to Philips. The players use the helical-scan system with two heads in a $4\frac{1}{8}$in. drum. The bandwidth is sufficient to resolve a 2·7MHz pattern and a preset control enables the chroma carrier frequency to be adjusted. Because of the bandwidth it would seem that the normal PAL signal is not used. The $\frac{1}{2}$in. tape is spooled in two concentric reels.

The bandwidth limitations of the Teldec video disc also prevent direct use of the normal PAL signal. Instead Teldec have adopted a line sequential system with red, green and blue signals recorded in sequence line by line. Delay lines are used in the playback condition so that all the information required is available on every line. The process reduces the vertical resolution to a third of that otherwise possible but this degradation is not considered to be important since it corresponds roughly with the restricted horizontal resolution of the Teldec system. To avoid staggered verticals on fine edges of the picture the matrixing of information from three successive lines is restricted to information below 1MHz. The basic Teldec system is described in detail later in this issue. An autochanger is still being developed and is expected to cost around £110.

With their show of VCR, EVR and Teldec equipment Telefunken have a foot in nearly every camp!

Only those backing the VCR system seem to be encouraging about the prospect of mass consumer sales—as reported in our last issue Philips are talking in terms of sales of several million players by the end of the decade. The other videorecording systems are at present being aimed mainly at specialist markets.

Meanwhile at the WESCON electronics exhibition in San Francisco the Japanese firm Panasonic were showing a conventional playback only videotape player at $800.

FIELD-SEQUENTIAL COLOUR CONVERTERS

We receive a steady trickle of enquiries from readers asking about systems for converting a monochrome receiver to colour reception. This is possible by adding a converter which demodulates the colour-difference signals, matrixes them to obtain the three primary colour signals and then switches these in field sequence so that on successive fields red, green and blue signals are used to drive the tube. A colour filter synchronised with the converter is then used in front of the screen to convert the black-and-white light output to red, green and blue colour outputs on successive fields. The results obtained are naturally much inferior to the colour picture provided by a PAL receiver with shadowmask tube, and with the price of colour sets now considerably reduced we seriously question whether the time, trouble and expense of constructing such a colour converter is worthwhile. For those determined to have a go however, a great deal of practical information on the subject was given in the September/October issues of *Wireless World*. For our own part we shall be starting on constructional details of a full PAL single-standard colour receiver for the constructor early next year.

TRINITRON PATENT CASE

The import into the Netherlands of sets fitted with the Sony Trinitron has been banned following a court order obtained by Philips claiming that the tube infringes one of their patents.

FOR THE SERVICEMAN . . .

The Mullard 1971/72 data booklet has now been published (recommended retail price of 30p). In addition to the usual features a section has been added giving information on equivalents to many long obsolete valve types—some of them pre-war.

Meteronic Ltd. (114/6 Shipbourne Road, Tonbridge, Kent) have introduced a new oscilloscope—type MSB101—at £69 featuring a d.c.-8MHz bandwidth, vertical sensitivity of 100mV/cm.-50V/cm., sweep range of 100nsec/cm.-150msec/cm. and a unique signal locking circuit which with a single control enables the user to select through free-running, internal signal sync to triggered. The size is 8×6×4in. and the weight 5lb.

A new soldering iron from Antex, Model CCN, has an element totally enclosed in a ceramic shaft giving near perfect insulation. With no measurable leakage, it is claimed that live transistors can be soldered without risk of damage. The 15W element generates temperatures up to 450°C at the tip. There is a choice of four iron-coated bits or one plated with iron, nickle and chrome. The iron is priced at £1·80 or £1·95 with special Seven-star bit. Standard bits are 25p, Seven-star bits 50p. Production models are tested at 2kV a.c.

A trigger-operated solder dispenser for clipping to most soldering irons has been introduced by Aextra Ltd. (rear 77/8 Chiltern View Road, Uxbridge, Middlesex) at £4·25 including a 1oz reel of 60/40 cored 22s.w.g. solder.

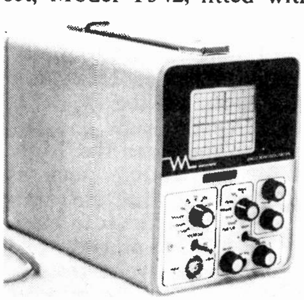
Servisol have introduced two new aerosol products. Servisol Foam Clenser (16oz aerosol 45p) removes grease and grime from radio and TV chassis, paintwork, glass, vinyl, etc. Servisol Plastic-Seal transparent insulator (6oz. aerosol 48p) prevents arcing and corona discharge from e.h.t. transformers and high voltage circuits.

TRANSMITTER NEWS

BBC-1 is now being transmitted from **Angus** (channel 57, aerial group C horizontally polarised), **Caldbeck** Cumberland (channel 30, aerial group A horizontally polarised), and the **Sheffield** relay (channel 31, aerial group A vertically polarised). BBC-2 is being transmitted from **Stockland Hill** (channel 26, aerial group A horizontally polarised). BBC Wales test transmissions have started from the **Kilvey Hill** (Swansea) relay station (channel 33, aerial group A vertically polarised). The ITA's high-power transmitters at **Heathfield** carrying Southern Television programmes on channel 64 (aerial group D horizontally polarised) and **Hannington** carrying Southern Television programmes on channel 42 (aerial group E horizontally polarised) are now in operation. In addition the ITA's u.h.f. relay stations at **Bath** carrying HTV West programmes on channel 25 (aerial group A vertically polarised) and **Chesterfield** carrying Yorkshire TV on channel 23 (aerial group A vertically polarised) are now in operation.

NEW SETS AND DEVELOPMENTS

Alba have introduced a new 26in. colour set. Model CS2126; **Ekco** a 20in. single-standard monochrome set, Model T542, fitted with the Pye 169 chassis, at £76·90; and **Hitachi** a 9in. portable monochrome set, the 189U, at £62. The latter set operates on a.c. or a 12V car battery, features a detachable anti-glare screen and weighs 11lb.



Left, Meteronic MSB101 'scope; right, Labgear Tele-Verta.

One of the most interesting introductions for some time is the Decca 12in. mains/battery model mentioned last month. This, Model MS1210, is expected to be in full production this month and to retail at about £66. The interesting point technically is that it is the first monochrome model on sale in the UK to make extensive use of i.c.s. Four of them are used. A Motorola i.c. type MC1352P provides most of the vision-sound i.f. gain between the tuner and the detector and incorporates a built-in gated a.g.c. system. Further amplification/limiting and low-level synchronous detection is then carried out by a Motorola type MC1330P i.c. which also incorporates a preamplifier section for the demodulated signals. (In addition to the video and intercarrier sound signals this i.c. provides a 350mV clipped carrier output for driving an a.f.c. circuit.) The gain of the MC1352P/MC1330P combination is over 88dB and provides the entire vision-sound i.f. gain in the Decca Model MS1210. The intercarrier sound-audio channel in this set is also completely integrated, consisting of a TBA750 intercarrier sound amplifier/limiter/detector/audio preamplifier and a TAA611B audio output i.c. A crystal filter feeds the 6MHz intercarrier signal from the MC1330P to the TBA750.

I.C. detectors of the synchronous type are inherently more linear than simple envelope detectors and we can expect to see them being used increasingly. The MC1330P is also used in the Thorn/BRC 8000 chassis employed in the Ferguson 17in. colour model and both this and the recently announced Decca 17in. colour set use a Motorola type MC1327P i.c. for colour-difference signal demodulation, PAL V-signal switching, de-weighting, matrixing and primary-colour signal preamplification.

NEW PRODUCTS

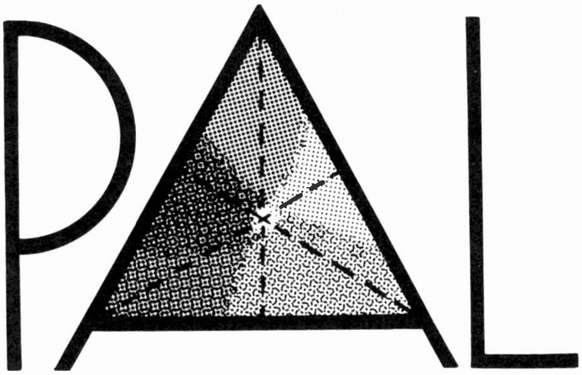
J Beam aerials have added two new models to their Multibeam range. The MBM18 has four director assemblies and the MBM10 two director assemblies.

A new masthead amplifier, the Gryphon, has been introduced by S. A. Collard Ltd., Wetherby Road, Derby. Group A, B and C/D versions are available. The power supply (full-wave) and amplifier are contained in a single housing.

Following our note about up-conversion last month we have heard that Labgear have introduced a model, the Tele-Verta, to enable those with single-standard u.h.f. sets to operate them on v.h.f. distribution systems. The converter converts 625-line signals on Band I to Band IV and 625-line signals on Band III to Band V. The oscillator is screened for minimum radiation and its frequency can be adjusted to eliminate patterning. The Tele-Verta Model CM6018RC has been designed to accept signal input levels from 500μV to over 5mV and is complete with internal stabilised 220-250V a.c. power unit.

A range of varicap diodes for u.h.f. and v.h.f. tuner units has been introduced by Motorola. SGS have introduced a medium-power h.f. transistor, type BFR36, intended primarily for CATV applications. Typical f_T is 1·3GHz, C_{re} 2·1pF and I_c max. 300mA. The low intermodulation and high gain make it suitable for the final stages of channel and band amplifiers at up to 860MHz.

A CLOSER LOOK AT PAL



PART 1

E.J.HOARE

A lot has happened in the four years or so since colour television broadcasting started on a regular basis in this country. Having started from scratch there are now over half a million receivers in use and manufacturers are at present barely able to satisfy demand. When you think of the slow start and numerous ups and downs experienced in such thriving countries as the United States and Japan it is all a bit bewildering. Why has colour TV in the UK been such a success?

Success of Colour

There are of course all sorts of answers to this question. It has to be good enough for people to want it and it has to be at a price that people are willing to pay. The question of timing is important too: when most people have acquired cars, refrigerators, washing machines and so on they tend to look around for something new. Perhaps colour TV came at just the right time.

Be that as it may there is no doubt that the whole enterprise would have fallen flat on its face if the quality of the product offered had not been of an adequate standard. As it is the broadcasters have done a magnificent job in generating nearly all programmes in colour while maintaining high standards of technical quality. The setmakers too have played their part: all present-day colour receivers are capable of giving very fine colour pictures provided the routine adjustments have been properly carried out. There have of course been problems. There have been some bad colour programmes just as there have been some bad receivers, but the improvements in broadcasting and receiver performance and reliability over the last three years or so have been impressive. And progress continues.

Choice of Colour System

Thinking back over all the hectic activity of the 1960s one thing is clear. We chose the right system—PAL. It seems obvious now but at the time of decision making it was not. It was a matter for balanced engineering judgment. Fortunately the mass of accumulated technical data was correctly assessed and the right system was chosen. PAL has made it possible for the broadcaster to achieve a consistently high standard of colour fidelity. PAL has also made it relatively easy for the setmakers to design receivers capable of displaying colour with a high degree of accuracy. The limitations are not primarily in the system, or in the receiver, but in the accuracy with which the receiver has been adjusted.

In this series of articles we are going to take a new look at PAL in order to see how much it has contributed to good colour performance in the receiver. The decoder is the main area of interest, but there are some important i.f. considerations as well. What sort of signal distortions does PAL resist, and what are the causes of the minor defects that do occur? How important is decoder alignment, and how is it best carried out?

Now that the heat of battle has died down a bit and engineers have had time to reflect it seems appropriate to review the present state and to consider what improvements can be made in the future. To start however it may be helpful to summarise briefly what we expected of PAL in the beginning. So back to some history.

Early Days of NTSC

Quite a lot of experimental colour work was carried out in the UK during the late 1950s, mostly based on 405 lines and NTSC. It was assumed that NTSC would be the system to be used because it had been adopted in the USA and a great deal of experience had been gained under operational conditions. Also the possibility of achieving a common international system was an ideal which looked as though it was about to come true: it would have been a marvellous state of affairs if every country had had the same colour system, the same broadcasting and receiver techniques and facilities for easy interchange of programmes.

However a cloud hung over all discussions about colour TV—the slow rate of progress in the USA and later in Japan. Public acceptance of colour always seemed to be forecast for next year but next year never seemed to come. Also one heard stories about the need to engage a resident engineer when you bought your colour receiver in order to keep it going. The reasons for the difficulties were not very clear although in retrospect there is little doubt that colour was launched commercially before it had been properly developed technically. The shadowmask tubes and receiver techniques of today are far in advance of those available at the time we are discussing.

Phase Errors

It gradually became clear that one of the problems with NTSC which was contributing to the slow progress of colour in the USA was the generally low standard of colour fidelity. People got the idea that NTSC simply meant "never twice the same colour". It was a corny joke but rather too near the truth. There were many reasons for the trouble, such as poor purity and gray-scale tracking, but the most important one of all—because it was difficult to overcome—was the susceptibility of NTSC to phase errors. Any phase change greater than about five degrees in the transmitted colour subcarrier or in the receiver local oscillator or decoder alignment caused a noticeable change of hue on the picture. Except for this one defect, however important, it is only fair to say that NTSC was a brilliant piece of system engineering and nearly all of it is used in PAL.

Systems: The Great Debate

This problem of phase distortion troubled nearly everyone in the TV engineering world and it was hardly surprising that a great deal of controversy arose in the early 1960s about the relative merits of rival systems which claimed to overcome the problem. Most European countries were keenly interested in colour and the great debate became international. This unfortunately meant that national politics and prestige became involved.

The French were very keen on a system of their own design known as SECAM and over the years several variations were developed, each with a different balance of good and bad characteristics. Herr Bruch of Telefunken in Germany produced PAL and gave many excellent and convincing demonstrations. Variations of the system were Simple PAL, Delay-line PAL and New PAL. The Russians, not to be out-done, signed an agreement with the French and then produced a hybrid system known as NIR. All in all the whole situation became thoroughly confusing.

Committees and Discussion Groups

Fortunately a mechanism existed for sorting out these differences on an international basis. To begin with most countries had their own committees and discussion groups representing broadcasting, government and setmaker interests. In the UK we had a National Study Group taking overall charge of the situation and the setmakers were represented in this by BREMA. There were other bodies as well, involving the broadcasters and the Post Office in particular. On an international basis there was the European Broadcasting Union and the overall body was the CCIR.

We need not delve any more deeply into this complicated system of international communication. The point is that it existed and made possible the exchange of engineering data about matters of common interest. The relative merits of NTSC, PAL and SECAM were debated at great length and the various European countries aligned themselves into the three camps. In an attempt to achieve a common system something or somebody had to give way, and it was NTSC. The reasons were partly political and partly engineering ones. In the end only PAL and SECAM were left. The various countries realigned themselves into two camps and so it remained: France and her friends chose SECAM, nearly all the other countries chose PAL.

The Engineering Problems

If NTSC had displayed good immunity to phase errors in transmission and reception it is quite possible that most countries would have adopted it so that there would have been a more or less standard international system. The great debate of the early 1960s, of which we have given only the merest outline, would have been reduced to a simple matter of technical discussion. As soon as PAL and SECAM appeared a very difficult problem arose. Just how do you compare two or more complete colour television systems? It is not merely a matter of assessing the immunity to phase errors. When you have no operational experience of the systems you have to start from scratch and compare every aspect of their performance. This involves carrying out many complicated theoretical calculations and assessments and building complete equipment so that comparisons can be made under normal working conditions.

It is worthwhile looking into this problem in greater detail. If we want to judge how well the PAL system is working in practice it is necessary to know what aspects of its performance we should be considering —it is all too easy to miss quite obvious defects simply because one is not specifically looking for them. There are a great many items that could be taken into account but here are some of the more important ones in random order: colour fidelity in general; compatibility on monochrome receivers; immunity to phase errors; noise peformance; cost; stability during life; resolution of the picture; ease of manufacture and alignment; problems of installation and maintenance; transient response; compatibility with one-gun displays; effect of asymmetrical pass-bands; cross-colour; spurious patterning; effect of signal echoes; broadcasting problems.

The length of this list shows how widely one has to cast the net when assessing how well PAL has been performing in practice. And of course it is not complete. Some of the problems listed are not of much concern to us because they lie in the broadcasting field while we are primarily concerned with receiver performance. One should however bear them in mind. We will now consider each item in turn to see briefly what is involved.

Colour Fidelity

Colour fidelity is what colour TV is all about. How accurate is the colour display on the average receiver under normal conditions of use? Is it acceptable, and are any deficiencies due to defects in receiver adjustment, receiver design, the display tube, signal propagation or origination at the broadcasting end? What influence has the choice of the colour system on these effects?

The real problem here of course is how do you judge colour fidelity? The average viewer does not have the chance to compare the picture on his receiver with what the camera saw at the other end. Nor for that matter do many engineers. The viewer can only offer an opinion, and since the brain tends to colour the colour as it were a personal opinion has to be treated with great caution. The grass is always thought to be greener than in fact it is!

Assessing Colour

Over a period of time a skilled engineer builds up a fairly accurate subjective judgment of colour. One glance at a set of colour bars will be enough to tell if a receiver is displaying colour faithfully or not. It is always the complementary colours—yellow, cyan, and magenta—which should be studied. Yellow must be a pure yellow, not dirty or golden. Cyan must be definitely blue with a touch of green and magenta must appear an equal balance of red and blue. Skin tones are the final arbiter but these must be seen on a variety of programmes under conditions of low ambient lighting. Another factor that gives a clue for assessing colour performance is hue separation. If you can distinguish easily between colours of low saturation which have only a very small hue difference the chances are that you will be able to get good colour fidelity—at least in general terms.

Causes of Poor Colour

When it comes to trying to find the cause of poor colour fidelity one runs into difficulties. For example errors are inevitable if the chromaticities of the display tube phosphors do not match exactly those used by the broadcasters when encoding the signal. Computer aided theoretical analyses will show what these errors are but it is usually not practicable to do much about it. You can correct the errors in a receiver, but only for a particular c.r.t.—not for any tube in any receiver. If the wrong tube is used you may do more harm than good. The technique is called "masking" but fortunately it is not really needed because the errors are small.

Deficiencies due to maladjustment of the receiver are fairly easy to sort out. You must have perfect purity, a perfect gray-scale based on illuminant D, and a well aligned decoder with correctly apportioned outputs of R – Y, G – Y, and B – Y and with correct G – Y matrixing and luminance/chrominance matrixing. Any remaining hue errors are then due to faults elsewhere in the system.

Propagation errors causing phase changes in the chrominance subcarrier can be assessed by careful field testing under a variety of reception conditions. You must include here the case where the main signal is enhanced or reduced by the presence of an in-phase or out-of-phase reflected signal as this quite often occurs in built-up areas or in hilly country. The effect will be a change of hue or of saturation or of both together. You will also tend to find ghosts present on the picture with peculiar disturbances between the two images.

When all these various effects have been sorted out any remaining errors are probably present at the transmitting end. Different producers have different ideas about what colours they want you to see. The studio monitor plays a vital part too. If there is any error in its adjustment or if it has different colour characteristics compared with the receiver the two pictures will be different. Fortunately the broadcasters go to great lengths to line up their monitors and most of these difficulties have been overcome. The main weak link in the chain is that if you have a receiver with an old type of c.r.t. which has different phosphor characteristics to the monitor your picture is bound to differ although to only a fairly small extent.

The problems of colour fidelity form a wide ranging and complex issue and we have been able to summarise some of the main items only here.

Compatibility

Before PAL was adopted by the UK one of the most important engineering considerations that had to be assessed was the question of compatibility. Would a PAL colour signal give a good picture on a monochrome receiver? If it would not then PAL was no good. The owner of a monochrome receiver could not be penalised for the benefit of those who owned colour receivers.

The effects to look for here are dot patterning in large areas of highly saturated colour and disturbances on colour transitions. PAL proved to have a slightly more obtrusive pattern than NTSC and slightly less on average than SECAM. However this effect is not very severe and can be reduced by making the video passband narrower. Obviously it is a case for sensible compromise between no patterning and good resolution. Disturbances on colour transitions are not usually noticeable at normal viewing distances if the dot patterning is acceptable, but the shape of the roll-off of the chrominance and i.f. passbands can influence results quite markedly if they are ill chosen.

Immunity to Phase Errors

We shall be considering immunity to phase errors later on in some detail. It is really the basic justification for choosing a system other than NTSC. We are concerned with two types of phase error: one in the transmitted signal and the other in the decoder. Signal errors can occur anywhere between the studio and the synchronous detectors in the PAL decoder; phase errors in the decoding process are caused by either local oscillator mistuning or incorrect phase changes between the oscillator and the synchronous detectors. The important factor to assess is how much effect on the picture is caused by the sort of phase errors that occur in practice? If you will stay with us we shall be answering this question by drawing a few diagrams when we get on to the problems of PAL decoding.

Noise Performance

Noise is a very difficult parameter to describe or assess. Electrical measurements are not always easy to carry out and do not give the whole answer. For a given signal-to-noise ratio the obtrusiveness of the noise depends upon the bandwidth, the phase and amplitude response of the i.f.s, the contrast control setting, the ambient lighting, the picture content, the black-level setting and what you had for lunch! With a colour receiver it also depends upon the colour system, the chrominance bandwidth and the level of saturation. There is also to consider the behaviour of the receiver under impulsive noise from rotating machinery.

Really the only subjective way to assess noise is to compare a new receiver against a known one and to switch the colour on and off to see how much extra noise is added to the picture via the chrominance channel.

Cost and Stability

We can dismiss the subject of cost quite quickly. Within reason one can ignore the extra costs of broadcasting PAL because they are only incurred in a comparatively few places. Receiver costs have to be multiplied by millions of times and are obviously important. A delay-line PAL receiver costs about 2%-3% more than an NTSC one: say a fiver on the average model.

Broadcast equipment can be tickled at regular intervals, but not so a receiver. Stability is important and so either the chrominance channel must have very stable alignment properties or the decoder must have good immunity to effects caused by ageing. In a PAL decoder this means phase changes of the reference subcarrier, of which more anon.

Picture Resolution

We have already pointed out that the presence of the colour subcarrier causes a beat pattern on the picture via the luminance channel unless the bandwidth is curtailed. Some loss of luminance definition is therefore usually accepted. One tends to forget that there is a loss of chrominance definition as well with delay-line PAL decoding. The averaging of the information from successive lines of the picture by means of the matrixing process in the decoder inevitably causes a loss of vertical resolution. It is not very important in practice, partly because it is a vertical and not a horizontal degradation and partly because most of the impression of picture sharpness is carried by the luminance signal anyway.

NTSC does not suffer from this defect but SECAM does—to an even greater degree because the colour-difference signals are transmitted sequentially (in turn) and not simultaneously.

Manufacture and Alignment

Ease of manufacture and alignment is a very important aspect of any piece of electronic equipment. It is no good having a colour receiver which can only be adjusted to high standards of performance by using complicated and expensive test gear which nobody but the manufacturer can afford to instal. In order to achieve good colour performance in the average home it is essential to have a colour system/receiver combination which is not critical to adjust or which can be adjusted easily without special equipment.

When we come to discuss PAL decoding and decoder alignment it will become clear why PAL is a very good system indeed from this point of view. It even has a built-in indicator showing whether realignment is necessary. This is just as useful to the setmaker as it is to the service engineer and helps to raise the standard of quality on delivery.

Installation and Maintenance

With installation and maintenance once again the choice of system plays an important part. Admittedly it has no bearing on the difficulties of adjusting purity, convergence and gray-scale tracking, but once these have been carried out the key problem remains: is the colour correct? With NTSC you have no means of knowing except by staying to watch some colour programmes. With PAL you can take one look at the colour bars and you know that if the gray scale is correct then the chances are that the colour is also correct.

Transient Response

The different systems vary in their performance characteristics on colour transients. Some demand almost full double-sideband chrominance information in order to avoid crosstalk between the two colour-difference signals and hence colour distortions. PAL is not very susceptible to crosstalk and this form of transient misbehaviour can be largely overcome. The averaging process from line to line breaks down however so that a crawling dot pattern is usually visible though not very obtrusively.

Another aspect of the matter is the degree to which the system resists the effect of r.f. mistuning in terms of transient response. This is important in our quest for good average colour quality because most receivers are not very well tuned in the normal household.

One-gun Displays

No one knows what the future holds with regard to display devices. It is therefore essential that any system should be fully compatible with any kind of display device likely to be invented. All three systems satisfy this requirement as far as it can be foreseen.

Effects of Asymmetrical Passbands

We mentioned the effect of asymmetrical passbands under the heading of transient response. We shall see later what happens to a PAL signal when the i.f. or the chrominance passbands are distorted.

Cross-colour

By cross-colour we mean the presence of unwanted luminance information in the chrominance channel giving rise to spurious coloured outputs. These can be readily seen in the frequency gratings of test card F. Cross-colour can occur in several ways. In the first place it is clear that some of the luminance information at 4·43MHz, corresponding to fine detail in the black-and-white picture, will get into the decoder. The decoder cannot of course tell the difference and so random colour output voltages are produced. Similarly the second harmonic of luminance information at 2·2MHz--caused by non-linearity in the detector—will produce a spurious low-amplitude 4·4MHz output. This is not a very important effect.

A more interesting problem is posed by the sound carrier. Sound at 6·0MHz beats with 1·6MHz luminance to give 4·4MHz and hence cross-colour. Thus on test card F you will see spurious colour in the diagonal low-frequency gratings in the corners. This trouble can be avoided by using a separate chrominance detector in the i.f. channel. Luminance information outside the wanted chrominance passband can then be rejected.

Spurious Patterning

Apart from the 4·4MHz colour subcarrier the patterning most usually seen is the beat between the sound and chrominance signals. This is of course a beat of $6{\cdot}0-4{\cdot}4=1{\cdot}6$MHz and can be very obtrusive, particularly if the receiver is over tuned. It is normally reduced by attenuating the sound signal present at the detector where the chrominance signal is extracted—usually a common detector for the 6·0MHz sound, vision and chrominance is used.

Patterning can also be caused by harmonics of the reference oscillator at i.f. or r.f. beating with the signal. This is independent of the system used but can in some cases be difficult to cure.

Effect of Signal Echoes

There are two main reception conditions where signal echoes can be extremely troublesome. In built-up areas it is common to find u.h.f. signals bouncing off nearby buildings and being picked up by the aerial out of phase with the direct path signal. If the echo is a strong one the resultant of the two signals will have a distorted chrominance phase in addition to the effects of normal ghosting. If the burst phase is distorted by an amount different to that of the main chrominance signal, desaturation will occur. In severe cases there may be hue distortion and blinds as well. NTSC is very much more prone to this effect than PAL.

In Europe there is the added hazard of echoes in mountainous country such as the Swiss Alps and in Austria. In some cases it is aggravated by the presence of lakes as the direct signal can bounce off the water and be combined with echo signals from neighbouring hills.

The cure in all such situations is to use a highly directional aerial aligned very carefully on the strongest and cleanest signal.

At first it was thought that PAL would present some difficult problems compared with NTSC when carrying out typical studio signal processing such as cross-fade and inlay. However these difficulties have been largely overcome and the various techniques for error correction etc. now available, together with the robustness of the PAL signal, have allayed earlier fears.

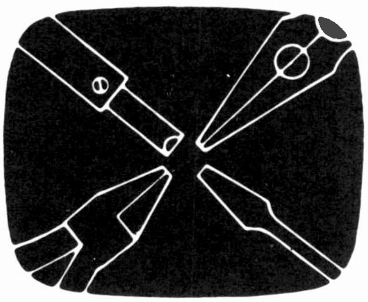
How Good is PAL?

Having listed some of the performance features that have to be assessed when judging the system as a whole we are still left with this difficult question. Perhaps it is an impossible question, or an unfair one, because we have no experience of other systems operating under the same conditions.

Let us beg to be excused for ducking the issue and ask instead is PAL providing the colour TV service that we expected. The answer is surely yes. There have been all sorts of difficulties, particularly in the early days, but very few of these have been of a type that can be attributed to the PAL system. Indeed it is interesting to carry out an experiment that provides partial proof of this statement. If you take a batch of ordinary production receivers and compare them side by side you will find small differences in the colour performance. If you then adjust them for identical gray scales and correct purity the colour performance is remarkably consistent. Furthermore there is nothing that the average viewer can do to spoil the effect. Try to achieve the same results with NTSC and our point will have been well and truly made.

With an NTSC receiver a hue control is almost obligatory. With PAL no sensible control of this type can be devised and it is not necessary in any case. This is of course only one aspect of receiver performance, though a very important one. When one considers the other performance features one comes to the conclusion that there is probably no very significant difference between the various colour systems. What is important is the quality of engineering in general. This falls into three categories: reliability; stability; and ease of factory and service adjustment. If a receiver is easy to adjust in such a manner that it gives the best performance of which it is capable and is thereafter stable and reliable then this is surely the way to obtain good colour in the average viewer's home. This is what the TV industry should aim to achieve. The PAL system will do the rest.

TO BE CONTINUED



SERVICING television receivers

L. LAWRY-JOHNS

PLESSEY DUAL-STANDARD CHASSIS—2

The Field Timebase

This consists of the usual PCL85, with the field sync pulses fed to the triode section from a sync pulse inverter stage—the triode section of an ECH84. The latter rarely gives trouble. The PCL85 is most often the cause of field collapse and in some cases a distorted one. Thus is it imperative to check the PCL85 in all cases and then go on to check less likely possibilities. There are several components which are most likely to fail to cause the following symptoms.

Even loss of height at top and bottom gives the impression of watching a CinemaScope picture except that nothing seems to have its correct aspect ratio (they're fat men, not tall, just wide). This suggests that the supply to the height control is not what it should be and a voltage check will probably reveal that the voltage at the height control is low. If the voltage is well up (over 300V) at the boost end of resistor 502 check this component as it may have gone high-resistance. We have found on most occasions however that the voltage at the high end of resistor 502 is only that of the h.t. line. One immediately concludes that a capacitor has shorted but without the circuit it is sometimes difficult to locate which. Without the diagram one would follow the track or lead from resistor 502 in order to arrive at the suspect. Looking from below, the trail only leads to more supply resistors on the other end of the panel. It is not until the dust is swept away from the top that one sees a track leading to capacitor 505 (0·05μF) which is the usual offender. Over a period of time the writer has developed a suspicion of all capacitors which are coloured dark brown and are of lozenge shape. The explanation is probably experience of early European tape recorders!

If the supply to the height control is not low check resistor 503 the 680kΩ resistor from the control to pin 1 of the PCL85 valve base.

Bottom Compression

If the PCL85 has been replaced it is quite possible that the bias resistor 509 (330Ω) has been damaged at some time and is of incorrect value or that the electrolytic capacitor 501 (500μF) has lost capacitance. This can of course cause bottom compression. Check both. The smaller linearity components do not seem to give much trouble on this chassis.

Field Hold

If the setting of the field hold control varies especially with heat check capacitor 516 (0·01μF) as well as the more obvious resistors 527 and 518. Check capacitors 517 and 529 if necessary.

If the symptom is one of weak lock where the setting of the hold control is very critical, check the diode 526 and then the sync inverter V6B anode resistor 530. This 33kΩ resistor tends to overheat and

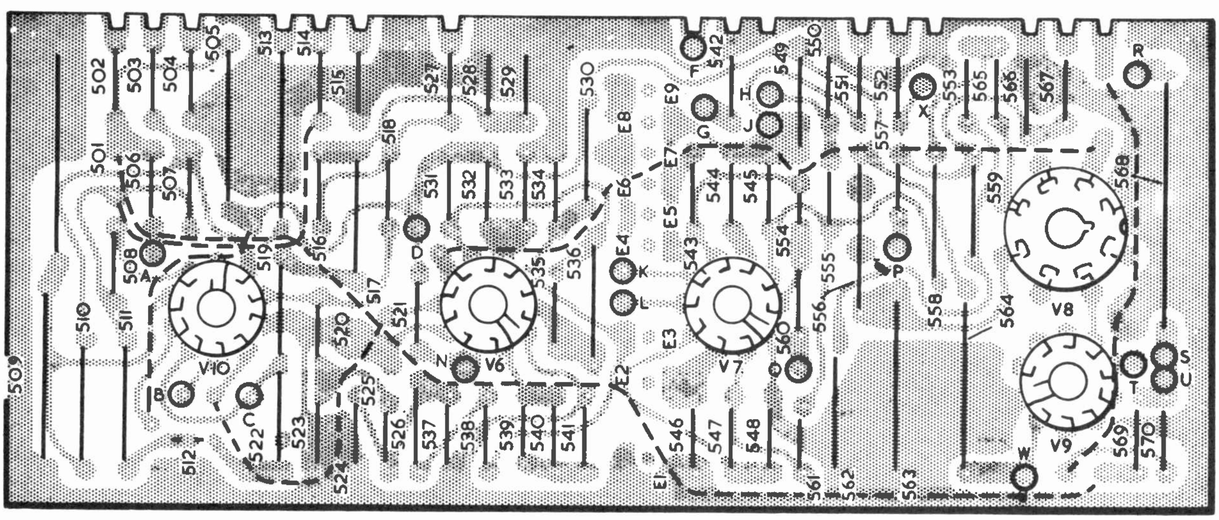


Fig. 3: Layout of the timebase printed panel.

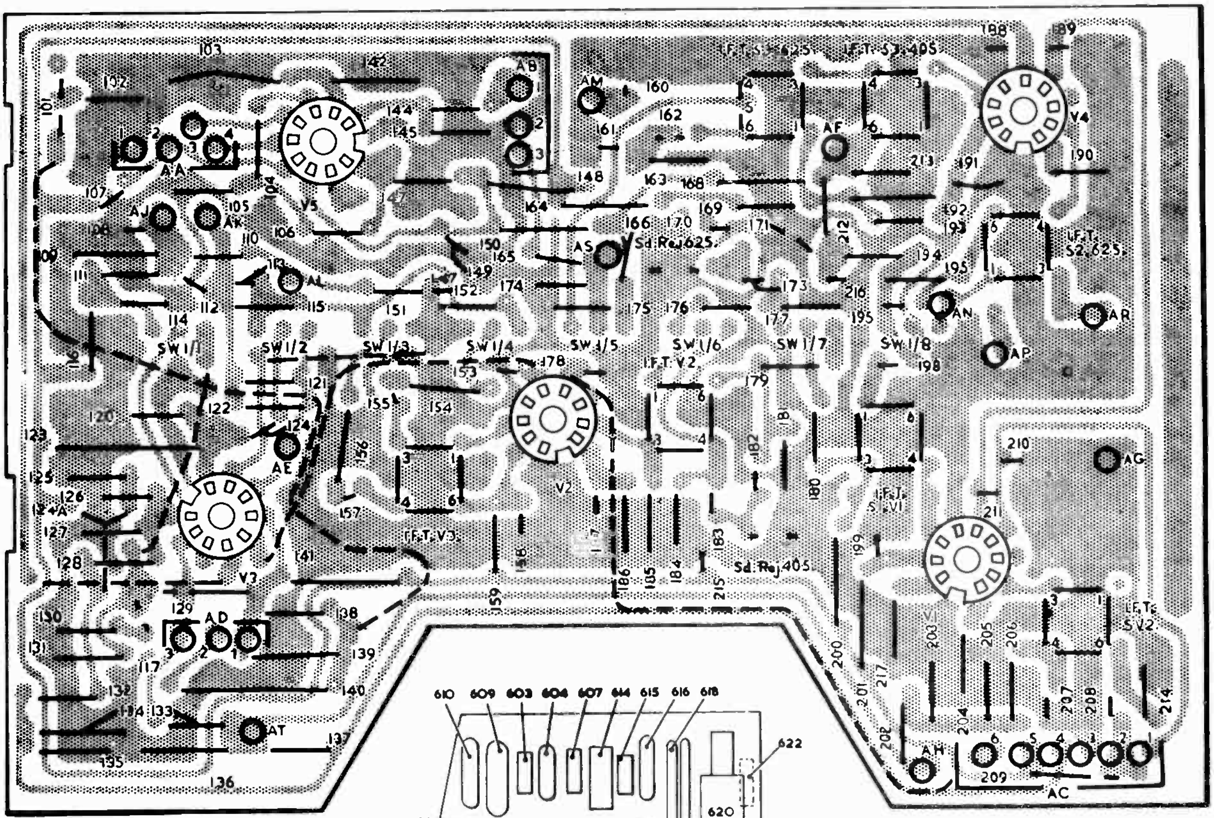


Fig. 4 (above): Layout of the vision and sound printed panel.

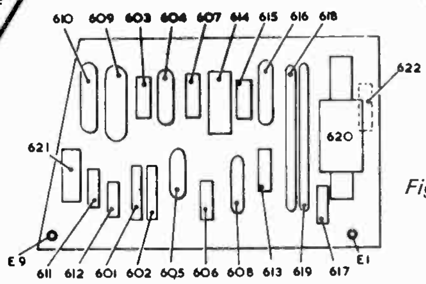
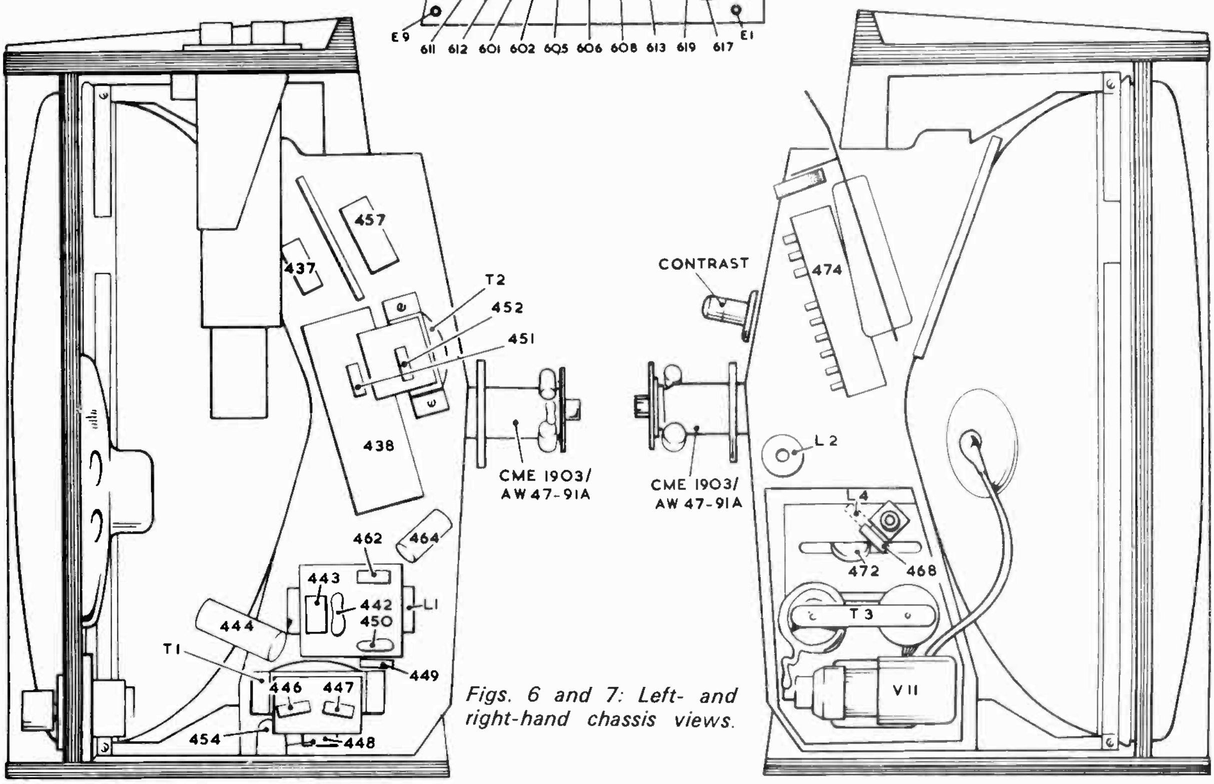


Fig. 5 (left): Layout of the flywheel sync printed panel.



Figs. 6 and 7: Left- and right-hand chassis views.

change value thus weakening the field sync pulses. Also check the resistors 532 (100kΩ) and 531 (680kΩ) both of which tend to change value.

If all these are in order revert the set to an upright position and swing open the upper panel. Check the video resistors 124 (18kΩ total) which were mentioned earlier. Whilst these may not have gone low enough in value to affect the h.t. supply or damage the series resistors they could have gone low enough to affect the operating conditions of the video amplifier and thus affect the sync pulses (as well as the contrast and, more drastically, the 625 reception).

Video Resistors

Digressing a moment from these receivers we would stress the importance in a video circuit of the correct value of resistors which form a series chain from h.t. to chassis (usually through the video cathode resistor). In a large number of cases where the line locking is well nigh impossible much time can be wasted looking for a timebase fault when the trouble is in the video circuit. Many Bush receivers in the TV105 to TV115 series used a 33kΩ loading resistor on the left side panel (second from top) which changed value and become discoloured due to overheating, causing video ringing and pulling. The same thing happens regularly in the Thorn single-standard (405 only) semi-portables (980 and 981 chassis) where the resistor (R26, 39kΩ) is upright and hides behind the video amplifier valve. Back to the Plessey chassis however.

Video and AGC Stages

The triode section of the PCL84 functions as a pulsed a.g.c. amplifier the input to which is switched in phase from either the cathode or the anode of the video amplifier (625 or 405). It is most important to appreciate that the grid voltage of this valve determines the contrast level. As its grid voltage rises the contrast level is reduced. As this rise is with respect to the cathode it will be clear that if the cathode voltage falls the contrast will weaken. Whilst a strong signal may not be seriously impaired a weaker one will provide a very washed-out appearance particularly on 625. There is a preset control (117) for the initial setting up of the 405 contrast level.

When therefore the condition of weak contrast is encountered, check the operating conditions of the PCL84. Check the valve itself, the video resistors 124, 123 and the cathode resistor 122 (220Ω); then note the effect of shorting pin 1 of the PCL84 to chassis. This removes the a.g.c. altogether. If the result is a nice black-and-white picture on a weak signal or overloading on a stronger one check the triode's grid circuit—resistors 127 (100kΩ) and 132 (10MΩ)—and the cathode resistor 109. In difficult cases a 100kΩ resistor from pin 1 to chassis in addition to the existing one is quite permissible.

If the fault is not in the a.g.c. line and the PCL84 is in order (together with the associated resistors) check the vision detector diode OA70, ensuring that the back-to-front resistance reading has a reasonable ratio. This can be done externally at pin 8 of the PCL84. About 3kΩ one way and very low the other is to be expected.

Next check the cathode voltage of the EF184 (about 2V is acceptable). If it is low the valve is probably failing whilst a high reading may indicate grid-cathode leakage. This latter condition is not usual in view of the low value of the grid leak resistor 185. As far as the EF183 is concerned the cathode voltage is very low as the voltage drop across a 27Ω resistor is quite small. The valve should be substituted if suspected and it is also worthwhile taking the screen grid reading at pin 8 as the feed resistor 201 (56kΩ) can change value.

Tuner Units

The v.h.f. tuner can be one of several types depending on the model. For example the Defiant 9A51 uses a push-button unit of the slug-tuned type. This is relatively trouble free except for inevitable failure of one resistor the 12kΩ oscillator anode load (722). The resistor is located under the front of the tuner and to gain access the tuner must be freed from its 4BA fixing nuts and the bottom cover removed. The value is not unduly critical between 10-20kΩ. Weak signals usually denote a failing PCC89 and the rule is: check the valves, make sure the slug is following the push plate and check all resistors.

The push-button type used on the 9A50 was of the more troublesome moving-bar contacts type and access to resistors is not so easy by any means—quite apart from the fact that the bar can move out of engagement with one side of the operating lever and travel over the contacts at an angle (which is most interesting). Check valves, resistors (if you can) and clean the bar spring contacts and the print over which they travel.

A rotary type of turret tuner is used in most other models and this is of the usual pattern needing only routine cleaning and a valve change where necessary.

The u.h.f. tuner is the common valved type employing a PC88 and PC86. The one misleading and quite minor fault (when it is spotted) is that the grub screws on the drive tend to work loose so that although the knob is rotated the tuner spindle does not always follow the drive and inaccurate tuning (or no tuning at all) results. Apart from this most faults respond to valve changing.

Once in a while a fault develops which seems to defy all attempts to rectify it. In its most awkward form the fault is not present when the set is first turned on and all programmes are received normally, continuing for some considerable time before beginning to fade. The signals then fade out altogether. This tends to suggest valve trouble (which indeed it usually is) but there are times when it is not. Resistors can be checked and the clearance of the tuning vanes verified, joints can be resoldered and all to no avail. If a spare tuner is available the obvious remedy is to use it (fitting takes only a matter of minutes) but in many cases the 18pF capacitor 638 which couples the PC88 anode (pin 8) to its tuning line will be found at fault.

Picture Faults

The effects of a failing tube are almost too well known to require detailing in each of these articles but generally if the picture presents a faded appearance which blushes and turns silken when the brilliance or contrast is advanced it is likely that the tube is in need of replacement. In some cases a sharp

—continued on page 66

COLOUR RECEIVER CIRCUITS

CHROMINANCE CIRCUITS—2

GORDON J. KING

In all PAL-D colour receivers the chrominance channel terminates at the PAL matrix and delay line. We shall be looking at this part of the circuit in detail later. For the moment we will continue with our exploration of the channel leading up to the matrix.

Last month we concluded with the first section of the chroma channel used in the latest RBM chassis, including the chroma i.f. stages, detector and a.c.c. system. The final section of the chroma channel is shown in Fig. 1. Transistor 3VT1 provides the colour killer control, the chroma signal being fed via 3D2, 3D5 and 3C5 to 3VT2 base. As this transistor feeds into the delay line it is called the delay line driver.

Burst Suppression

The series diodes 3D2 and 3D5 act as switches to provide both the colour killing and burst blanking actions. The latter is affected by switching off the diodes during the burst periods. This is done by feeding positive-going flyback pulses from a winding on the line output transformer via 3C2, 3R3 and 3R4 (with 3D1 providing d.c. restoration) to the junction of 3D2 and 3D5. The chroma signal feed to 3VT2 base is thus interrupted while this positive-going flyback pulse is present. The timing of the pulse is such that the diodes switch off during the periods of the bursts only, the switching being sufficiently swift to avoid partial suppression of the chroma signal at the line extremes.

Colour Killing

The colour killer action is under the control of the colour killer transistor 3VT1. In this chassis the reference subcarrier required for chroma signal demodulation is produced only when a colour signal is being received. The subcarrier produced during colour reception is rectified to obtain a negative bias and fed to the base of 3VT11. As this transistor is a pnp device it is switched on and a voltage is developed across 3R72. This voltage is used for two purposes, as a bias for the PAL switch circuit and to switch on the colour-killer transistor 3VT1. When 3VT1 switches on its collector will be virtually at chassis potential so that the lower end of 3R6 is earthed and 3D2 and 3D5 are biased into conduction. On monochrome the reference subcarrier is not generated and 3VT11 is biased off. Its collector is then at chassis potential so that 3VT1 is also switched off. In consequence 3VT1 collector rises towards +18V, switching off diodes 3D2 and 3D5 so that the chroma channel is "killed."

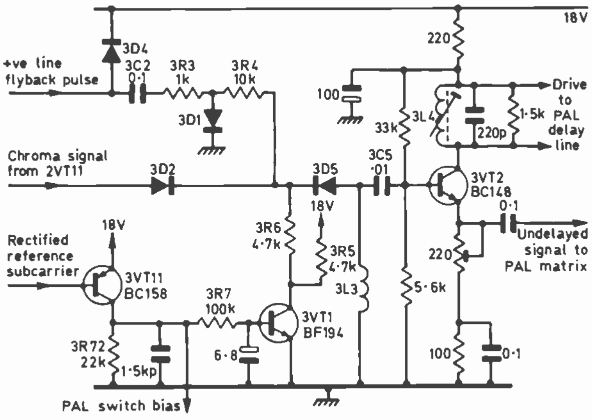


Fig. 1: Final stages of the chrominance channel used in the RBM single-standard chassis.

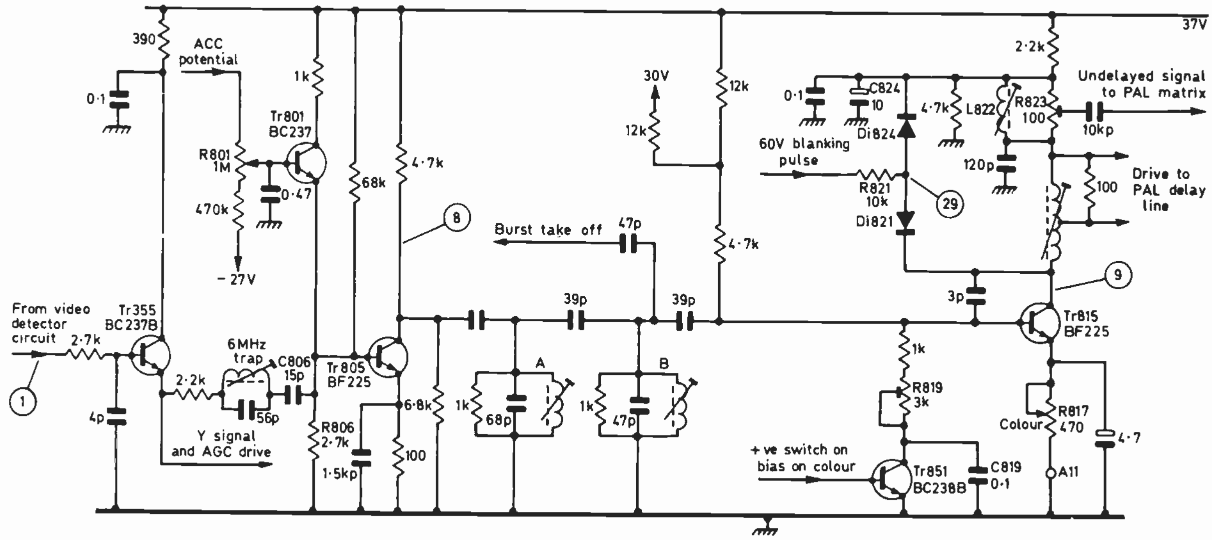
Grundig Chrominance Circuits

The circuit of the chroma stages of the Grundig Model 717, which is now being sold in the UK, is shown in Fig. 2. Signal from the video detector is fed to the base of the emitter-follower Tr355 which drives the Y delay line, the a.g.c. circuit and the chroma channel.

On colour the composite video signal along with the bursts is present at Tr355 emitter. Before arriving at the base of the first chroma amplifier transistor Tr805 the signal is given a sharp roll-off at the high-frequency end by the 6MHz sound trap and a roll-off at the low-frequency end by the low-value capacitor C806. After amplification by Tr805 the signal is first "filtered" before arriving at the base of the second chroma amplifier Tr815. The filter coils (A) and (B) along with the 6MHz rejector trap are set to provide the chroma passband characteristic shown in Fig. 3.

The colour control is R817 in Tr815 emitter circuit, adjustment of this merely regulating the gain of the stage. The receiver also has provision for remote control at this point. Tr815 collector feeds the PAL delay line. The separated U and V signals are then fed into a type TAA630 colour demodulator integrated circuit. In addition to synchronous demodulation this i.c. carries out the following operations: (1) PAL V signal switching, (2) G−Y matrixing and (3) colour-difference signal preamplification. A growing number of colour sets are now using an i.c. to undertake these operations.

There are two signal feeds from Tr815 collector circuit, one to the PAL delay line and the other an undelayed and 180-degree reversed signal obtained from L822 and the preset R823. This preset makes it possible to adjust the amplitude of the undelayed signal so as to balance with that of the delayed signal obtained from the delay line. Lack of balance in part of the PAL matrix produces Hanover bars on the



colour display: I shall be having more to say about this section in subsequent articles.

Colour Killer

The biasing of Tr815 is such that it fails to provide chroma channel continuity during monochrome transmissions, thereby giving the normal colour killing action. The bottom section of Tr815 base circuit is composed of the collector circuit of the colour killer transistor Tr851 which during monochrome transmissions is switched off. The base circuit of this transistor is connected to the cathode of a diode which rectifies the ident signal produced from the swinging bursts. These are of course present only during a colour transmission. Thus on colour Tr851 base goes positive and the transistor switches on. This action returns the bottom section of Tr815 base circuit to chassis, via Tr851 emitter, and adjusts Tr815 biasing for chroma signal continuity. Lack of colour killer action—signified by coloured noise on monochrome transmissions for example—would indicate either that C819 is shorting or that Tr851 is failing to switch off—possibly due to an internal short.

Burst Blanking

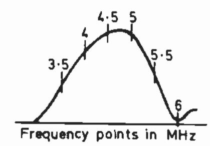
Burst blanking is handled by the two back-to-back diodes Di821 and Di824 connected across the collector circuit of Tr815. These are non-conducting during the chroma parts of the lines since their cathodes are connected to positive supplies. During the line flyback periods however their anodes are driven much more positive than their cathodes by +60V p-p pulses fed from the line timebase through R821. Heavy conduction then occurs and the unwanted burst information at Tr815 collector is deleted as the diodes short the load circuit of Tr815, bypassing the signal to chassis via C824.

ACC

The first chroma transistor Tr805 is under the control of an a.c.c. bias from Tr801. The bias fed to Tr801 base is obtained from rectified bursts—if the burst amplitude tends to rise Tr801 base goes more

Fig. 2 (above): Circuit of the chroma channel used in the Grundig Model 717GB.

Fig. 3 (right): Passband of the Grundig chroma channel.



positive. This increases the voltage across R806 so that Tr805's base voltage and hence its conduction also increases. The gain of Tr805 then falls due to forward a.g.c. action. The converse happens when the burst amplitude falls. Preset R801 allows the a.c.c. takeover point to be adjusted while preset R819 adjusts the sensitivity of the colour killer.

The signal levels at the oscilloscope test points (circled numbers) are as follows: 1 composite video 4·5V p-p; 8 chroma signal at 1·2V p-p; 9 chroma signal at 1·4V p-p; 29 line pulses at 20V p-p.

Philips G8 Circuits

In the Philips G8 chassis the chroma channel proper is preceded by a stage of chroma channel selectivity located in the i.f. section. The circuit of this and the chroma channel proper is shown in Fig. 4. The input signal is obtained from the emitter circuit of a transistor fed from the vision detector. The chroma selectivity department tailors the response over the chroma passband and provides suitable out-of-band attenuation. The bandpass proper is provided by top bandpass coupling consisting of C2402, L2403, C2405 and L2406, with R2413 and R2414 giving the necessary damping action.

Forming the Passband

6MHz sound rejection for h.f. end roll-off is provided by the bridged-T filter L2420, C2419, C2422 and R2421, while the similar type of filter consisting of L2410, C2408, C2411 and R2409 gives rejection at 2·2MHz. The purpose of this is to delete any spurious 2·2MHz components present in the luminance channel, since their harmonics would fall in the chroma passband and thus constitute unwanted in-band signals thereby causing incorrect colouring. The processed chroma signal appears at the base of Tr2417, an emitter-follower providing a low-impedance feed to

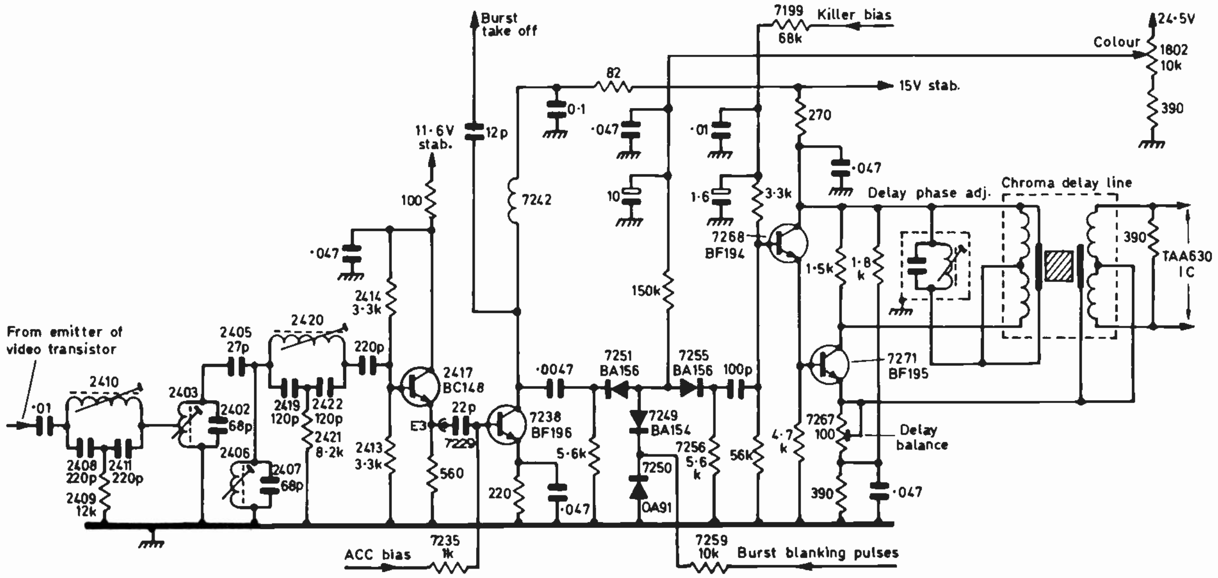


Fig. 4: Chroma channel of the Philips G8 single-standard colour chassis.

the first chroma amplifier Tr7238—a low-impedance feed is desirable here since Tr7238 is a controlled (a.c.c.) transistor.

ACC

The chroma signal from Tr2417 emitter is fed to Tr7238 base via C7229 and the output signal obtained at the collector is governed by the biasing. The a.c.c. bias is derived from rectified bursts and is fed to an a.c.c. amplifier and delay system and thence to Tr7238 base as a positive potential which increases with increase in burst signal amplitude. As with the other a.c.c. circuits we have looked at the action is one of forward gain control. To enhance this action the collector load is an inductor L7242 (with a low d.c. resistance) which avoids the collector potential changing significantly with change in base bias. The time-constant C7229/R7235 in the base circuit is adjusted to minimise the change in transistor parameters with control current. The control is of the order of ±3dB for input level changes over the range −20 to +10dB.

Colour Control

The signal at Tr7238 collector is passed to the base of the second chroma amplifier transistor Tr7268 through a diode colour control circuit consisting of D7251 and D7255. Back-to-back connection is employed to avoid transference non-linearity, and the degree of conduction and hence the level of signal fed to the second chroma amplifier transistor is controlled by the forward bias applied from the colour control potentiometer R1802. The action on the chroma signal is similar to that of a potentiometer: the series diodes represent the top half of the resistance and R7256 the bottom half. Clearly, as the resistance of the diodes decreases so more signal is fed to the base of the second chroma transistor from the tapping point. The circuit will be recognised by those familiar with the Pye single- and dual-standard chassis.

Negative-going line flyback pulses are also fed to the diodes through D7249 so that the chroma signal path is interrupted during the periods of the bursts (but some versions differ slightly in this area of circuit).

Rectified ident signal is used to open the colour killer stage which is Tr7268 (the second chroma amplifier). On monochrome transmissions this transistor is without base bias and thus non-conducting. On colour however the rectified ident signal provides about +15V d.c. and this is fed to the base of the transistor through R7199 to bias it on.

The PAL delay line is driven by Tr7271 the base of which is fed from the emitter of the previous transistor. Undelayed signal is fed from preset R7267 in Tr7271's emitter circuit. The PAL matrix is balanced by this preset to provide the correct U and V chroma signals for the sychronous detectors about which more will be said in subsequent articles.

SERVICING TV RECEIVERS

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tap on the tube neck may clear away particles which may be shorting out part of the heater element but this is only possible when a voltage check across heater pins 1 and 8 shows that the voltage drop is less than 6V (if this is the heater rating of the tube fitted).

A very dark picture (brilliance fully up) is not usually due to a tube fault at all. It is very often due to incorrect tube base supply voltages. The first voltage to check is that to pin 3. This should read over 300V. If the reading is only that of the h.t. line check capacitor 477. This has a value of 0·25μF and is suspended above the chassis near the PCL85. Clipping one end will immediately restore the voltage to the tube first anode with perhaps some shading on one side of the screen. We have not had any cases of capacitor 466 shorting but if this was to happen there would be no screen illumination at all as pin 3 would then be grounded.

Remember that no voltage should be expected at pin 2 (or 6) as both the video drive and the brilliance control are applied to the cathode pin 7.

TV TEST REPORT

E. M. BRISTOL

THE KLIK RIVETER

THE construction of modern TV receivers entails the use of struts and frames to hold together the various printed panels. Occasionally these come adrift and have to be repaired, while the home constructor of course continually needs to join up various pieces of metalwork. Nuts and bolts are the time-honoured method of doing this but sometimes access to both sides of the work is not available. The alternative, self-tapping screws, is widely used but this also has its limitations especially if the metal is thin.

An answer to these workshop fixing problems is the Klik Riveter manufactured by Riveting Systems Ltd., Harehill, Todmorden, Lancs. This inflicts no violence on the work—as is the case with conventional rivets which need to be hammered over—and furthermore needs access to only one side of the work.

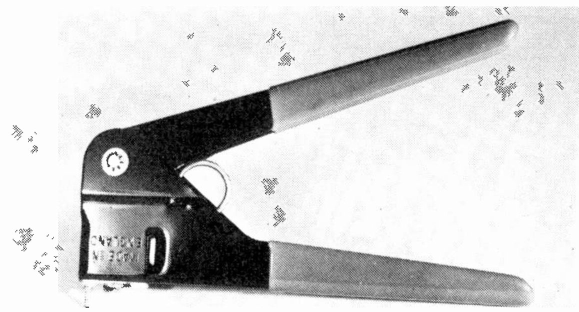
Operation

Each rivet is formed on a steel mandrel—something like a nail which has a "head" no larger than the outside diameter of the rivet. The rivet is loaded into the nozzle of the tool, shank first, and the exposed rivet is then inserted into the hole in the metal work. Squeezing the handles of the tool together exerts a pressure which pulls the mandrel away. This makes the head flatten the rivet on the blind side of the work. When the maximum compression of the rivet has been achieved further pressure breaks off the head so that the shank can be withdrawn and discarded.

Models

The tool is constructed rather like a pair of pliers, but squeezing the handles together makes the jaws move apart. One jaw holds the nozzle into which the rivet is loaded while the opposite one grips the shank to pull it away. Over a period the firm has made various models for industrial, workshop and handyman use, both separately and in kits containing the tool, drills and a selection of rivets. The two latest models are a single-size one costing £1·50 which takes $\frac{1}{8}$in. sized rivets and one priced at £1·90 which takes both $\frac{1}{8}$ and $\frac{5}{32}$in. rivets.

The model tested for the purpose of this report was an older one that also accepted a $\frac{3}{16}$in. sized rivet. To change from one size to another the appropriate nozzle must be screwed into the tool, although there is also a model that has the nozzles on a turret which



The Klik Riveter loaded ready for use.

can be quickly swivelled to the chosen size. Also available for special purposes are rivets of $\frac{3}{32}$, $\frac{7}{64}$ and $\frac{1}{4}$in. diameters.

Rivets

The main diameter rivets come in seven or eight different lengths. The length used for a particular job should be about $\frac{1}{10}$in. longer than the thickness of the material being riveted. There is a choice of material for the rivets, either aluminium alloy or monel, and these can be obtained in either domed or countersunk versions. The choice is extended further with air and watertight types, special high clamping-force types which will set rigidly in out-of-line or oversized holes, and decorative types with various sized bowls.

There is then hardly a purpose for which a rivet is not made and certainly for the general repair and construction work of the average workshop there will be a suitable one. Where the material to be joined is soft, for example plastic mouldings or cabinets, backing plates are also available.

Test

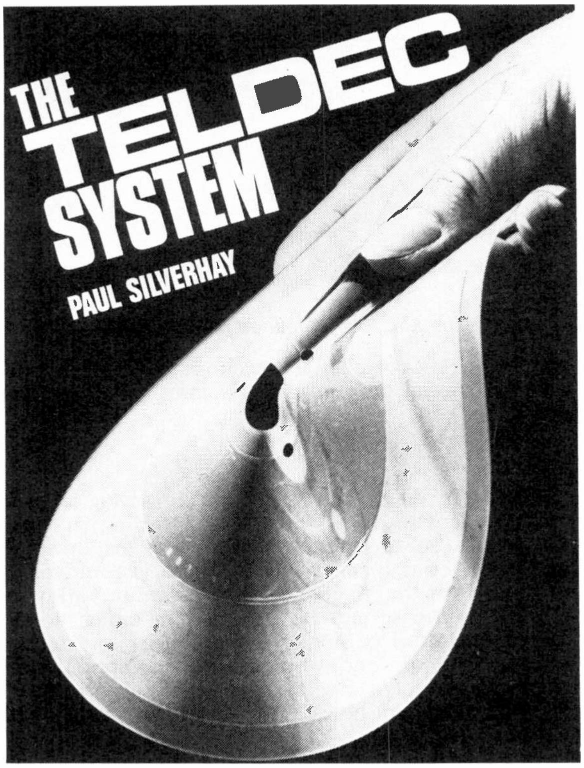
The tool that was tested was very strong and light, being made of diecast aluminium alloy with the working parts of hardened chrome molybdenum steel, and gave the impression that it would stand up to many years of work without wear.

At first I thought that a strong grip would be needed to operate the tool in order to flatten the rivet and then break the mandrel. This however is not the case. The force required is obtained by leverage within the tool and the mandrels are weakened at the head so that they break quite easily after the rivet has been flattened. The pressure needed on the handgrip is therefore not excessive. The moulded plastic covering on the handles helps with the grip.

There is just one word of warning though: when using always grip the tool by the handgrip as it should be gripped, and never farther up the tool toward the head. Not only will more leverage be obtained but the two halves of the tool above the grip are parallel and come together with some force when the mandrel head breaks. If any part of the hand should be in the way at this point the result could be very painful!

The jobs that were carried out with the tool were very neat and firm. It is a very useful workshop tool indeed and to be recommended. Workshops that carry out repairs on electrical appliances and white goods (refrigerators, spin dryers and washing machines) will find the tool especially useful.

FEATURE TO BE CONTINUED



As early as 1927 video material was recorded on a gramophone disc and played back on a record player. These experiments were made by John Logie Baird who managed to achieve a bandwidth of about 5kHz —sufficient to be able to engrave on the disc and reproduce from it his 30-line, 30 fields/sec pictures. This kind of bandwidth is of course achieved with present audio disc technology with no difficulty whatsoever. Nevertheless the fact must still stand in the records that the first recording/storage medium for video was disc and not tape.

Bandwidth

Although 15kHz is the normal upper limit for recording and reproducing material on a disc it is theoretically possible to achieve reproduction up to an audio limit of about 50kHz with a fair amount of ease. Using specialist recording and pickup techniques it is even possible to extend this to about 80kHz. This is not possible with domestic discs and reproducing equipment simply because of the very high costs involved.

Information Density

To be able to record video material on a disc the basic need is for some way of increasing the amount of information on the disc, that is a higher information density is required.

Conventionally, increased recording bandwidth has been achieved by increasing the tape or, in this case, the disc speed. For a 2·5MHz bandwidth for example the disc speed needs to be increased at least fifty times: on an LP disc using audio fine-groove recordings this would mean a disc speed of about 1,500 r.p.m. which is clearly an impractical speed for conventional pickups and one that would give only about 40 seconds of useful playing time for each side of the record.

To achieve a useful playing time therefore the concentration of information within the grooves of the disc or within the size of one groove spacing must be considerably increased. Looking at the left-hand side of the photograph in Fig. 1 we see the magnified detail of the grooves of a standard microgroove audio recording. The most noticeable thing about this is the amount of wasted space on the disc surface—space that is not used for recorded material. The space has to be left to allow for the very wide lateral excursions that occur with high-level signals. But as can be seen the surface of the groove is quite smooth—a characteristic of modern disc materials. It would therefore be very possible to scale down the whole groove and its excursions to a more reasonable size—with of course a corresponding reduction in the size of the stylus used to track the recording.

Such a technique could mean that where there is one groove on an audio disc we could implant perhaps five grooves. There is of course no reason why such techniques should not be extended to new audio recordings, but the cost of the changeover, making redundant many millions of current pressings and the record reproducing equipment that now exists in nearly every home, would not make economic sense.

Use of Frequency Modulation

We can take our logic of improvements a stage further. Why use an amplitude sensitive groove anyway? Why not employ a frequency sensitive one? In other words why not use a frequency modulation disc rather than an amplitude modulation one. With f.m. a constant excursion amplitude would be required rather than one varying in amplitude.

Present disc surfaces can have roughnesses in the groove of the order of only 10nm (100 Angström units). A groove excursion of the order of 50nm should therefore be quite sufficient to indicate that an excursion is present—i.e. to give a simple yes-no indication of the presence of signal. This is all that is required for an efficient f.m. system to operate with no noise problems. The groove cannot however in practice be made quite this narrow because of the cutting angles required by the disc cutting machines and by certain limiting features of the pickup equipment.

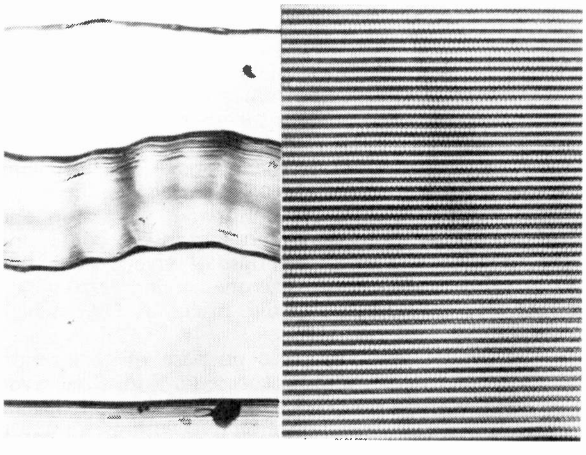


Fig. 1: Comparison of grooves in a video disc (right) and microgroove audio disc (left)—to same scale.

Dense Storage Technology

On the basis of these limitations the Teldec system uses groove spacings of the order of 0·0075mm which give a groove concentration on the disc surface of about 130 grooves per millimetre of disc width. The name coined for this new technique is "dense storage technology". Examination of the right-hand side of the photograph in Fig. 1 (which is to the same scale as the left-hand side) shows that the concentration is about 25 grooves for every one groove in the fine-groove audio recording. To give an idea of the size of these grooves one could compare them with the size of human hair: there are about ten grooves to the width of a hair. Because of the use of frequency modulation the space between the grooves can be virtually non-existent, little guard-space being needed for the constant amplitude grooves. To assist even further the recording is made "hill-and-dale" instead of lateral within the groove. The most noticeable thing in comparing the two halves of the photograph is the incredible gain in information storage that has taken place.

Playing Time

The disc speed chosen for use with this dense storage groove system is such that two complete fields are laid down per rotation, i.e. one complete picture per rotation. This means that the disc must rotate at 25 revolutions per second or 1,500 r.p.m. With a 12in. LP type disc this means that with about 25 times more grooves than the equivalent audio disc it should be possible to record about 16 minutes of material. In practice this is not so because the groove circumference shortens considerably for every rotation towards the centre of the disc so that it is then not possible to resolve as great a number of frequency changes in any one groove. This results in a poorer signal-to-noise ratio (remember it is an f.m. system) and therefore unsatisfactory performance. As a result of these limitations it appears that about 12 minutes of recording is the maximum practical and even then there is some deterioration in performance towards the centre of the disc. This means that we will never see video discs with material recorded right to the centre but the loss in playing time could be made up by a slight increase in the overall record diameter. The demonstration discs so far seen have only had about 5 minutes of recorded material on them.

Synchronisation

Recording two fields per revolution means that on looking at the video disc a pattern is clearly visible where the field blanking occurs and a close look at the disc clearly resolves the pattern of sync pulses as well. It also means that as there is a piece of repeated information at every turn of the disc a servo system can be fairly simply constructed to lock the field blanking intervals to the motor speed during playback—a technique which should give quite stable pictures even in the presence of noise, should noise occur (see *Helical-Scan Videotape Recorders*—TELEVISION March 1971).

Disc Manufacture

Obviously the very size of the grooves on the video disc means that new disc cutting techniques have had to be evolved and this work has been more complicated because of the hill-and-dale recordings. The playback machinery too has to have a different stylus system to the conventional audio one.

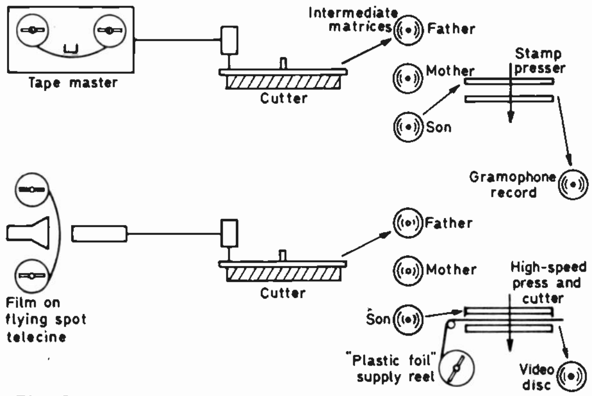


Fig. 2: Pressing methods used for an audio disc (above) and a video disc (below).

The roughness of the recording grooves on which the basic video disc calculations are based is a function of the crystal size of the disc material and the type of disc-cutting machinery used. The latter is no longer a problem because of the development of new types of machinery while the new plastic materials that are used all have a small enough crystal size to fall well within the required capacity. A very thin plastic foil which satisfies these requirements is used for the final disc pressings.

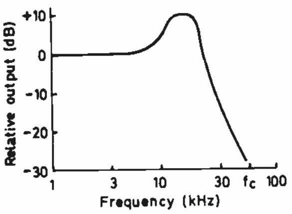
The schematic shown in Fig. 2 indicates the slightly different order of processes involved in the mass production of video discs compared to audio discs. The major difference of course is that the original source is film for the video disc and tape for the audio record. The final gramophone record pressings are formed by compressing a carefully controlled amount of granular material under the "son" disc while the video discs are pressed from a large roll of plastic foil —a system open to very high speed pressing thus reducing the production costs. The cost of the video disc is expected to be about 50 pence per double side of material (i.e. about ten minutes of material).

The results of this method of production are shown in the heading photograph. The disc is inherently very flexible, thin and of course light.

Disc Reproduction

Because we are considering a groove recording it might be as well to remind ourselves how the standard audio pickup operates. Briefly a sharp tip or stylus is located in the groove. As the disc rotates the tip is forced to follow the lateral excursions of the groove. The tip is connected by a short spindle to a mechanical transducer—e.g. crystal or magnetic—where the stylus movement is converted into an electrical signal. This is analogous to the operation of a microphone where mechanical movement of the diaphragm is converted by the crystal, magnet, ribbon or whatever into an electrical equivalent of the audio (pressure) signal.

The whole cartridge (i.e. stylus plus transducer) will obviously have some weight and is mounted at the end of a fairly long arm. Excessive weight in the groove would obviously damage it so the whole assembly is normally counterbalanced to give only a small weight



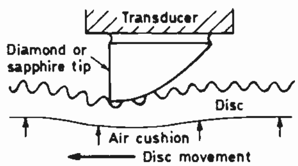


Fig. 3 (left): Resonance in the response of a conventional audio magnetic pickup.

Fig. 4 (right): Deformation of the video disc by the pressure of the pickup.

effectively in the groove. Too small a playing weight and the stylus tends to be pulled out of the groove towards the centre of the record—the so-called "skatting" action. Playing weights on high-quality audio systems are typically 1-2 grammes.

Certain conditions must also exist at the stylus tip. The diameter must be small enough to fit into the groove and its surface must be hard enough to withstand a fair period of wear. This means in practice that a tip such as a diamond or sapphire must be used. We are not unfortunately working into a very hard surface—the disc groove is elastic to a certain degree so that it deforms as the tip tracks within it. This and the finite playing weight lead to a resonant frequency in the reproduction system—the stylus resonance. Fig. 3 shows the usual position of this resonance in the frequency response with a high-quality pickup. This resonance occurs with magnetic cartridges used for audio reproduction: with good choice of damping and working into the correct amplifier impedance it gives an almost flat response up to about 20kHz.

In an undamped cartridge the output falls off rapidly above the resonant frequency as the inertia of the stylus—due to its weight—does not allow high-frequency movement. The frequency at which the output is completely lost is normally between 50 and 80kHz. This is obviously not practical for tracking a 2MHz disc.

Tip Size

Because of the much smaller groove width the tip on the video disc player would have to be considerably smaller—in fact a tip radius of about 0·001mm. There are obviously considerable difficulties in accurately and repeatedly producing tips of this radius though this can be overcome. There is the additional hazard that such a tip would probably cut through the video disc after only a few playings.

This tends to suggest that mechanical replay of the video disc is not practical. A number of alternatives come to mind: optical tracking, tracking using interference between beams of light, etc. None of these offers a simple system however and they would certainly prove expensive for a piece of domestic equipment. For domestic use price dictates a mechanical tracking system and as the conventional audio system is not usable another form must be found.

Teldec Replay System

As we have seen the solution to one of the recording problems was to use a form of frequency rather than amplitude modulation. A similar piece of radical thinking produces an answer to the replay problem: instead of using a stylus that moves in sympathy with the groove excursions on the record, use is made of a stylus which measures the *pressure of the groove against the tip*. This also gives an output corresponding to the recorded (f.m.) signal. The stylus is mounted at a fixed vertical position and the disc held up against it. In this way a much smaller tracking weight than before can be used because the stylus does not have to follow any lateral movements in the groove. In fact the playing weight is only 0·2p and with this weight the tip resonance can be made high enough to give the required bandwidth.

It seems in fact that the playing weight could be reduced still further with a sufficiently good mechanical stylus. Nevertheless the present position allows a bandwidth of about 3MHz.

The other problem mentioned with using a stylus system is the damage that could be inflicted on the recording by an excessively sharp tip. The only possible solution here is to use a stylus tip which is much larger than the groove width—so that the pressure on any point is reduced. This is achieved in the Teldec system by using an asymmetrical stylus tip.

At the forward part of the stylus shoe (see Fig. 4) the tip is curved upwards whilst the trailing edge is sharp. The leading edge "glides" over the groove hill-and-dale crests so that no damage occurs. Under the tracking weight of the stylus the disc is deformed: at the trailing edge the crests of information pass out and there is a sudden change in the deformation. This change in deformation at the trailing edge represents a sudden change in pressure on the tip: the greater the number of such changes the higher the output signal level (f.m.). The stylus is connected to a piezo-ceramic transducer which converts the mechanical pressure changes to an electrical output.

To allow for deformation of the disc without damage there must be some freedom for the surface to move. This can be achieved either by using a thick disc—which puts up its cost—or some form of springy surface. Teldec obtain this latter effect by supporting the disc on a cushion of air.

There will also of course be pressure variations conveyed to the transducer because of the groove crests passing under the leading, rounded edge of the stylus. These pressures however will vary from point to point and are therefore a form of amplitude modulation. In an f.m. system they are not therefore going to contribute to the output signal.

Transducer

The sapphire or diamond stylus tip is rigidly connected to the piezoceramic transducer (Fig. 5). Side electrodes sense the electrical signal generated within the transducer and pass it to the associated electronic circuitry. The transducer measures about 0·2mm square. A hollow tone arm supports the transducer to which it is connected by a flexible layer which also acts as a cushion. Further damping is provided at the support end of the arm. This care in damping is necessary to prevent tone arm resonances negating the care taken in the design of the stylus.

The Teldec Player

The basic construction of the Teldec player is shown in Fig. 6. We have already described the basic

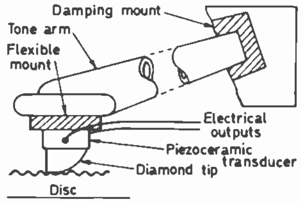


Fig. 5: Teldec pickup arm and stylus—note scale compared to Fig. 7.

features. The disc is supported on a cushion of air to allow surface deformation. This also gives a mechanically more even surface than would a machined turntable so that the "wobble" on the thin disc can be kept below 0·005mm. This is important because any variation of this sort gives the impression (to the stylus) of a pressure change.

The bottom plate of this air sandwich is fixed. The disc rotates with the centre drive shaft and care is necessary to ensure that there is virtually no eccentricity of the spindle; the elastic suspension of the stylus and transducer allows a little variation, the stylus being pulled slightly into the groove, but it must still be better than an audio turntable by a factor of about 25 times. The same shaft that drives the disc is mechanically coupled to a transverse cable system which by means of a cord and pulleys advances the position of the pickup by one groove width per revolution of the disc—i.e. 0·008mm per revolution.

To provide stop-motion facilities the cable drive to the pickup can be broken by a mechanical switch. The stylus continues to follow the groove but returns to the same point after each complete revolution because the pickup carrier is unable to move. It therefore repeats the same two fields of information again and again.

Although only five minutes or so can be put on one side of a video disc larger programmes could be accommodated on a number of discs with an autochanger mechanism. Teldec give as an example that a two-hour programme could be put on a stack of discs only 5mm high and say there would be only a small break between sides. This has not yet been demonstrated and clearly the prototype player is unsuitable for autochanger use because the pickup carrier goes from the edge to the centre of the assembly. It is understood however that an autochanger for use with a cartridge containing a stack of discs is being developed.

Sound Signal

Pulse-position modulation during the blanking periods is used for the sound. This is similar to the pulse-code modulation system used in the BBC sound-

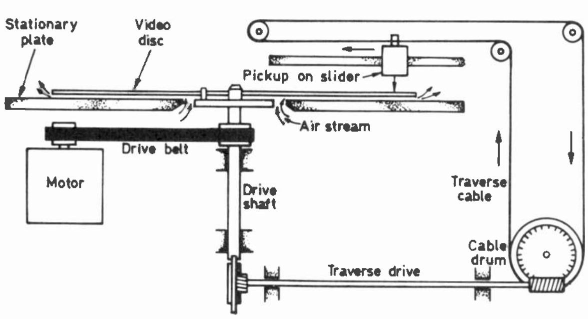


Fig. 6: The mechanical system used in the prototype Teldec video disc player.

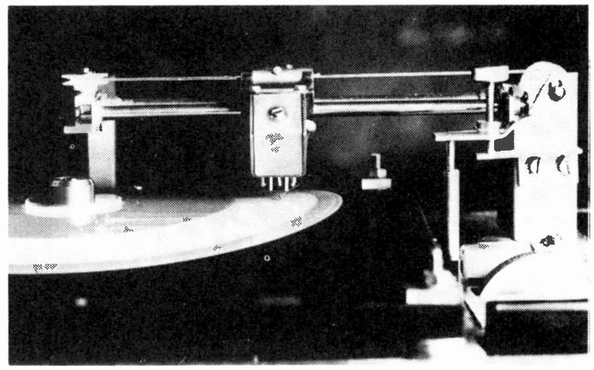


Fig. 7: The prototype Teldec video disc player. An autochange version is being developed.

in-sync system (see PRACTICAL TELEVISION January 1969). The distinction between these two systems is that although PCM is more accurate in the presence of noise PPM is easier to decode.

Colour

The video disc has not been publicly demonstrated in the UK since the end of last year but a colour version was shown at the recent Berlin Radio Exhibition. In the monochrome version the vertical resolution is considerably higher than the horizontal resolution. If the vertical resolution can be reduced to match the horizontal resolution it is possible to record the extra information needed for colour. This is the approach which Teldec have adopted. Sequential red, green and blue signals are recorded line by line and delay elements used in the reproducing equipment to make the three colour signals continuously available. Electronic mixing of the three colour signals is used mainly below 1MHz so that detail is not lost.

General

The earlier demonstrations showed that quite reasonable pictures and sound could be produced from the prototype machine although personally I found the presence of a certain amount of line noise rather annoying. What quality can be obtained from mass-produced discs and machines is a question that will have to wait until 1973 for solution.

The Teldec system cannot of course be used to record one's own television material but the intended market is similar to that at present catered for by the audio disc. With large-scale production of discs for domestic playing the estimated cost is 50p for ten minutes of television material and £100 for the player. At this price the market may very well exist.

Teldec is an amalgam of the German company AEG-Telefunken and the Decca record company: the equipment and discs will be marketed in the UK by Decca.

Teldec also has a possible future as an audio disc system. With the bandwidth available quadrophony recordings are simple and even stereo recordings at 8¼ r.p.m. are possible. The latter would give about two hours of recorded material *per side* of an audio Teldec disc at a cost of about 50p. The present hi-fi problems of bias compensation, tone arm alignment and rumble would no longer exist. ■

a look at Imported SETS.....

Russian TEMP 6M/7M models

H.K.HILLS

There are many unusual and unorthodox features in the design of the Temp series single-standard receivers manufactured in the USSR and now being widely distributed in this country. Except for the tuner they are completely valved. Features include: (a) Power supply from a double wound transformer thus isolating the chassis from the mains and eliminating the usual high wattage dropper resistor. Six h.t. and three negative l.t. rails are provided. The valve heaters are connected in parallel. (b) A transistor *RC* preamplifier is contained within the u.h.f. tuner unit. (c) A three pentode plus one tetrode vision i.f. amplifier is employed, the tetrode being used in the final stage as it is more suitable for handling the high-amplitude predetector signal. (d) The a.g.c. potential, which is directly related to true signal strength, is developed by a triode gated by pulses fed to its anode from the line output stage. (e) A user definition control varies the vision i.f. response by altering the bias on a varicap diode. (f) The line and field sync pulses are separately amplified before application to their respective timebase circuits. (g) An autotransformer blocking oscillator is used to generate the line scan waveform, with an adjustable feed-in point for optimum flywheel sync control. (h) The video output stage contains an automatic brightness control circuit. (i) A triode is used as an active component within the field linearity negative feedback loop in the field output circuit.

Field Timebase

This lengthy list makes it difficult to select features for detailed review but as the field timebase circuit has a number of unusual aspects we will look at this first. The complete circuit is shown in Fig. 1. The first point to mention is that the 720V rail is used for the field charging circuit (R28, C21, C22) only and does not supply the line output stage or the first anode and focus electrodes of the c.r.t. This arrangement naturally contributes to height stability and the linearity of the field output waveform. Also, and unusually in valved circuits, the height is not adjustable by varying the oscillator anode potential fed from this source but by varying the waveform amplitude applied to the tetrode output valve.

The sync pulse feed is applied to V10A which produces an amplified, limited and phase-inverted output across its load resistor R12 for application to the grid of the field oscillator (V11A) via the dual integrator R18, C16 and R21, C17. Note that although the values of these components differ the two time-constants are the same, 51μsec. A useful rule to remember in calculating time-constants when, as is usually the case, the component values are in picofarads and kilohms is that their product divided by 1,000 equals the time-constant in μsec. Thus a capacitor of 200pF coupled with a resistor of $150k\Omega$ has a time-constant of 30,000/1,000 or 30μsec. The double integrator used in the Temp circuit makes for solid lock and good interlace by "absorbing" all the line and most of the noise pulses present.

Linearity Circuit

The output tetrode is as usual transformer coupled to the scan coils but one side of these is returned to chassis via a *one* ohm resistor (R20). The junction of the coils and this resistor is taken to the grid of the triode V10B. The waveform developed across R20 is proportional to the scan coil current. Thus a reverse phase negative feedback signal is produced across the anode load resistor R17 of V10B. This signal is *RC* coupled to the output tetrode's grid to linearise the forward sweep. Applying the negative feedback in this way—including a triode as an active component within the loop—has the advantage that increase in scan coil temperature and therefore resistance, which would normally reduce height, results in a smaller waveform being developed across R20 thereby keeping the height constant by reducing the negative feedback developed. The 1Ω sensing resistor R20 must be very low in value to minimise power loss since the resistance of the scan coils is also quite low. As can be seen the feedback waveform can be varied by R22 to alter the overall linearity and by R39 to alter the linearity at the top of the raster. In addition to this scan current shaping by negative feedback there is the usual slight positive feedback introduced by taking C22 to the cathode circuit of the output tetrode to optimise bottom linearity.

Line Timebase Generator

The line generator is also rather different from accepted British practice, using (Fig. 2) a triode arranged as a blocking oscillator in conjunction with an autotransformer. One end of the autotransformer is connected via a capacitor to the grid and the other to chassis while a tapping point is taken to the valve's cathode via a ringing coil which helps to maintain correct frequency and reduces the generator's sus-

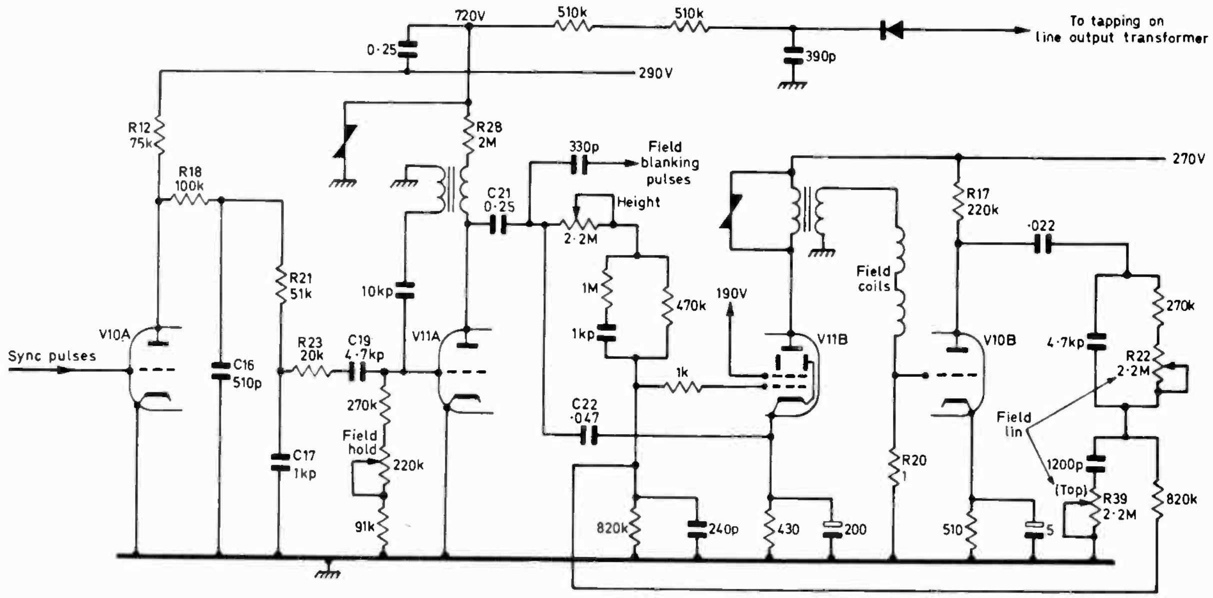


Fig. 1: Field timebase circuit, with triode in linearity feedback circuit to stabilise the height.

ceptibility to noise pulses. The operating frequency is set by the grid voltage and the d.c. resistance to the h.t. rail. The latter is varied by the hold control R8 while the grid voltage is augmented by the positive or negative control potential obtained from the flywheel sync circuit should the generator frequency tend to wander away from the correct figure. This control potential is of high amplitude as the line sync pulses are amplified before being fed to the discriminator, so the balance control R7 is factory set to produce optimum spread for the line hold locking position.

Video Stage

The video stage (Fig. 3) is interesting in that (a) it is d.c. coupled from the vision detector diode, with low standing bias and maximum anode current on no signal, (b) its cathode drives the cathode of the gated triode used to develop the a.g.c. while (c) it includes an automatic brightener circuit.

The vision detector load resistor R49 is returned to the junction of pentode cathode resistors R51 and R52. Thus the valve is biased by only the small voltage developed across R51. R52 is included mainly to develop drive potential for the a.g.c. triode, though it does tend to raise the pentode's input impedance towards the lower frequencies. As the picture black and blanking level on 625-line transmissions equals 77% modulation depth the detector output must be negative-going to increase the pentode bias, decrease the anode current but raise the anode voltage so that with the brightness control correctly set the c.r.t. beam current is cut-off at this level.

The video output is a.c. coupled to the c.r.t. by C55, brilliance control being achieved by varying the cathode d.c. potential by R64. When brilliance control is effected in this way the c.r.t. grid voltage is usually held constant by being fed from the junction of a potential divider shunted across the h.t. rail and chassis. In this model however the grid voltage is obtained from the video pentode anode via D5, R62 and R61. The sync pulses represent the peak signal

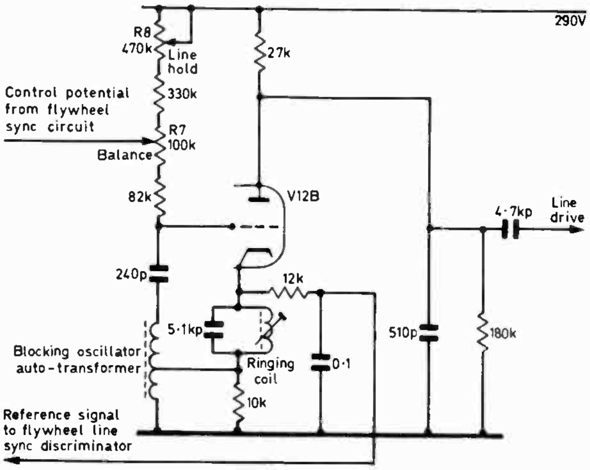


Fig. 2: The line blocking oscillator circuit features a cathode-coupled autotransformer.

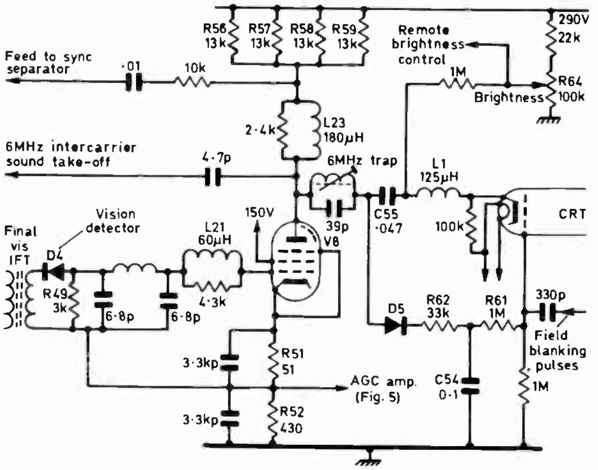
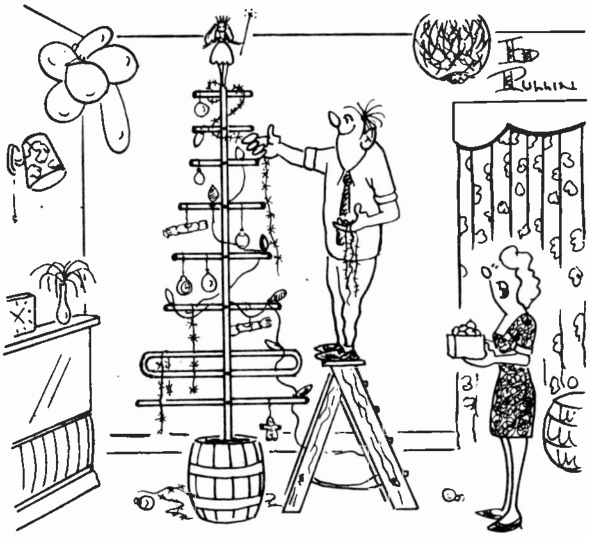


Fig. 3: The video circuitry.



"Couldn't we possibly have a tree for once?"

and are rectified by D5, charging C54. The voltage across C54 is thus the c.r.t. grid voltage and automatically increases with increase in signal amplitude—particularly useful when changing between channels of widely differing strength. This arrangement is somewhat analagous to the sync-pulse a.g.c. technique. It could also provide a basis for interesting experiments in many 625-line video circuits that are a.c. coupled to the c.r.t.!

The overall response of the video stage depends on (a) the effective load resistance presented by R56-R59,

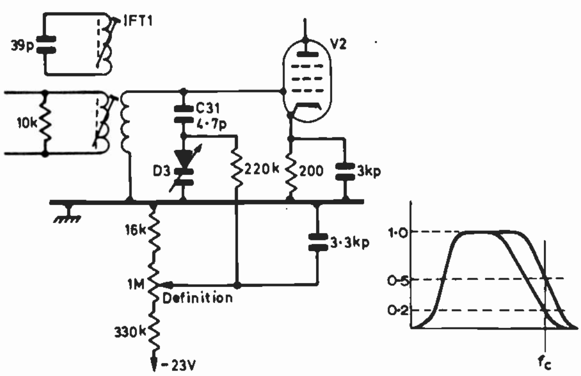


Fig. 4: The definition control circuit uses a varicap diode to alter the vision carrier amplitude.

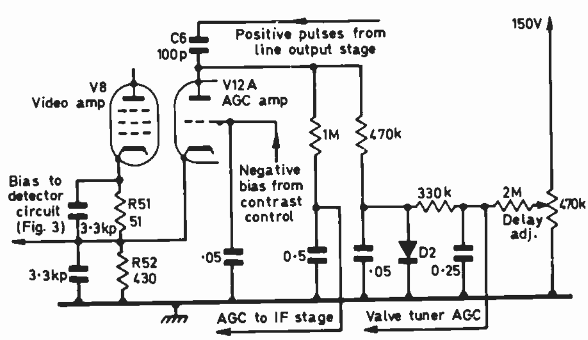


Fig. 5: The a.g.c. circuit with gated triode.

(b) grid corrector coil L21, (c) anode circuit peaking coils L23 and L1, (d) cathode negative feedback towards l.f. due to the use of only 3·3 kpF for decoupling and (e) l.f. attenuation due to the rising reactance of C55 at the lower video frequencies. The net effect of these measures plus the low net value of anode load resistor (13kΩ/4 or 3·25kΩ) results in a particularly linear and hump-free response right up to the h.f. roll-off.

Definition Control Circuit

For any given video circuit, the quality of picture definition obtained depends largely on the overall vision i.f. response, in turn contributed by each tuned circuit. In this receiver the response is made variable by means of a varicap diode shunted across the secondary of the first vision i.f. transformer (see Fig. 4) as a tuning capacitance whose effective value is controlled by the reverse potential tapped from the definition control. The variation in response obtained is shown in the inset curve in Fig. 4. As the bias on the varicap D3 is reduced so the total capacitance across the tuned circuit is increased. The carrier amplitude can be varied between 0·5 and 0·2. With reduced carrier amplitude the h.f. response and phase characteristics of the i.f. amplifier are improved, giving improved picture definition.

AGC Circuit

There are variations in these Temp models for the European and American markets. In some the tuner is also valved with a conventional cascode r.f. amplifier and triode-pentode mixer. In all versions however a gated a.g.c. system is used in which the control potential is directly related to true signal strength. The circuit is shown in Fig. 5 where V12A is the triode which develops the negative a.g.c. potential. Its anode is fed with high-amplitude gating pulses from the grid circuit of the line output valve while its grid is supplied with a negative d.c. potential from the contrast control and its cathode is directly linked to the junction of R51/R52 in the cathode lead of the video pentode.

The video pentode is directly coupled from the vision detector diode and the signal d.c. level is thus preserved. With this arrangement the sync pulse tips produce the maximum voltage *reduction* at the junction of R51/R52. A negative-going cathode pulse is equivalent to a positive-going grid pulse so that the conduction of V12A during the period it is switched on by the line pulse is determined by (a) the negative potential applied to its grid from the contrast control and (b) the amplitude of the cathode-injected sync pulses. The net effect is that rising signal strength or a reduction in the negative grid voltage increases the triode's anode current during the line pulse periods, increasing the negative charge developed by C6. Readers will note the similarity between this circuit and the one used in the Plessey chassis at present being covered in *Servicing Television Receivers.*

Add to all the foregoing features provision for making tape recordings, for phone listening, internal speaker muting, plus a brilliance/volume remote control facility in the Rubin models and it becomes apparent that these well-constructed receivers represent formidable competition.

FEATURE TO BE CONTINUED

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ECC88	55p
E88CC	62½p
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U78	25p
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UCH81	54p
UCL82	51p
UCL83	61p
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5V4G	40p
5Y3GT	30p
5Z3	45p
524GT	40p
6/30L2	75p
6AB4	32½p
6AF4A	47½p
6AG7	37½p
6AH6	50p
6AJ8	29p
6AK5	30p
6AK6	57½p
6AL3	42½p
6AL5	16p
6AM5	25p
6AM6	22½p
6AQ5	32½p
6AQ6	50p
6AR5	32½p
6AR6	32½p
6AS5	35p
6AS7G	80p
6AT6	45p
6AU6	29p
6AU6	30p
6BA6	47½p
6BE6	60p
6BH6	42½p
6BJ6	42½p
6BK7A	50p
6BL8	35p
6BN5	42½p
6BN6	40p
6BQ5	25p
6BR7	75p
6BR8	95p
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6F14	60p
6F15	55p
6F18	40p
6F22	32½p
6F23	77½p
6F24	67½p
6F25	75p
6F26	35p
6F28	70p
6F29	32½p
6F30	35p
6J4	47½p
6J5GT	30p
6J7	42½p
6K6GT	50p
6K7	32½p
6K8G	30p
6K23	50p
6K25	75p
646GT	45p
6L7	32½p
6L18	30p
6LD20	32½p
6N7GT	35p
6P1	60p
6P25	£1·05
6P28	62½p
6Q7	37½p
6R7G	35p
6S2	40p
6S4A	55p
6SA7	37½p
6SG7	32½p
6SJ7	37½p
6SK7	32½p
6SL7GT	32½p
6SN7GT	30p
6SQ7	40p
6SR7	37½p
6T8	32½p
6U4GT	62½p
6U8	35p
6V6GT	32½p
6X4	25p
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6X8	55p
6Y6G	60p
7Y4	60p
9BW6	42½p
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12AT6	25p
12AU6	75p
12AV6	30p
12AV7	45p
12AX7	30p
12AY7	67½p
12B4A	50p
12BA6	32½p
12BA7	32½p
12BE6	32½p
12BH7	32½p
12BY7	50p
12K5	50p
12K7GT	35p
12Q7G	25p
12SC7	25p
12SG7	35p
12SH7	25p
12SJ7	25p
12SK7	40p
12SL7GT	40p
12SN7GT	40p
12SQ7	40p
12SR7	32½p
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20P4	£1·00
20P5	£1·00
25C5	45p
25L6GT	37½p
2524G	30p
25Z6GT	50p
30A5	40p
30AE3	40p
30C15	75p
30C17	80p
30C18	75p
30F5	85p
30FL1	75p
30FL2	92½p
30FL13	50p
30FL14	77½p
30L1	45p
30L15	85p
30L17	85p
30P12	80p
30P18	35p
30P19	75p
30PL1	77½p
30PL13	90p
30PL14	85p
35A3	50p
35A5	55p
35B5	65p
35C5	35p
35D5	65p
35L6GT	47½p
35W4	25p
35Z3	55p
35Z4G	25p
35Z5GT	37½p
50A5	65p
50B5	35p
50C5	35p
50L6GT	40p
83A1	90p
85A2	37½p
90AU	£2·40
90C1	60p
90CU	£1·25
807	47½p
811A	£1·50
612A	£3·25
813	£3·75
866A	70p
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AW59-91	CME2303	£9·58½	£7·20
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	CME2302		
	CME2303	£9·58½	£7·20
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A59-13W	CME2306	£13·85	£10·97½
A59-16W	CME2306	£13·85	£10·97½
A59-23W	CME2305	£12·60	£10·50
A59-23W/R		£12·60	£10·50
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2N698	25p	2N4061	23p	AF118	60p	BC135	P/A	BF163	35p	**DIODES &**	
2N706	13p	2N4062	23p	AF124	13p	BC136	P/A	BF167	25p	**RECTIFIERS**	
2N706A	13p	2N4286	18p	AF125	20p	BC137	P/A	BF173	33p	1N914	8p
2N930	28p	2N4291	18p	AF126	20p	BC138	P/A	BF178	35p	AA119	10p
2N1132	33p	**RCA**		AF127	18p	BC142	30p	BF179	73p	BA102	23p
2N1303	18p	40253	P/A	AF139	38p	BC143	P/A	BF180	35p	BA115	8p
2N1305	23p	40398	P/A	AF178	45p	BC147	18p	BF181	33p	BA114	13p
2N1306	25p	40458	P/A	AF179	45p	BC148	15p	BF184	25p	BY100	23p
2N1307	25p	AC107	30p	AF180	53p	BC149	18p	BF191	23p	BY126	20p
2N2614	30p	AC117	60p	AF181	43p	BC152	18p	BF195	28p	BY127	23p
2N3826	30p	AC126	20p	AF186	67p	BC158	18p	BF196	43p	BZY88	
2N4905	P/A	AC127	25p	AF239	43p	BC169B	14p	BF197	32p	(Series)	33p
2N4914	P/A	AC128	20p	ASY28	28p	BC169C	15p	BF200	37p	OA5	13p
2N1711	25p	AC176	25p	BA144	P/A	BC171	18p	BF224	30p	OA47	8p
2N2147	73p	AC187	63p	BA145	P/A	BC175	28p	BF225	30p	OA70	8p
2N2160	58p	AC188	38p	BA148	23p	BC183	23p	BF257	47p	OA79	9p
2N2646	58p	ACY17	28p	BA155	P/A	BC184	23p	BFX29	35p	OA71	8p
2N2905	40p	ACY20	25p	BA156	P/A	BC187	29p	BF161	P/A	OA90	8p
2N2926		AD140	40p	BC107	15p	BC213L	27p	BF162	P/A	OA91	8p
Green	14p	AD142	58p	BC108	15p	BCY32	38p	BF163	25p	OA202	10p
Yellow	13p	AD149	58p	BC109	15p	BCY58	23p	BFY19	23p	P/A = price	
Orange	13p	AD161	38p	BC113	28p	BCY70	20p	BFY50	23p	on application	
2N3053	28p	AD162	38p	BC114	38p	BD121	65p	BFY51	23p		
2N3055	75p	AF102	58p	BC115	33p	BD123	83p	BFY52	23p		
2N3392	20p	AF114	25p	BC116	63p	BD124	63p	BSX21	38p		
2N3702	18p	AF115	25p	BC116A	38p	BD131	98p	P346A	25p		

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BASIC CIRCUITS FOR THE CONSTRUCTOR

6

J.W.THOMPSON

LINE TIMEBASE CIRCUITS

When considering television timebase circuits we come inevitably to the question of whether to use valves or transistors. It is the writer's opinion that at the present time a *hybrid* approach is the best, that is to say with transistors used in the oscillator and driver stages and valves in the output stage. Although the long-term reliability of transistors is very good (they do not suffer from low emission after a number of years) the short-term reliability depends largely on the type of circuit in which they are used. Transistors are never particularly happy in line output stages and are likely to blow up at the slightest provocation even in a well designed circuit. Complicated setting-up procedures involving the use of an oscilloscope are often required and the wound components (transformer, scan coils, etc.) are not readily available to the constructor. Valve line output stages on the other hand are relatively simple and inexpensive and are well able to withstand transient overloads. They are however rather inefficient and almost half the input power is wasted, taking into account h.t. and heater supply currents. The unused input power appears in the form of heat energy and thus efficient ventilation is necessary. The heat ouput of the stage may be reduced by about 30% by the use of silicon rectifiers in place of the boost diode and e.h.t. rectifier.

Line Oscillator

The constructor is given this month the choice of two line oscillator circuits (Figs. 1 and 3). Both circuits employ flywheel sync thus enabling the line oscillator to lock satisfactorily without line tearing on weak and noisy signals.

Flywheel Sync

The transistorised circuit shown in Fig. 1 works as follows. Negative-going sync pulses from the collector of Tr37 (see July circuit) pass to the base of Tr601 through a differentiating circuit (C601, R601 and R602) which removes most of the field sync pulses leaving a relatively pure line sync waveform. Tr601 is held conducting by R602 in the absence of a signal. The negative-going sync pulses applied to the base of Tr601 cause it to switch off for the duration of each pulse and the transistor acts as a phase splitter with positive-going sync pulses being developed at its collector and negative-going pulses at its emitter to briefly switch on the flywheel sync discriminator diodes D601 and D602. A line reference waveform from the line output stage is also applied to the balanced phase discriminator circuit (D601, D602 and associated components). The phase discriminator produces a voltage at the junction of R608 and R609 which may be positive, zero or negative relative to the mean voltage at the junction of R606 and R607. The voltage between these two junctions is zero when the line oscillator is running in the same phase and at the same frequency as the incoming sync pulses. Should the oscillator be out of phase with the sync pulses an error voltage is produced by the discriminator the polarity of which is such that the line oscillator is pulled back into lock.

Residual line ripple is removed from the discriminator output voltage by C606 and C607 and a small amount of d.c. amplification is provided by Tr602 whose forward bias is set by R606/R607. The amplified error voltage then passes to the base of Tr604 through RLY601 and the line hold controls.

Multivibrator Circuit

Tr603 and Tr604 comprise a standard multivibrator line oscillator circuit with Tr604 acting as a driver stage as well. The output at the collector of Tr604 has a mark-space ratio of approximately 10:1. The shorter time-constant is determined by C608 and R617 while the longer time constant which effectively determines the frequency of the line oscillator is set by C609, R615, the line hold control position and the voltage at the collector of Tr602.

Most people concerned with electronics know that if two transistors are connected in the multivibrator configuration a squarewave oscillation will be produced. For those readers unfamiliar with the operation of this circuit the following explanation may be helpful. Fig. 2(a) shows the voltage waveforms on the base and collector of the two transistors. We must first note that when the collector of one transistor is "up" (i.e. near supply rail voltage) the collector of the other transistor is "down" (i.e. near zero volts) and vice versa. This assumption will be shown to be true as the explanation progresses. If the collector of Tr603 is "up" it means that Tr603 is drawing zero current which implies that its base voltage must between $t1$ and $t2$ in Fig. 2(a) be near to or less than zero. This is due to a negative charge on C608. This situation is not likely to last very long because the base of Tr603 is connected via R617 to the positive rail. Thus C608 charges positively and the voltage on Tr603 base rises. It cannot rise instantaneously because of the time-constant of C608 and R617. When Tr603's base voltage rises above +0·6V its base-emitter junction becomes forward biased and the collector current of the transistor rapidly increases, dragging the collector voltage down to near zero (at $t2$). This rapid negative-going change in voltage is passed by C609 to the base of Tr604 which thus takes up a negative voltage. The amplitude of the negative voltage is limited in practice by the reverse base-emitter breakdown voltage of Tr604, which is generally between 5 and 15V.

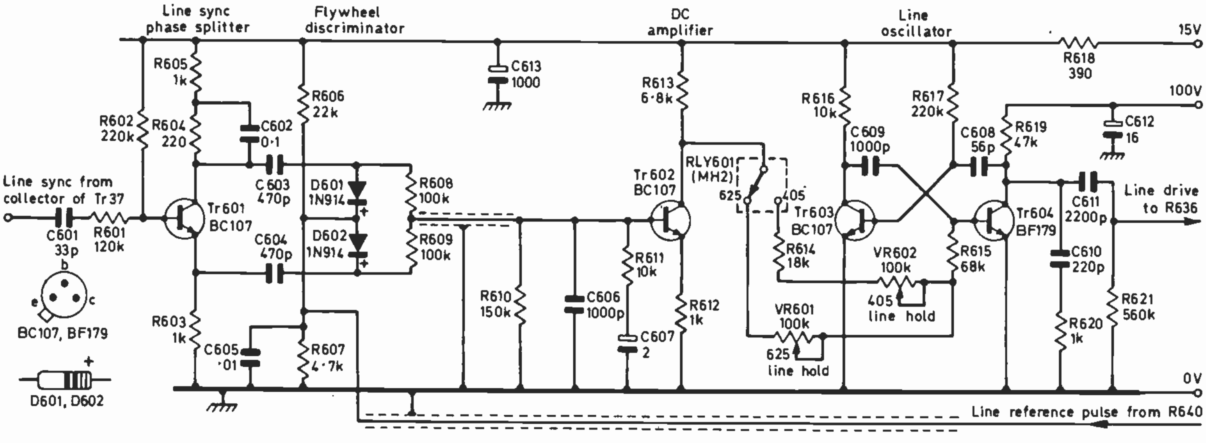


Fig. 1: Transistor line oscillator circuit with flywheel line synchronisation.

As the base of Tr604 has become negative it stops drawing collector current and its collector voltage goes "up". As with Tr603 in the same condition, Tr604's base voltage cannot remain negative and starts to rise immediately because of current supplied from the +15V rail through R615, VR601/602 and R613. The left-hand side of C609 is near zero volts as the collector of Tr603 is now "down" but the potential of the right-hand side starts to rise as the capacitor charges. Tr604 base voltage thus starts off negative and then increases beyond zero to a level of about +0·6V at which its base-emitter junction becomes forward-biased (at $t3$) and Tr604 starts to draw collector current. The collector voltage of Tr604 is rapidly reduced to zero by the increasing collector current and the negative-going change in voltage is passed by C608 to the base of Tr603 which becomes negative. The collector voltage of Tr603 thus goes "up" and the base voltage starts to rise because of the current supplied by R617. C608 charges (between $t3$ and $t4$), and we are back where we started.

Valve Circuit

The above explanation holds for valve multivibrators as well—look at the circuitry around V602 (Fig. 3) and note the similarities. The only significant differences are in the voltage levels around the circuit. With a valve multivibrator the grids remain negative throughout the cycle. This is because the grid voltage for the start of anode-cathode conduction in a valve

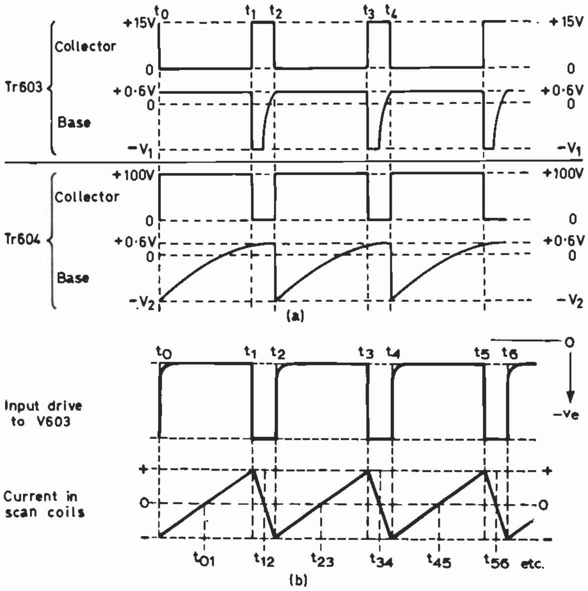


Fig. 2: Multivibrator voltage waveforms (top) and line output stage waveforms (bottom).

is usually around −10V while the base voltage for collector-emitter conduction in a transistor (silicon) is about +0·6V.

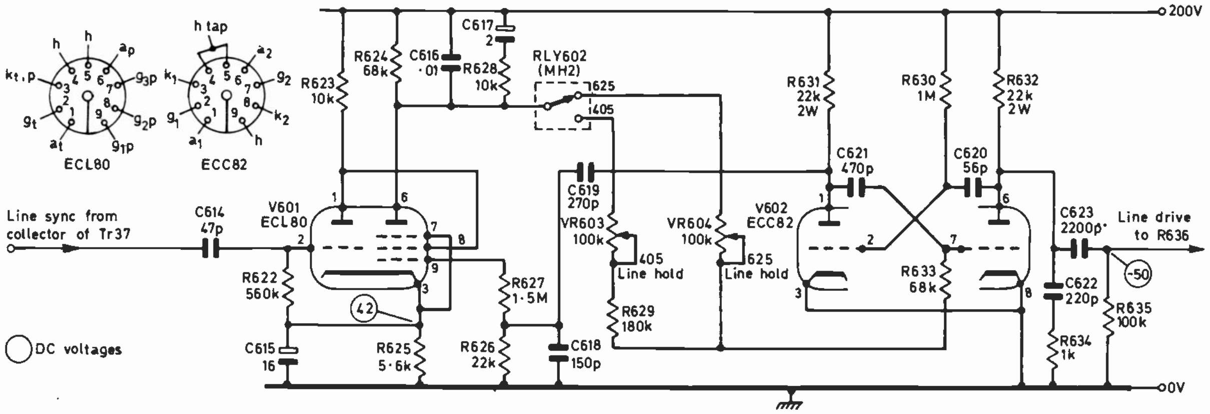


Fig. 3: Alternative valve line oscillator circuit with pentode coincidence detector.

★ components list

Resistors:

R601	120k Ω	R611	10k Ω	R621	560k Ω	R631	22k Ω 2W	R640 10k Ω
R602	220k Ω	R612	1k Ω	R622	560k Ω	R632	22k Ω 2W	VR601-4
R603	1k Ω	R613	6·8k Ω	R623	10k Ω 1W	R633	68k Ω	100k Ω lin.
R604	220 Ω	R614	18k Ω	R624	68k Ω 1W	R634	1k Ω	VR605
R605	1k Ω	R615	68k Ω	R625	5·6k Ω	R635	100k Ω	2·2M Ω preset
R606	22k Ω	R616	10k Ω	R626	22k Ω	R636	1·2k Ω	
R607	4·7k Ω	R617	220k Ω	R627	1·5M Ω	R637	2·7k Ω 5W	* Home Radio type
R608	100k Ω	R618	390 Ω	R628	10k Ω	R638	800 Ω 0·3A	R25.
R609	100k Ω	R619	47k Ω 1W	R629	180k Ω		tapped *	All $\frac{1}{4}/\frac{1}{2}$W 5% unless
R610	150k Ω	R620	1k Ω	R630	1M Ω	R639	1M Ω	otherwise stated

Capacitors:

C601	33pF SM	C612	16µF 200V E	C623	2200pF PE	SM silver mica; PE 400V
C602	0·1µF PE	C613	1000µF 25V E	C624	0·1µF PE	polyester; E electrolytic;
C603	470pF SM	C614	47pF SM	C625	0·33µF PE	PC pulse ceramic (C85);
C604	470pF SM	C615	16µF 50V E	C626	600pF 8kV PC*	M mixed dielectric
C605	0·01µF PE	C616	0·01µF PE	C627	500pF 8kV PC†	(2EJ41).
C606	1000pF PE	C617	2µF 200V E	C628	0·1µF PE	Numbers in brackets are
C607	2µF 15V E	C618	150pF SM	C629	22pF 12kV PC	Home Radio catalogue
C608	56pF SM	C619	270pF SM	C630	22pF 12kV PC	Nos.
C609	1000pF SM	C620	56pF SM	C631	0·47µF 600V M	* 250pF in parallel with
C610	220pF SM	C621	470pF SM	C632	0·22µF PE	350pF
C611	2200pF PE	C622	220pF SM			† 2 × 250pF in parallel

Semiconductors and Valves:

D601	1N914	Tr602	BC107	Tr604	BF179	V602	ECC82	V604	PY800
D602	1N914	Tr603	BC107	V601	ECL80	V603	30P19	V605	EY86
Tr601	BC107								

Miscellaneous:

T1 Line output transformer for Thorn 850 chassis
T2 Scan coils—Thorn 850
RLY601-3 Omron type MH2, 6V d.p. changeover (Home Radio WS159)
RLY604 Radiospares type 11A
F601-3 Ferrite beads (Home Radio FR4A)
Valveholders, e.h.t. cable, etc.

The circuit shown in Fig. 3 is included for the constructor who feels more at home with valves. It offers no particular advantage over the equivalent transistor circuit in Fig. 1 but the way in which the flywheel synchronising works is rather different. The triode section of V601 amplifies the incoming negative-going sync pulses so that positive-going pulses are developed across R623. The pentode section of this valve acts as a coincidence detector. A reference waveform derived from the line oscillator (not from the line output stage as is conventional practice) is applied to the control grid (pin 9) of the pentode while the positive-going sync pulses are fed to its screen grid (pin 8). An error voltage is developed at the anode (pin 6) the amplitude of which is proportional to the phase difference between the sync pulses and the line

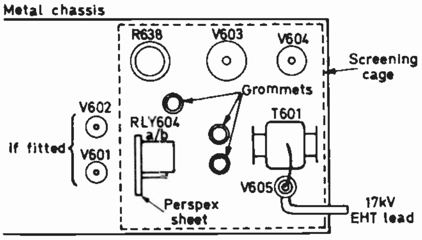


Fig. 4: Top chassis layout of the line output stage.

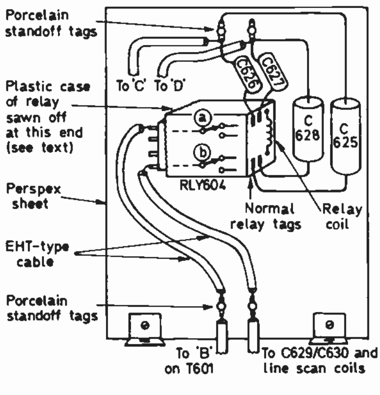


Fig. 5: Layout of the components around RLY604 a/b.

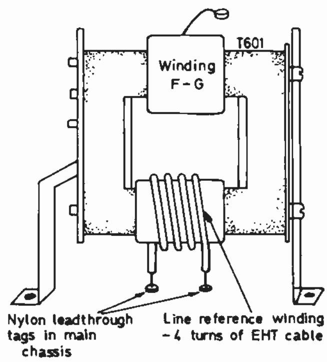


Fig. 6: Method of winding the line reference winding.

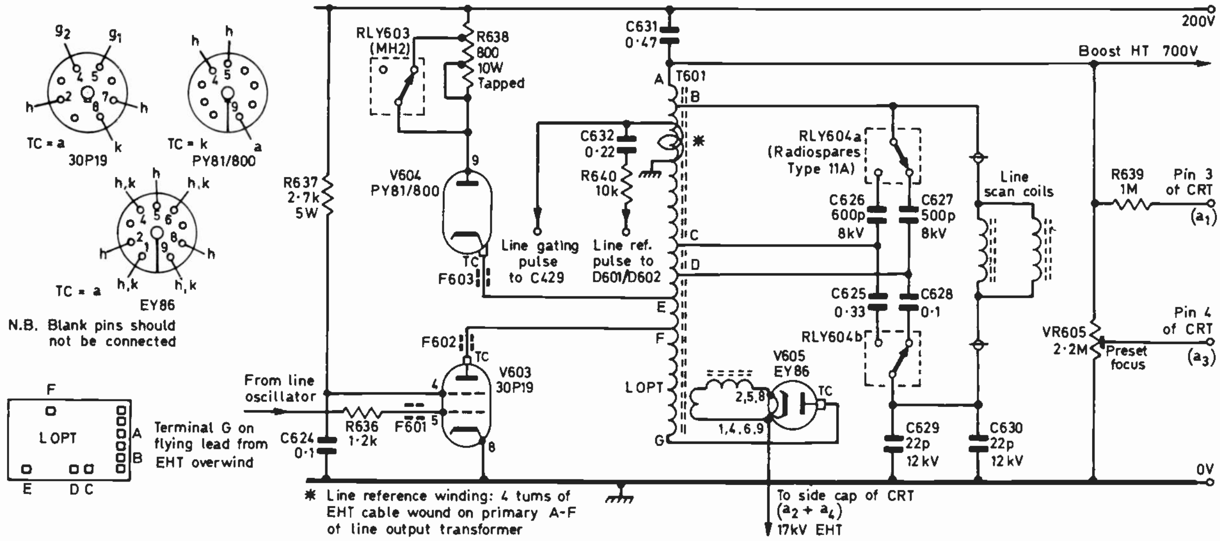


Fig. 7: Basic line output stage circuit.

oscillator reference waveform. Ripple is smoothed from the error voltage by C616 and C617 and the voltage then passes through RLY602 and the line hold controls to the grid (pin 7) of V602. This valve operates as a multivibrator with the output taken from the anode (pin 6) of the right-hand triode section.

Line Output Stage

For the sake of simplifying the description of the multivibrator action we have assumed—Fig. 2(a)—a squarewave output. The drive waveform for the line output valve is however slightly rounded by the charging process of C610 (transistor circuit) or C622 (valve circuit). Fig. 2(b) shows the waveform at the grid of the line output valve and the scan current waveform in the coils. The output valve V603 is actually cut off during the first part of the forward scan—between times $t0$ and $t01$—even though its grid is forward biased by the input voltage waveform. At time $t01$ the current in the scan coils is zero and V603 starts to conduct. Current flows through V603, winding F—E of the line output transformer T601, V604 and R638. By autotransformer action a voltage is induced across windings E—A. This charges the boost reservoir capacitor to about 700V and also supplies current to the scan coils during time $t01$ to $t1$. At time $t1$ the voltage at the grid of V603 drops suddenly and the valve stops drawing current. The current in the scan coils and T601 decays quickly to zero ($t1$ to $t12$) and then becomes negative ($t12$ to $t2$) due to the inductive back-e.m.f. effect. This "ring" produces a positive pulse voltage of several thousand volts at V603 anode and the cathode of V604, cutting the efficiency diode V604 briefly off. The time-constant of the ring is determined by the capacitance present in the circuit. Only a half-cycle ring occurs because when the oscillation tries to swing negatively—at time $t2$—the efficiency diode V604 conducts again damping any tendency for the ringing to continue. The negative current then decays linearly until at time $t23$ it reaches zero. The line output valve then starts to conduct once more and the current rises positively until at time $t3$ V603 is switched off and the flyback occurs once again.

The positive pulse that occurs at V603 anode during

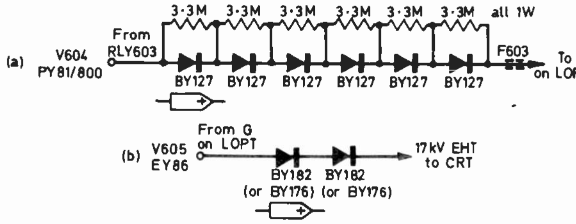


Fig. 8: Semiconductor equivalents to V604, V605.

the flyback period is stepped up across the e.h.t. overwinding F—G on T601 and is rectified by V605 to provide an e.h.t. of about 17kV for the c.r.t. final anode. The 700V boost voltage at tag A of T601 is used for the c.r.t. focus and first anode electrodes and for sawtooth generation in the field timebase.

Construction and Testing

The line timebase circuit should be built on a metal chassis of either aluminium or mild steel and it is recommended that the chassis is separate from the i.f./video chassis so that the risk of interaction is minimised. The power supplies and the field timebase may also be mounted on the line timebase chassis, the minimum size of which will then be about 14×10×2in. The line output stage is enclosed in a perforated zinc cage (see Fig. 4) to reduce harmonic radiation and also to keep most of the dangerous high voltages safely out of the way. Perforated zinc sheet (meat-safe metal) is readily available from most ironmongers and may be bent and soldered into the desired shape. Allow at least 2cm. clearance between the zinc and V603 and V604 and at least 5cm. clearance around the line output transformer.

RLY604 is not specifically designed for high-voltage use and will require some modification. As supplied by Radiospares the relay is in a polythene case which is removable. Slide off the case and observe the contact layout inside. It will be seen that the changeover contacts of the relay come out to tags at the top of the relay assembly (these tags normally being hidden inside the case). Black insulated wires are connected to these tags and travel down to the external connecting pins at the base of the relay. These wires are not insulated to the necessary standard and should be cut and removed. The relay case is

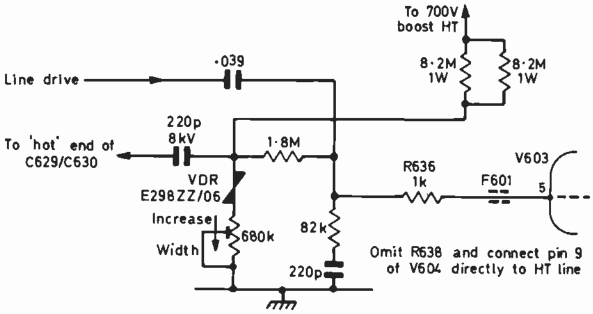


Fig. 9: Optional width stabilisation circuit. The line drive is from Tr604 (Fig. 1) collector, omitting C610, C611, R620 and R621 or pin 6 of V602 (Fig. 3) omitting C622, C623, R634 and R635.

then sawn off at the top, leaving a rectangular tube of plastic open at both ends. It should be replaced on the relay assembly and connections made both at the top and at the base of the relay: at the top to the changeover poles (of which the two outermost tags should be used) and at the base to the fixed relay contacts. The relay is glued to a small perspex panel and C625, C626, C627 and C628 added as shown in Fig. 5. The recommended position of the relay inside the line output cage is shown in Fig. 4.

Deviation from this layout is permissible because the lead lengths are not unduly critical but it must be appreciated that high voltages are present at many points in the circuit. Apart from the obvious danger of electrocution, there is also the possibility of a fire hazard existing if the wiring is inadequately insulated from the chassis. To be on the safe side it is recommended that e.h.t.-type cable be used for all connections to the following points: B, C, D, E and F on the line output transformer, RLY604, V605 and the line scan coils. As a further precaution do not use ordinary paxolin tagstrip at any point in the line output circuit—porcelain stand-off tags are much safer. If any printed-circuit board is used it should be made from fibreglass, not SRBP.

The line oscillator circuits are much easier to build. The transistor circuit in Fig. 1 can be built on paxolin pinboard and laid out as it appears in the circuit diagram. If the connection between the junction of R608 and R609 and the base of Tr602 is of any appreciable length it should be made with screened cable. The line reference waveform for the phase discriminator in this circuit is obtained from an extra winding on the line output transformer—details of how this should be wound are given in Fig. 6. The winding also supplies a gating pulse to the 405 gated-a.g.c. circuit (see Part 4, October 1971). The valve line oscillator circuit may most easily be built on the same metal chassis as the line output stage but outside the cage: see Fig. 4. A few short lengths of paxolin tagstrip near the valvebases will enable all the necessary connections to be made. Relays RLY601, RLY602 and RLY603 can be screwed to the underside of the chassis with the threaded fixing holes provided.

When switching on for the first time it is advisable to set R638 to maximum resistance. If all appears to be working and there are no ominous sizzling noises to be heard it is safe to reduce the resistance until the correct picture width is obtained. Two preset taps on the resistor are used to set the width on 405 and on 625 lines. If the correct synchronising point occurs to one side of the raster so that the picture is displaced sideways it is possible to alter the flywheel phasing by changing the value of C605 or C618 as appropriate.

Modifications

Width stabilisation may be fitted if desired by using the circuit shown in Fig. 9. In this case R638 is left out of circuit and pin 9 of V604 is connected directly to the h.t. line. The value of the width control in Fig. 9 is not critical and may be between 500kΩ and 1MΩ. It is advisable to use a metal-enclosed potentiometer for this application; skeleton presets are liable to accumulate dust thus giving rise to the possibility of arcing. The e.h.t. regulation and heat output of the timebase can be considerably improved by the use of silicon diodes in place of V604 and V605 as shown in Fig. 8. Unfortunately, these diodes are rather expensive compared to the price of a valve.

Component Availability

The line output circuit is similar to that used in the Thorn 850 chassis and the transformer and scan coils are obtainable from D. & B. Television (Wimbledon) Ltd., 80 Merton High Street, London SW19 or Manor Supplies, 172 West End Lane, London NW6.

C254 (3·9pF SM) in the 625-line i.f. strip has proved difficult to obtain. The exact value is not unduly critical. A 4pF ceramic (Home Radio) may be used or two 1·8pF SM capacitors in parallel.

TO BE CONTINUED

CAMERA DEVELOPMENTS

Fernseh have now demonstrated in the UK a prototype of their new three-tube colour camera—Type KCP40—which has been designed mainly for use as a compact OB camera. With dimensions (without lens) of 405 × 208 × 270mm. and weighing approximately 20lb. it is no larger than many monochrome cameras in current use. Less lens and Plumbicon tubes a price of £10,000 is quoted. Anti-comet tail tubes can be used without modification to the camera and auto-centring and vertical aperture correction can be provided as optional extras.

Electrocraft instruments have developed a single-tube (vidicon) colour camera for industrial, educational and it is claimed broadcast use at under £2,000. The tube is fitted with a fibre-optic faceplate on the surface of which are video encoding colour stripes. The output consists of a broadband luminance signal and narrowband red and blue signals. There is a 5in. viewfinder and the total size is 5 × 10 × 12in.

Two low light level cameras—types 4250 and 4350—fitted with silicon vidicon camera tubes have been introduced by Litton precision products. They will produce a usable picture with only 0·003 foot-candles (less than the light of a quarter moon) illumination on the tube and are intended for CCTV applications such as day and night security and safety surveillance.

CORRECTION : PANORAMIC MONITOR

In Fig. 3 page 9 last month the i.f. amplifier output should have been shown connected to the oscilloscope Y input: we apologise for this error.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

WITH the approach of autumn, Sporadic E signals tend to fall to a rather low level. This year is no exception. Apart from some activity towards the middle of September Sp. E this month has been minimal. The tropospherics have fortunately come to the rescue for many of us, thanks to the prolonged fine spell of weather over much of the month, although personally my record for the month isn't too good—living in a valley does not assist matters! A number of enthusiasts have written telling of their reception and generally conditions seem to have been fairly good. Tropospherics have opened up sufficiently to allow u.h.f. reception of Sweden, West Germany and the Low Countries. We even have a report of the DFF East German transmitter at Brocken ch. E6 being received at Mayfield, Sussex, by Hugh Cocks (September 3rd at 0850 BST). My own log for the period is as follows:

1/9/71	BRT (Belgium) E2; NOS (Holland) E4—both trops.
2-4/9/71	BRT E2; plus various ORTF (France) trops.
5/9/71	RAI (Italy) IA, IB (Sp. E); BRT E2; RTE (Eire) B7, H; Channel Islands B9; plus various ORTF-trops.
7/9/71	CT (Czechoslovakia) R1 (Meteor Shower—MS).
8/9/71	CT R1; DFF (East Germany) E4—both via MS.
9/9/71	CT R1.
10/9/71	BRT E2.
11/9/71	USSR R1, R2; TVP (Poland) R1; CT R1. Sp. E opening. Also BRT E2 trops.
12/9/71	DFF E3; BRT E2; plus unidentified Sp. E signals ch. E2 at 1924 BST.
14/9/71	NOS E4; BRT E2.
16/9/71	CT R1 (MS); BRT E2.
17/9/71	BRT E2.
18/9/71	CT R1 (MS); TVE (Spain) E2 (Sp. E); plus ORTF trops.
19/9/71	BRT E2; plus unidentified line sawtooth ch. E2 at 1655 BST.
20-24/9/71	BRT E2.
25/9/71	CT R1 (Sp. E). There were many very strong MS bursts of signal this day.
27-28/9/71	BRT E2.
29/9/71	CT R1 (MS); BRT E2; plus ORTF, UK trops.

Although there have been signals of sorts noted most days via MS (the mechanism of MS was discussed last month) I generally do not log such bursts unless they are particularly strong and prolonged or alternatively repeated several times within a short space of time.

In the August column we speculated as to who would be the first to receive Soviet colour signals. Now we have the answer! A letter has arrived from David Griffin of Norwich in which he details the exciting news. During an Sp. E opening on August 25th—a Sunday—he noted a colour programme at 1100 BST on ch. R1. The receiver David was using was apparently a Philips colour multi-standard model modified for SECAM. Our congratulations to David on this magnificent achievement.

Some time ago we had news of u.h.f. DX-TV in the USA when apparently distances of over 1,000 miles were obtained. Now an even greater distance has been received! Although we do not have exact information yet we gather that veteran TV-DXer Robert Cooper of Oklahoma City has received a Boston, Massachusets station operating on ch. A38. The distance is in the region of 1,500 miles. When more information has arrived we will report in more detail.

We often receive queries about identifying various news captions. To assist readers we hope to include over the next few months the main news captions from various East European countries since these seem to give the most trouble in establishing the country of origin. This month we illustrate the Czechoslovakian caption.

The British Astronomical Association has kindly supplied us with the dates for the 1972 meteor showers—at least those that are likely to provide us with signal reception.

	Overall dates	*Maximum activity*
Quadrantids	Jan. 1st-5th	Jan. 4th at 1000
Lyrids	April 19th-24th	April 21st at 1800
May Aquarids	May 1st-8th	May 4th-5th
Delta Aquarids	July 15th-Aug. 15th	July 28th
Perseids	July 25th-Aug. 18th	Aug. 12th at 0600
Orionids	Oct. 16th-27th	Oct. 21st
Taurids	Oct. 10th-Dec. 3rd	Nov. 1st
Leonids	Nov. 15th-19th	Nov. 17th at 0700
Geminids	Dec. 7th-15th	Dec. 14th at 0500
Ursids	Dec. 17th-24th	Dec. 22nd

News Items

Denmark: We understand that the Danish TV authorities have decided to include an identification on their electronic test card. In the top rectangle will be carried "Danmarks Radio" and in the lower rectangle at the bottom of the central circle will be carried the transmitting site location. This should ease our problems on ch. E4. Test transmissions and times of same are as follows:

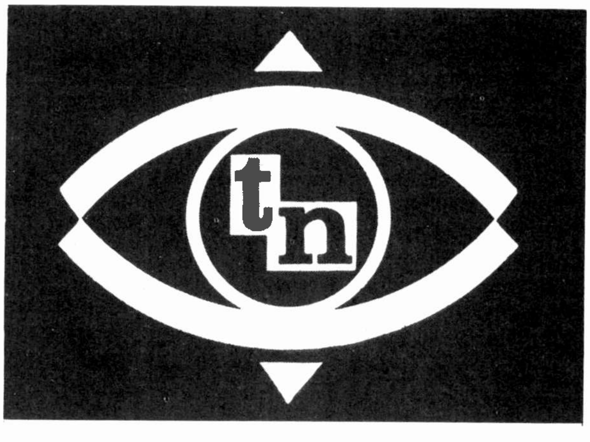
Daily 0900-1000 electronic test patterns.

Daily 1000-1100 colour test card (type PM5544).

1100-1730 local test card (i.e. carries transmitter identification) on Mon., Tues., Thurs., Fri.; on Weds. 1100-1600; Sat. 1100-1400.

After these times the colour test card returns until the start of programmes. Programmes usually start around 1900, consequently we can expect the colour test card to be in use between 1730-1900 each day.

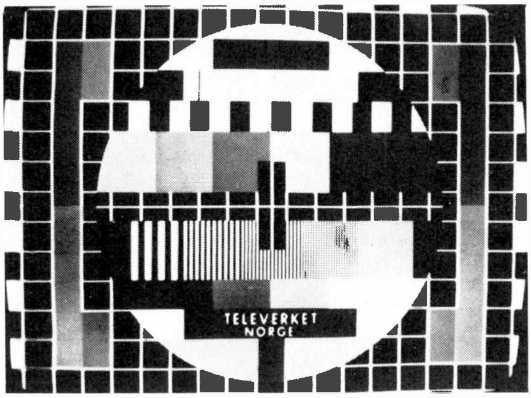
Nigeria: Marconis at Chelmsford have advised us that Ibadan will be increasing power to 60kW e.r.p. We understand that this is the NBC outlet on ch. E2 as the Ibadan



Main Czechoslovakian news caption—Televisni Noviny. Photo courtesy OIRT Prague.

DATA PANEL 5—2nd series: NORWAY

NRK—NORSK RIKSKRINGKASTING



Electronic Test Card—Colour

Identification slide showing the Oslo transmitting mast

NRK Clock

Test card G (see Data Panel No. 2) is also radiated with an appropriate identification. NRK advise that except for Tuesday and Sunday the colour test card is radiated from 0930-1735 CET with the PTT identification "Televerket". The procedure is that during the 20 minutes before the start of programmes the PTT accept signals from NRK Television in the following routine:

20-10 mins.	Colour test card as above but with the NRK identification.
10-5 mins.	Black-and-white test card G or SWF/YLE type with NRK identification.
5-4 mins.	Clock as above.
4-2 mins.	List of evening's programmes.
2-0.30 min.	Clock.
0.30-0.00 min.	Identification slide of Oslo transmitter as left.

Our thanks to NRK for their assistance.

outlet of WNTV on ch. E4 is already 60kW e.r.p. This is extremely welcome news and certainly the ch. E2 transmitter could be a possible here in the UK via multiple hop Sp. E—Nigerian TV has been received once before in the UK on ch. E2, from the now defunct Enugu transmitter.

West Germany: Radio Bremen and Bayerischer Rundfunk are now using the electronic test card similar to SWF (West Germany)/YLE (Finland), see photo in the June 1971 DX-TV column. The card carries the identification "Radio Bremen" or "BR Munchen" respectively.

From Our Correspondents

Clive Morton has sent in a most interesting letter (see also Letters, October TELEVISION, page 548) with information on reception in the Leeds area this summer. Unfortunately chs. E2/R1 are rendered almost unusable due to strong local signals from Holme Moss ch. B2. Clive has been to Tunisia recently and was impressed with the confusion of aerials to be seen there. Band III aerials of 16 elements are commonly used together with stacked u.h.f. arrays. The X type director (as used in the J Beam Multibeam series) is commonly seen but single arrays have anything up to 18 elements! The nearest u.h.f. transmitters would be in Sicily some 160 miles distant—the RAI 2nd service. Various five-element Band I arrays suitably orientated also indicate that Mt. Cammarate ch. IA is used by Tunisian residents for entertainment purposes.

Derby DX enthusiasts Garry Smith and Keith Hamer have both sent in detailed letters and as usual have passed on an interesting point. The ORF (Austria)/NRK (Norway) electronic test card type PM5544 presents problems with identification—at least in confirming reception of one country or the other—when NRK omit their identification (as they sometimes do!). A close look at the lower black rectangle within the centre circle—where any identification would usually appear—will however reveal a thin white vertical line (a reflection check) to the left-hand side of the rectangle when the card is transmitted by ORF. Unfortunately we do not know the exact version transmitted by Denmark but at least this information may go some way in clearing a few problems.

Letters from overseas readers are always most welcome and we were delighted to receive an air letter from Peter Neal of Entebbe, Uganda, in which he describes reception in his part of the world, virtually on the Equator at 32°30′ east and with a local height of 3,800ft. Peter is rather fortunate in that Uganda Television transmits in Band III leaving Band I completely clear. Using a six-element ch. E2 aerial and two transistor amplifiers he has had reception from various transmitters in Africa by a variety of propagation modes. The Kenya TV Service is received virtually daily on ch. E2 from the 10,000ft. high transmitter at Timboroa at some 210 miles, 100 miles of this being across Lake Victoria. Further distant, also on ch. E2, Rhodesian Television (see July 1971 DX column) from Gwelo is received by we assume Sp. E at 1,000 miles. Usually the signals are present between 1600-2000 local time. Possibly the sunset effects on the E layer produc some form of Equatorial Sp. E not unlike Trans-Equatorial Skip that can give reception over considerably greater distances. The latter propagation mode has also given Peter a number of signals to the west. English speaking and with the vision signal suffering with multiple images—a characteristic of this type of propagation. The signals probably originate in Nigeria and Ghana.

Sun Spots

Predictions—courtesy of the Swiss Federal Observatory, Zurich: September 57, October 55, November 53, December 51, January 1972 49, February 47.

DX-TV Publications

We regularly receive queries asking for information on any DX-TV publication. Apart from our own basic guide we know of none that deal exclusively with this subject. However two publications have recently come to our attention which certainly have a bearing on our interests.

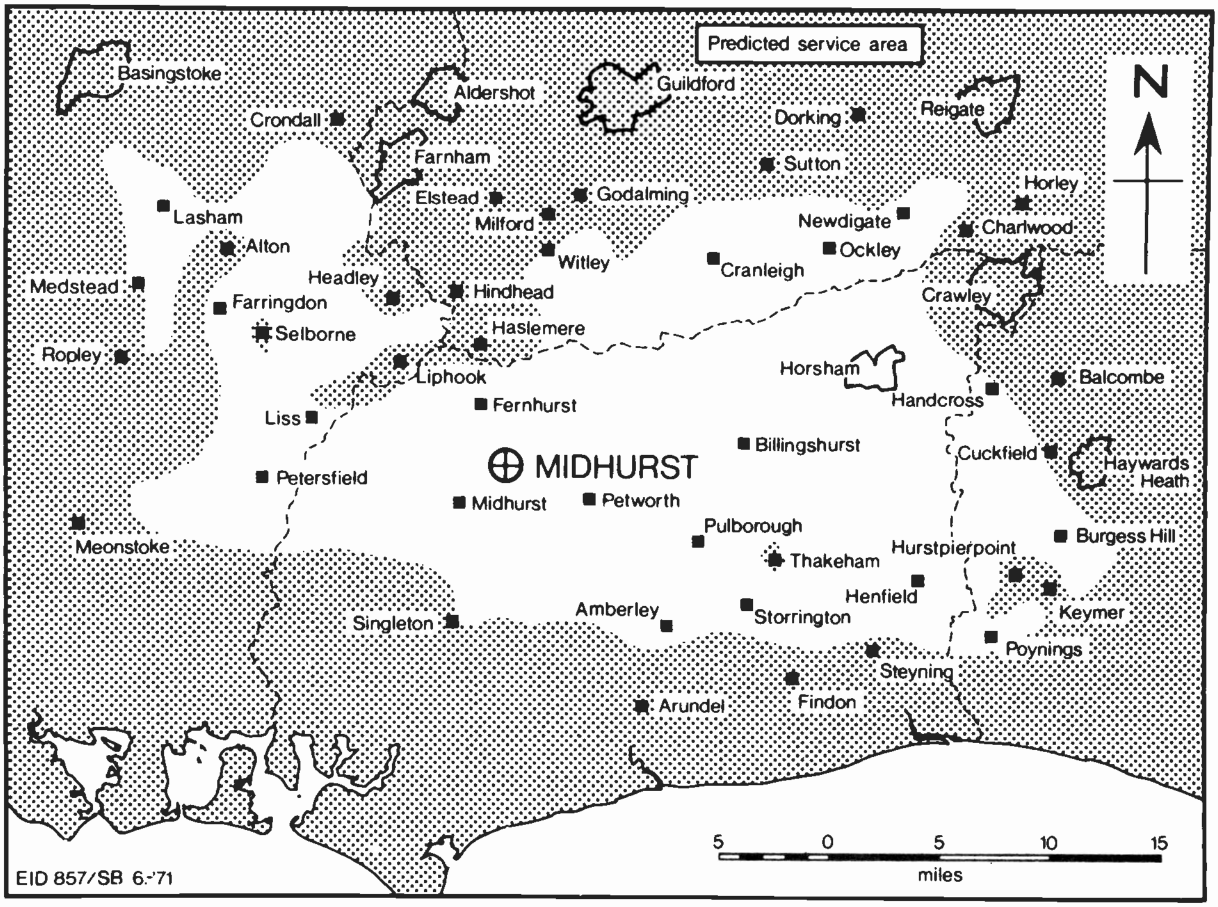
BBC Publications, 35 Marylebone High Street, London W1 have an Engineering Division Monograph, no. 61 March 1966, "Sporadic E ionization and television interference" by W. J. G. Beynon. This contains detailed analysis and theory relating to Sp. E and we can recommend it to the serious enthusiast of this hobby.

Benelux DX-Club, PO Box 2027, Den Bosch 4004, Nederland has a transmitter list detailing TV and f.m. transmitters likely to be received in that area via all propagation modes. There are 72 pages, 45-72 devoted to TV. The introduction to each section is in Dutch and the cost of the publication—"TV-FM Zenders van Europa"—is B£ 0.45 or 8 IRC. The poundage on an International Money Order does unfortunately tend to make it expensive.

New Transmitters

France: Bergerac ch. 34 hor. 250kW (south of France); Argenton-Sur-Creuse ch. 40 hor. 100kW (central France—near Limoges); Wissembourg ch. 48 hor. 50kW (north-east France—near Strasbourg).
Norway: Stord ch. E5 hor.—increase of e.r.p. to 30kW. This is located on an island south of Bergen and could be a possible to northern enthusiasts.
Sweden: Sveg ch. 21 hor. 1,000kW (located approximately 80 miles south-west of Sundsvall in a mountainous area—a "possible" in excellent conditions to East Coast enthusiasts); Oestersund ch. E4—we understand that a higher mast is in use, now over 800 feet—every little bit helps!
Holland: Smilde ch. E6, Markelo ch. E7, Goes ch. 29, Goes ch. 32, Markelo ch. 54 have all reduced the sound channel e.r.p. to 10% of that of the vision transmitter.
Greece: Two of the Band III transmitters have increased e.r.p. considerably, an encouraging sign and we hope soon to be followed with some Band I activity!

Finally I sincerely wish you a Happy Christmas and a successful 1972.



The expected service area of the **Midhurst** *u.h.f. transmitter is indicated by the unshaded area of the above map. Channels: BBC-1 61; BBC-2 55; ITV 58; fourth 68. Effective vision e.r.p. 100kW. Polarisation horizontal. Receiving aerial group D. Map courtesy BBC Engineering Information Service.*

ICs for TELEVISION

PART 4 **K. T. WILSON**

MOTOROLA TV ICs—I

SEVERAL Motorola i.c.s are now being used in UK produced TV sets. The Decca MS2000/MS2400 series uses an MC1351P intercarrier sound limiter/amplifier /detector/audio preamplifier; the recently announced Decca 12in. mains/battery portable Model MS1210 uses an MC1352P vision i.f. amplifier/gated a.g.c. amplifier; this 12in. Decca model and the Ferguson 17in. colour set (BRC 8000 chassis) use an MC1330P video synchronous detector/preamplifier; and both the BRC 8000 and the Decca 17in. colour model use an MC1327 chrominance signal synchronous demodulator/RGB matrix/PAL switch i.c. in the decoder.

MC1352P IF/AGC IC

This i.c. is of particular interest in being the only one in use in a UK produced set in the pre-video detector stages. It is a vision i.f. amplifier incorporating a gated a.g.c. system to control its own gain and also to provide a delayed a.g.c. feed for the r.f. section of the receiver. In the Decca Model MS1210 it provides most of the i.f. gain between the tuner unit and the vision detector. The power gain at 45MHz is quoted as 53dB (typical) and an output change of 0·3dB is quoted for a 60dB change in i.f. input. The i.c. is encapsulated in a 14-pin flat pack and requires a 12V supply.

The internal circuit and basic external circuitry are shown in Fig. 1. The i.f. response must be shaped by filters connected between the tuner and the input (pin 1) of the i.c. The input is applied to Q5 and Q6 which operate with constant emitter currents so that the input impedance remains independent of the a.g.c. action. The input signals may be applied single-ended (as shown) or differentially (a.c.). The input terminals 1 and 2 may be driven by a transformer but a d.c. path from either terminal to earth is not permitted.

The input transistors drive the emitters of Q1, Q2 and Q3, Q4 respectively. The i.f. a.g.c. potential is applied to the bases of Q2 and Q3 whilst the differential output developed at the collectors of Q1 and Q4 is used to drive the bases of Q13 and Q16 in the compound differential output stage. A.G.C. action occurs as a result of an increasing voltage on the bases of Q2 and Q3 making these transistors conduct more heavily thereby shunting signal current from the interstage amplifiers Q1 and Q4. The output from Q14 and Q15 is generated across an external transformer with centre-tapped primary winding. The 12V supply at pin 11 may be used here but the output admittance remains more nearly constant if a separate 15V supply is used as the base voltage of the output amplifier varies with the a.g.c. bias. For this case *R*s is chosen to allow 30mA of current flow.

The high-gain a.g.c. section requires a gating pulse (which as shown can be obtained from a winding on the line output transformer), a d.c. reference level and a composite video signal which may have positive- or negative-going video. The necessary signal levels and connections are shown in Fig. 2. The basic difference is that the video signal is fed to pin 10 and the d.c. reference level to pin 6 when the composite video signal has positive-going sync pulses while the input connections are reversed for negative-going sync pulses. If the available video signal has negative-going sync pulses it should sit on a 2V bias (Fig. 2) and have a p-p amplitude of 3·5V; the reference voltage fed to pin 10 should be set by a decoupled potentiometer capable of supplying 1-4V—the nominal setting of this preset is 2V. If the video signal has positive-going sync pulses it should be of 4·5V p-p d.c. restored to earth potential; the reference voltage for pin 6 should then be between 1V and 8V, nominally 4·5V. In both cases the gating pulse should have a peak amplitude of 8V: with negative syncs it is fed direct to pin 5 while with positive syncs it is applied via a resistor of 3·9kΩ.

The action of the a.g.c. gate is such that the correct voltage *V*c is maintained across the external storage capacitor connected to pin 9 for a particular video level and d.c. reference setting. Voltage *V*c is the result of the charge delivered through D1 and the charge drained by Q21. The charge delivered to the capacitor occurs during the time of the gating pulse and its magnitude is determined by the amplitude of the video signal relative to the d.c. reference level. Voltage *V*c is amplified by Q21/Q22 and taken via the filtering resistor R1 (with externally connected—pin 14—filter capacitor C1) to the variable-gain stage in the i.f. amplifier section and to the r.f. a.g.c. amplifier section. Here it is compared in the differential amplifier Q24/Q25 to a fixed r.f. a.g.c. delay reference voltage connected to pin 13. The following stages Q27-Q29 amplify the output signal from Q24 and shift the d.c. levels causing the r.f. a.g.c. voltage to vary from zero to 7V for a very small change in i.f. a.g.c. voltage. C3 connected to pin 12 acts as storage /filter capacitor for the r.f. a.g.c. system.

The values of C1, C2 and C3 depend on the set designer's aim in terms of a.g.c. stability versus the speed of the a.g.c. action. Typical values are C1 0·1μF, C2 2μF and C3 10μF. To establish the maximum r.f. transistor gain with forward a.g.c. *R*pb is connected from the positive supply at pin 11 to pin 12 to form a pre-bias voltage divider with the 6·8kΩ resistor to chassis; the value of *R*pb is set to give maximum gain when the output emitter-follower in the i.c. is cut off. To set a fixed i.f. a.g.c. operating point (for example during receiver alignment) connect a 22kΩ resistor from pin 9 to pin 11 to give minimum gain and then bias pin 14 to give the correct operating point using a 200kΩ variable resistor to chassis.

The 12V supply must have a low impedance to

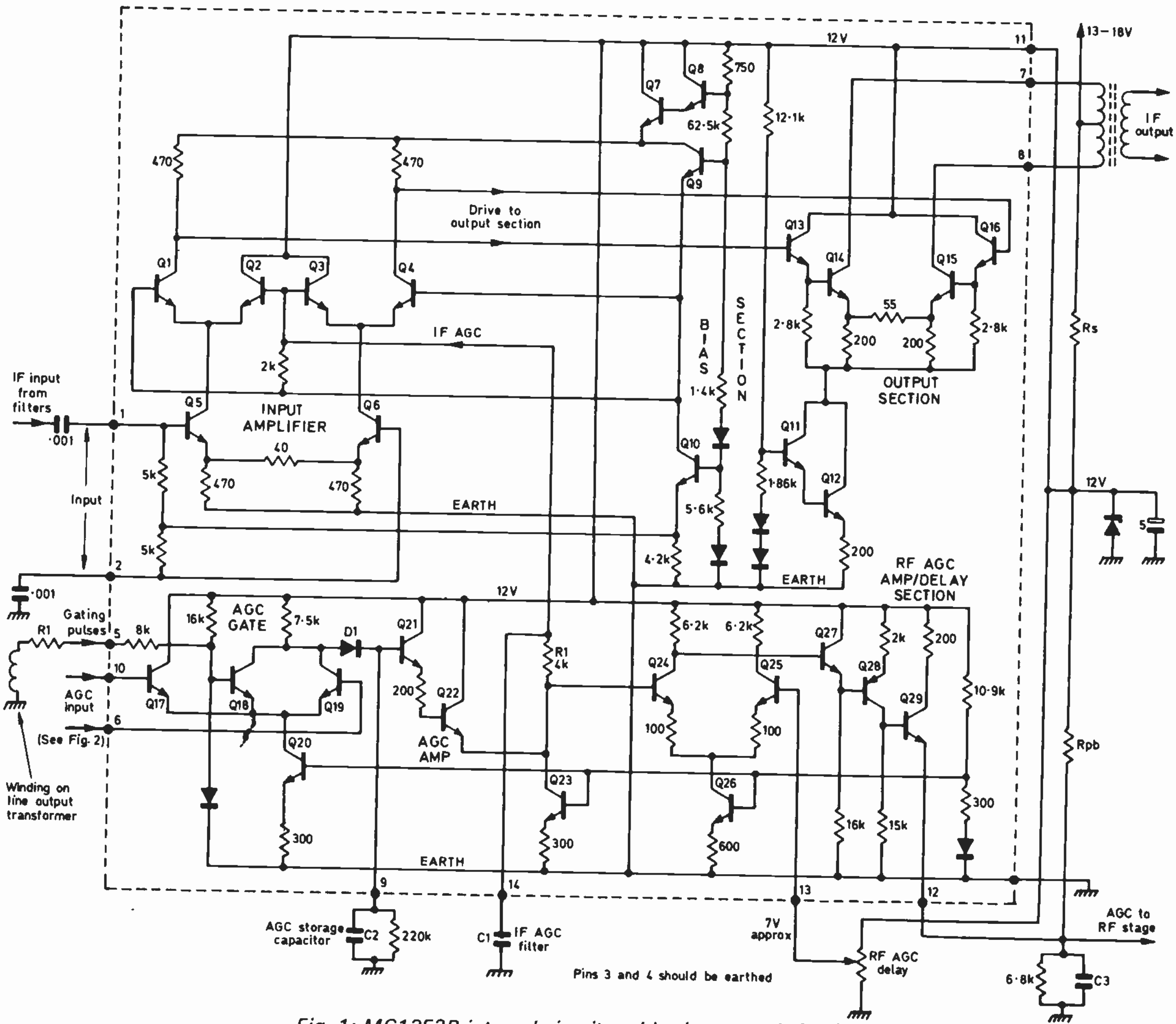


Fig. 1: MC1352P internal circuit and basic external circuitry.

prevent l.f. instability in the r.f. a.g.c. loop. This can as shown in Fig. 1 be achieved by using a 12V zener and large-value (5μF) decoupling capacitor.

Although the device will normally be operating with a very high power gain the pin configuration has been carefully chosen so that shielding between the input and output terminals will not normally be necessary even when a standard socket is used.

Video polarity	Pin 6	Pin 10	Pin 5 (R1,Ω)
Sync negative-going	5·5V, 2V, 0	Adjustable d.c. 1–4V Nominal 2V	0
Sync positive-going	Adjustable d.c. 1–8V Nominal 4·5V	4·5V, 0	3·9k

Fig. 2: Alternative MC1352P a.g.c. inputs.

MC1351P Intercarrier Sound Channel

This i.c. is representative of the i.c.s now being widely used in the intercarrier sound sections of TV sets. It contains three stages of i.f. amplification and limiting, a quadrature f.m. detector and an audio preamplifier designed to drive a single external class A transistor audio output stage. A 3V maximum r.m.s. output voltage swing is provided with a typical i.f. voltage gain of 65dB. There is built-in zener power supply regulation. It is encapsulated in a 14-pin flat pack.

The internal circuit is shown in Fig. 3 while Fig. 4 shows the external circuits used with this i.c. in the Decca MS2000/MS2400 series. The 6MHz input is to pin 4. In the Decca chassis the 6MHz signal is taken from a small coil coupled to a 6MHz rejector circuit in the cathode lead of the video amplifier (PFL200) and is fed via a 6MHz crystal filter to pin 4. After three stages of amplification/limiting in the i.c. the integrated emitter-follower Q9 provides two outputs, one to Q16 in the quadrature detector circuit and the other, taken from pin 8, to drive the external tuned circuit which provides the quadrature signal required by the detector. The quadrature signal from the external circuit is fed in at pin 13 to an integrated emitter-follower Q11 which drives Q12 and Q15 in the detector circuit.

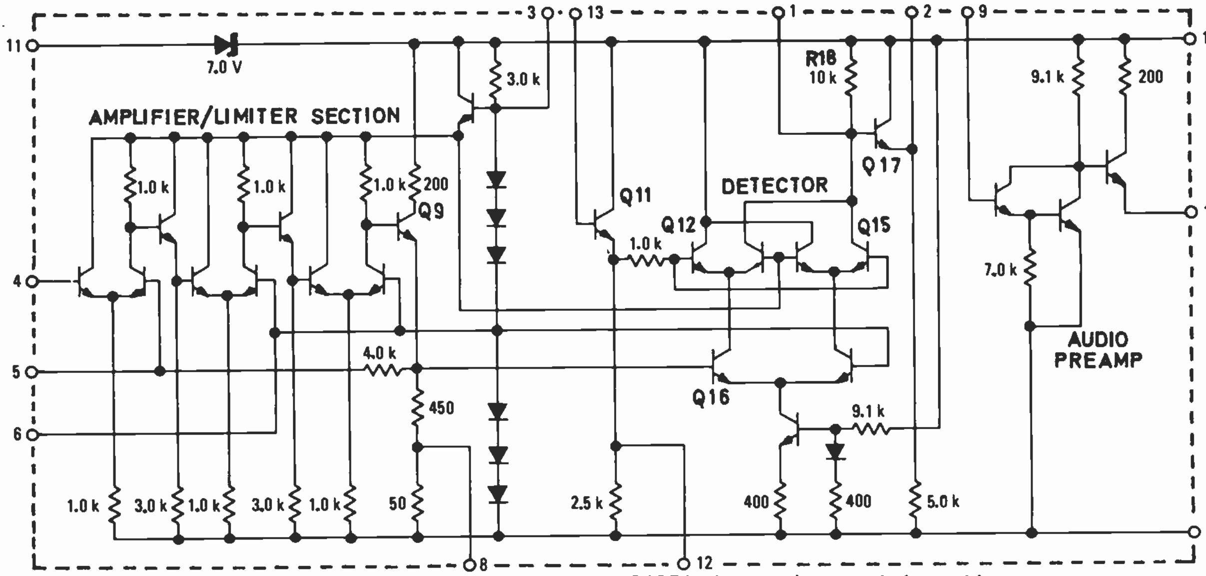


Fig. 3: Internal circuit of the Motorola MC1351P intercarrier sound channel i.c.

The detector load is R18 and its output is developed across an external integrating/de-emphasis capacitor connected to pin 1. The detector output is fed via another integrated emitter-follower Q17 to pin 2 where it is a.c. coupled to the volume control. The audio signal tapped from the volume control re-enters the i.c. at pin 9 and after audio preamplification is taken from pin 10 to the external output transistor.

The Decca circuit (Fig. 4) shows the output driving

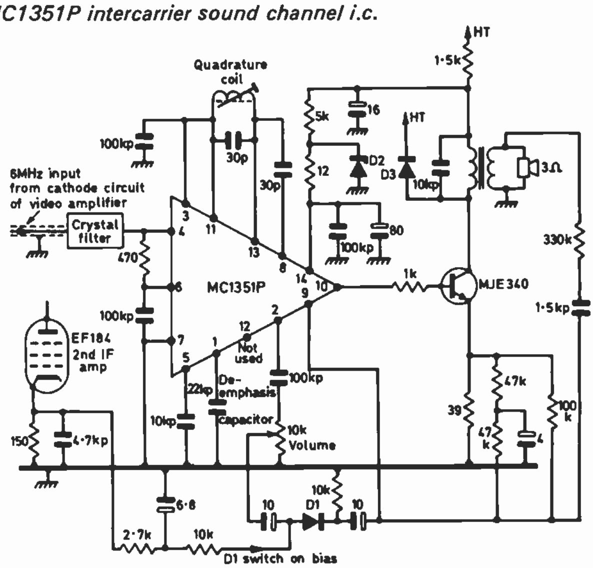
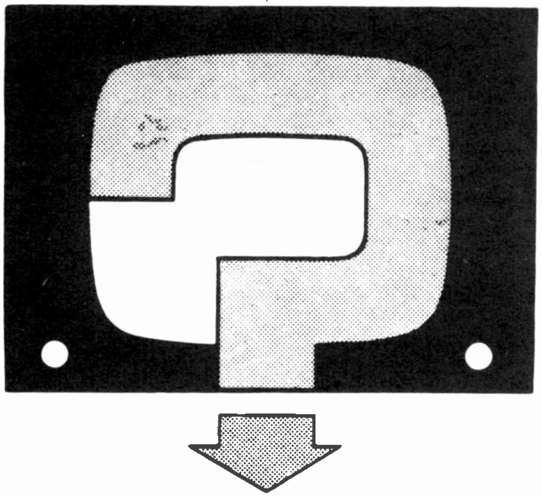


Fig. 4: Use of the MC1351P in a recent Decca chassis.

a single class A Motorola transistor type MJE340. Diode D3 is used to protect the collector-base junction of the transistor: it is normally held non-conducting but conducts if the transistor's collector voltage reaches that of the h.t. rail to which it then clamps the collector. The audio signal tapped from the slider of the volume control is a.c. coupled to a diode D1 and then a.c. coupled to pin 9 along with negative feedback from the secondary of the audio output transformer and a bias potential from the emitter of the output transistor. Diode D1 is switched on by a bias potential derived from the cathode circuit of the second vision i.f. amplifier valve. Prior to this valve warming up there is no bias on D1 and consequently the signal path between pins 2 and 9 of the i.c. is open-circuit. This prevents hiss and noise reaching the audio output section during the warm-up period of the set.

TO BE CONTINUED



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BUSH CTV25

There is quite severe streaking on this set—smears to the right of everything. Previously the fault could be cleared by switching from one system to the other and the set would remain all right for some time; no action will now clear the trouble however. The video valve has been changed without success.—T. Farrer (Govan).

The interconnecting plugs between the i.f. panel and the luminance panel on these receivers suffer from improper contact. It is a simple matter to check each connection and clean any that are suspect. If this is not the trouble it will be necessary to check through from the vision detector to the luminance output valve for dry-joints and other faulty connections.

REGENTONE TEN-7

Considering the age of this set it is giving a good picture but the trouble is it keeps tumbling and the flyback lines appear. The field can be locked by adjusting the field hold control but after a few seconds the fault reappears.—J. Doyle (Accrington).

First check the video amplifier cathode decoupling capacitor. This is C35, 500μF. If this is OK check the upper resistor of the potential divider which feeds the screen grid of the sync separator. This is R37, 100kΩ.

SOBELL ST284

There's lack of brightness. With the aerial unplugged and the brightness control turned fully up the raster is only just visible. Also on switching off there is a very bright spot which remains for a long time and is starting to burn a spot on the screen.—S. Gavin (Truro).

If the brightness circuit is working correctly there should be no spot lingering after switch-off. The earthy side of the brightness control is returned via a 47kΩ resistor (R105) to the neutral mains side of the on-off switch. Check this circuit and make sure that the switch is operating correctly. Also check the 390kΩ (R104) resistor on the hot side of the brightness control to ensure that adequate h.t. is being supplied to obtain sufficient brightness. If necessary check all components connected to the tube grid (pins 2, 6).

PHILIPS G19T210A

There is occasional field bounce on this set. The fault will continue for several minutes and then clears only to occur again after an hour or two.—J. Doyle (Southend).

The fault is most likely to be due to a slightly faulty valve in the field timebase. This is probably the PCL85 but the EF80 could be the culprit. Check these and the electrolytic C1012 which smooths the h.t. feed to the timebases.

BUSH TV141

The sync diodes are in a single block and I am having difficulty obtaining a replacement: is it possible to use three individual diodes? There is also hum on all channels which can sometimes be removed by operating the system switch.—A. Delaware (Tring).

If you cannot obtain the CSD11-7YDG it is quite in order to use three separate diodes. OA81 or similar diodes or the Radiospares silicon type 1SJ50 are suitable. The hum trouble depends on the nature of the hum. If it is present equally at all times check the smoothing components, the system switch and the valves for heater-cathode leakage. If the hum varies with picture content check the setting of the a.g.c. delay control and the smoothing components on the a.g.c. line.

PHILIPS 520

This set has only recently been bought and has been set up to give a reasonable picture. There is however some pincushion distortion on verticals which we have not been able to cure and we would appreciate any advice.—H. Propper (Loughborough).

Most colour receivers have a slight bow in the verticals caused by the shadowmask behind the screen of the tube. This however should not be annoying in any way when picture content is being viewed. The raster correction coil L4482 which adjusts the amplitude of the line frequency modulation fed to the field coils may help to correct the problem. It is situated behind the field hold control. Alternatively the raster correction transductor L4485 may be faulty: we have known this component cause a similar fault on another model.

BUSH CTV167

There are a lot of shadow-bars about 1in. in width on the picture. Have you any idea what the cause could be?—R. Elways (Liverpool).

If the bars on the picture are on the left-hand side the fault almost certainly lies in the line linearity circuit. We suggest you check the damping resistor across the line linearity coil—3R25, 1·5kΩ. If this does not clear the problem check the coil itself, 3L15.

PYE V310S

The picture and sound are good but the field hold is difficult to lock. The ECC82 field multivibrator has been replaced and also several resistors and capacitors associated with it, also the video valve PCL84 and sync separator PCF80, but with no cure.—P. Ridge (Newbury).

The prime suspect here is the interlace diode M3, circuit reference V15. It would also be worthwhile checking the associated chassis-connected capacitors C61 220pF and C62 1000pF.

EKCO T418

All is OK on 405 lines, with good picture and sound. On 625 lines however although the picture is OK the sound output is very low. The audio and tuner valves have been checked and found to be all right, and all voltage readings are as quoted in the manual. —R. Beattie (Feltham).

On this Pye/Ekco chassis all that is usually necessary to restore the 625-line sound is to adjust L28, the 6MHz coil just below the EH90 sound detector valve.

SOBELL 1000

There are two faults on this set. First the verticals are bent. Secondly there is a bright ragged vertical line on the left-hand side of the screen.—G. Royle (Barmouth).

The bright ragged vertical line down the left-hand side of the screen is probably due to corona discharge in the line timebase. Check the e.h.t. rectifier and its holder and the line output and efficiency diode valves. Check the connection to the c.r.t. final anode, being careful to discharge to earth first. If however you can move the line across the screen with the line hold control we suggest you check the line oscillator valve (PCF802) and its control grid components. If the bent verticals are bowed from top to bottom adjust the small magnets on each side of the scan coils around the neck of the tube. If the bent verticals are cogged at regular intervals you should check the video amplifier cathode components and possibly also the screen resistor.

PYE V200

When switched on the sound comes on normally but there is no raster. As soon as the EY86 e.h.t. rectifier lights up the PL81 line output valve starts to short. A new PL81 has been tried but with the same effect. There is 220V on the EY86 anode cap. Could the line output transformer be at fault?—L. Parker (Gt. Yarmouth).

Your symptoms suggest to us either that the EY86 is short-circuit or that there is a breakdown of the e.h.t. rectifier valveholder insulation.

PHILIPS 3170

The field scan fails to fill the screen—there is a black band about 2in. at the top and 3in. at the bottom of the picture. The field timebase valve has been replaced with slight improvement at the top only. After a while there is a sudden increase in the top of the picture.—R. McGuire (Aldermaston).

Try changing the 1·2MΩ (may be 1·5MΩ) resistor R446 in series with the height control to pin 1 of the PCL85. Then check the cathode components R443, R444 and C425. If the fault is still present the height control should be checked for faulty contact.

BUSH TV135RU

We are plagued by intermittent false line lock on one of these models. On switching on from cold the lines are completely unstable but can be locked with the line hold control except that this leaves a small black edge to the left of the screen: after ten minutes or so the black edge widens to an inch and a half, the top half inch begins to bend to the right and the picture breaks up again but is once more lockable with the hold control after which the whole process repeats. Correct locking can eventually be obtained but the black margin remains. The video and timebase valves have been replaced, the flywheel diodes replaced with a matched pair and the hold control circuit checked and found to be OK.—J. Rushly (Barnet).

The problem should be resolved by replacing the resistors 3R1 and 3R2 (both 120kΩ) in the antiphase reference signal feeds from the line output transformer to the flywheel sync discriminator circuit. These affect the phasing of the circuit.

PETO SCOTT 742

On switching on the bottom rolls down slowly, with foldover at the bottom of the screen. The top half of the picture expands slowly and when it reaches the top it rolls down. The picture then continues moving up and down. The field hold control does not alter the effect. The PCL85 has been replaced without improving matters.—G. Abbotson (Norwich).

The effect you describe is caused by severe hum in the field timebase. This may be entering via the h.t. line as a result of inefficient smoothing (check the smoothing electrolytics) or from the heater line. It is possible that one of the heater leads to pins 4 or 5 is punctured at some point or that a piece of wire or solder is shorting a heater tag to a sensitive (e.g. grid) part of the circuit.

MARCONIPHONE VT155

There is a ½in. gap at either side of the screen in spite of all the controls being at maximum. The line timebase valves have all been changed without improving matters. Also a very bright spot appears at the centre of the screen when the set is switched off—even with the brightness turned right down and left like that for several minutes before switching off.—E. Gordon (Fife).

The lack of width appears to be due to low h.t. and we suggest you check the h.t. rectifier—PY32, replace if necessary with a PY33. To remove the spot wire a 4μF or thereabouts capacitor from the slider of the brilliance control to chassis—do not turn the control down when switching off.

DER 5706

The picture on this colour set is shaking or shimmering all the time although the sound is in order. This seems to be a rather unusual condition: have you any idea as to its possible cause?—R. Belman (Andover).

If the size and focus of the picture tend to vary with the horizontal displacement we suggest you try fitting a new e.h.t. rectifier tray as it seems that one of the pencil rectifiers is decomposing.

STELLA ST1093A

BBC-2 can no longer be received: instead BBC-1 comes in on the BBC-2 channel. The resultant picture quality is not very good. The fault developed quite suddenly although for some time the BBC-2 picture had been difficult to lock and needed frequent adjustment.—L. Redman (Ashford).

We suggest you replace both valves in the u.h.f. tuner unit—the PC88 and PC86. Also replace the PL83 video amplifier valve which is very critical as far as 625-line reception is concerned.

REGENTONE 195

There is top foldover on this set. The PCL85 field timebase valve has been replaced, also the capacitor 511 in the linearity feedback loop, but the fault is still present.—R. Cotrell (Derby).

Check the resistor 522 and the top linearity control 574 which are in series with capacitor 511. If the trouble persists check the valve's bias resistor 509 (330Ω) and then the output transformer.

BUSH CTV184S

When the set is first switched on a ball of colour appears in the centre of the screen instead of the picture. If the set is switched off and on again about six times the picture appears. There is also bad vision-on-sound buzz.—G. Hardcastle (Northampton).

An overvoltage protection control is incorporated in this receiver and should be set correctly as follows: switch the receiver off and connect a 220kΩ resistor between the fuse 8F3 on the power supply board and the junction of neon 5N1 and resistors 5R11 and 5R12 on the timebase board. Switch on and adjust 5RV1 until the neon just strikes. Switch off and remove the 220kΩ resistor. Correct results should then be obtained on switching on. If you do not have a 220kΩ resistor handy turn 5RV1 very slightly anticlockwise: switch on and there should be a picture and the neon on the timebase panel should be out. You can adjust with the set switched on and see the neon cut out. It is, however, far better to use the first procedure. The vision-on-sound buzz is probably due to the pushbuttons being off tune.

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TELEVISION DECEMBER 1971

TEST CASE

108

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

? *A receiver with colour-difference drive came in with the complaint of incorrect colours. On test in the workshop it was found that perfect monochrome pictures were obtained by turning down the colour control and that by advancing the colour control the red portions of a picture were almost black while the blue portions carried a magenta tint. By advancing the brightness control under this condition it was found that the red gun was in fact responsible for some illumination, but below the value necessary for correct colouring.*

The receiver in question was equipped with a tint control (switching between cyan and magenta) but adjustment to this failed to alter the display significantly. Checking on the transmitted colour bars the yellow bar had a green tint, the cyan bar carried excessive white causing desaturation, the green bar was excessively dark green, the magenta bar veered toward blue, the red bar was almost black while the blue bar veered towards magenta.

After assimilating the conditions the service technician made one test with an oscilloscope and almost immediately located the fault area. What was this test and how was the technician able to make it so quickly? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 107

Page 43 (last month)

The symptom was, of course, that of field failure. By listening close to the receiver while operating the vertical hold control the field buzz can sometimes be heard from the field output transformer, the pitch changing as the control is adjusted. This gives a conclusive indication that the field generator is working. Moreover the technician was aware that an increase in field output transformer buzz occurs when the secondary is incorrectly loaded to the field scan coils.

His first move therefore was to check the connections from the scan coils to the output transformer and his hot soldering iron quickly cleared the dry-joint which existed in this circuit. This is another example of the ears aiding the servicing craft more than the multimeter or oscilloscope!

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