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Television

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VOL. 26
NO. 6
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APRIL
1976

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BACK NUMBERS

We regret that we are unable to supply back numbers of *Television*. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Television* can be published in the CQ Column of *Practical Wireless* by writing to the Editor, "Practical Wireless", Fleetway House, Farringdon Street, London EC4A 4AD.

QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

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Can you solve this servicing problem? Plus last month's solution.

SPECIAL SUPPLEMENT – TV TEST PATTERNS AND SIGNALS, PART 1
Features and use of the PM5544/Test Card G pattern and the vertical interval test signals.

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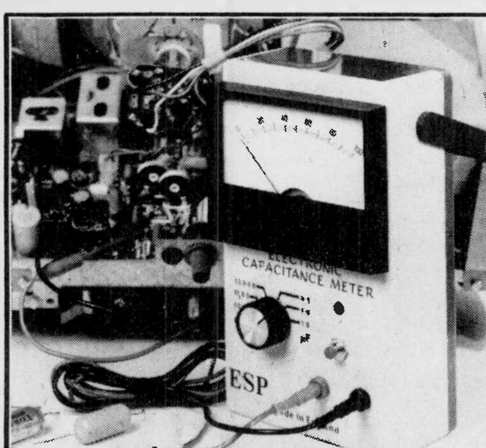

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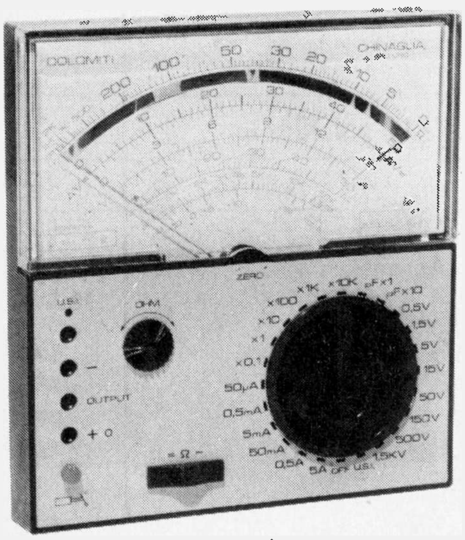

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THE COLOUR TUBE REVOLUTION

For many years there was only one thing you had to specify when ordering a replacement c.r.t., whether monochrome or colour – its size. Standardisation occurred a couple of decades ago, and whether you fitted the equivalent Mullard or Mazda tube, an imported one or a regunned c.r.t., you didn't have any problems. It was certainly a convenient arrangement, and kept everyone reasonably happy. Right now however the situation in the colour tube field is changing rapidly. We refer to the growing number of chassis fitted with in-line gun colour tubes, and the growing variety of these in-line gun c.r.t.s.

The original type of shadowmask tube, with its guns in delta formation, its phosphor dot screen and shadowmask with holes, was developed by RCA in the late forties and has served us well – it remains the basis of all subsequent practical developments. The first departure from the basic arrangement was the Sony Trinitron tube, which introduced in a practical, production tube the in-line gun, a vertical striped phosphor screen and a grille in the place of the traditional type of shadowmask. One advantage was the simplified setting up procedure. Sony seem to have regarded this c.r.t. as part of an integrated philosophy for TV chassis however, and have kept it and its associated circuitry to themselves. In more recent times RCA developed a similar approach – in-line gun, vertical striped phosphor screen and simplified adjustments, but in this case with a slotted shadowmask. Our June 1973 issue gave full details of the RCA "PI" tube. It's now being produced in several countries, and has already appeared in one UK chassis, the Thorn 9000. At much the same time various Japanese tubemakers, then the Philips group, decided to investigate the in-line gun/vertical striped screen/slotted mask approach. The result has been a rash of new colour c.r.t.s, such as the Philips/Mullard 20AX, Toshiba RIS and SSI, and Mitsubishi SSS – all of which are incompatible.

One of the main reasons for this incompatibility is the different approaches adopted to tube scanning. The PI tube uses a toroidal yoke, the 20AX a saddle-wound yoke, while the Japanese tubemakers seem to have adopted a half-way solution, the semi-toroidal yoke with saddle-wound line coils and a toroidal field coil. This means considerable differences in the timebase output circuits.

The Toshiba RIS tube made its first appearance in a UK made set with the advent of the Rank Z718 chassis earlier last year. Since then Toshiba have been further developing their SSI tube, and this has now arrived on the UK scene in the new Decca 80 series chassis. Continental setmakers are going the same way, Korting with the PI tube and Grundig with the SSI and 20AX tubes for example.

With their simplified convergence and pincushion distortion correction requirements, these tubes all need far less setting up than the conventional shadowmask tube (especially in its 110° form). So set production is quicker and cheaper, and servicing presents fewer problems. These benefits probably outweigh the problems produced by a multiplicity of non-compatible colour tubes. But a multiplicity of colour tubes also means a multiplicity of deflection yokes, output transformers and so on, meaning smaller overall production runs, and more items to stock. It seems a pity that we couldn't have had the benefit of a standard new type of tube. One or other of the newcomers will probably come to predominate eventually: for the moment however the advantages and disadvantages of each seem fairly evenly balanced, though development of them is by no means at the end of the road.

In fact a very great deal of development work has been put into these tubes in recent years and is continuing. When Mullard announced the 20AX in early 1974 they pointed out that UK setmakers would not be using the tube until 1977. This development schedule seems to be on time, running parallel with the programmes being carried on by RCA, Toshiba, NEC, Sylvania and so on.

It may be wondered why, with little to choose between the various tubes, one setmaker goes for one tube and the next for another. This raises the interesting point of the subtle relations between the setmakers and the tube manufacturers. A tube, like any other electronic component, is produced to certain tolerance limits; and it has to be driven. The production of a chassis that will accept these tolerances and drive the tube adequately is the setmaker's responsibility – with help from the tube manufacturer who after all is trying to sell his tubes. This means that there's a lot going on at present in the design and production laboratories of both the setmakers and the tube manufacturers. Luck and compromise probably both play quite a substantial part in the results the various setmakers manage to achieve in terms of practical production chassis suited to the various tubes on offer.

With the prospect of solid-state and plasma displays on the more distant horizon, we certainly seem to be in a prolonged period of continuous and quite rapid change.

SUFLEX LTD.

In recent articles on GEC hybrid colour receivers reference was made to troubles experienced with the polystyrene capacitors used in the decoder reference oscillator circuit. These were inadvertently referred to as "Suflex" capacitors. We have since been informed that the polystyrene capacitors used in this circuit are not manufactured by Suflex Ltd. We apologise to Suflex Ltd. for any embarrassment this may have caused and the false impression created.

teletopics

NEW TV SETS

The release of a completely new colour chassis by a UK setmaker is not an everyday occurrence at present, so the advent of the new **Decca** 80 series chassis is something of an event – especially as it is based around a type of colour c.r.t. that has not previously been used by a UK setmaker, the Toshiba SSI tube. The chassis is a solid-state one of modular construction, but it's the tube that is of particular interest.

Toshiba first announced their new generation of in-line gun, slotted shadowmask tubes in early 1974. There were two basic varieties: the SSI (Simplified convergence, Slotted shadowmask, In-line guns), a 90° deflection tube initially intended for use in smaller screen sets (14 and 16in.); and the RIS (Rectangular cone, In-line gun, Slotted shadowmask), a 110° tube intended for use in large screen sets. These tubes differ from the PI type of tube in that they use separate, semi-toroidal scanning yokes while the grids and first anodes of the guns in addition to the cathodes are separately available, simplifying colour background adjustments. The SSI tube has since been further developed however and the Decca chassis will be using it in the 18 and 20in. sizes. The great advantage of the SSI tube is the very small number of dynamic convergence adjustments required – just three. There are the usual purity and static convergence magnets, and a single pincushion distortion correction control. Thus setting up is greatly simplified. Although this tube is a 90° type, the tube length in comparison to a delta-gun tube shows a worthwhile reduction. Decca is initially introducing two 20in. models, the CT802 and CT812. The tube used in these features black stripes in the areas of the screen between the phosphor stripes. An 18in. set, Model CT801, will be added to the range later.

There are numerous other innovations apart from the tube. The new dual-posistor degaussing circuit (see *Teletopics*, November 1975) is used. The thyristor regulated power supply features an elaborate crowbar trip and a double-transistor switch to fire the thyristor – thus avoiding those dodgy diacs that have caused so much trouble in other thyristor power supply circuits. A single transistor (BU205) line output stage is used.

Extensive use is made of i.c.s throughout. Perhaps the most surprising feature here is that the entire field timebase consists of a single TDA1170. A TBA920 takes care of the sync separator and line oscillator functions. Apart from the RGB output stages, a pulse shaper and the luminance delay line driver, there is not a transistor to be seen on the signal panels. The i.f. strip consists of an MC1349 (another first appearance) for gain and a TCA270 for detection, a.g.c. and a.f.c. The sound channel consists of a TBA120S intercarrier and TBA800 audio output i.c. Decoding makes use of the Motorola three i.c. approach – TBA396/TBA395/MC1327. Since there is no feedback to stabilise the d.c. connected RGB output stages, cascode circuits are used here.

All in all the chassis makes use of the latest techniques and benefits from the considerable simplification made possible by the use of the Toshiba SSI tube. There seems little to go wrong, and when it does the simple panel replacement procedure will make field servicing easy. It looks to us like a chassis that both rental concerns and individual owners will be able to sleep easily with, and is surely an indication that the UK colour setmaking industry is still on its toes.

In addition, Decca have introduced a four-year tube guarantee on all their colour models. This could be a course which others will follow: it is understood that Rank have been considering a comprehensive four-year guarantee scheme for their latest colour sets.

A new 14in. mains-battery portable has been added to the **Ekco** range. This is Model T554 which has a recommended retail price of £99·90 including VAT.

DOMESTIC TV INDUSTRY WRITTEN OFF?

The question as to whether the government has decided to write off the UK domestic TV setmaking industry seriously arises since it has not been included amongst the thirty or so industries selected in the government's "industrial strategy" as being crucial to the country's economic future. This would be understandable in the case of the domestic radio receiver industry which has almost ceased to exist in the UK. The TV setmaking industry is still substantial however. It has a distinguished history, being the first in the world to commence large scale production, and has kept up with the developing technology, as developments in colour sets and the Teletext experiments show. It is competitive, with recommended prices generally well below those of Japanese and continental imports. It also contributes in various ways to the country's export effort. Not a great deal is heard about this, but here are a couple of examples. GEC are producing advanced sets using the Philips/Mullard 20AX colour tube for export to the Continent – it's likely to be many months before this chassis is released on the UK market. And several firms have done well out of the highly successful start of colour TV in Australia, with Decca for example contributing the knowhow to the establishment of the EMI colour set plant there. The one thing the industry lacks is a stable home market, with actions like the 25% VAT having a highly damaging effect.

The will and the knowhow, both electronic and productionwise, are there: they need and deserve the government's encouragement. The only reason we can think of for the exclusion of TV from the government's "industrial strategy" is the total confusion that seems to exist about the industry in lay minds. MPs and the press seem unable to distinguish between TV sets and the tubes that go in them, and are completely at sea when it comes to the different types of tube. There appears to be a need for the industry to promote greater knowledge of its wares and problems amongst the public at large.

AN ANNIVERSARY

The situation was different fifty years ago. It seems extraordinary that something so taken for granted as TV reception was but an uncertain experiment just fifty years back. It was on January 26, 1926, that Baird gave the first public demonstration of a working television set-up – with flickering, semi-locked pictures. His propagandist and entrepreneurial efforts certainly ensured that the public was well aware of the possibilities however.

Perhaps the most noteworthy thing was that modern high-definition TV as we know it today (except for colour that is) was developed in the short time of the ten years following that demonstration of Baird's – mostly during a brief period in the early thirties. It was then that the first practical TV camera tube (the Emitron), reliable sync pulse generation and processing, wideband amplifiers and v.h.f. transmitters were developed, culminating in the start of the first regular public TV service from Alexandra Palace in August 1936.

One thing that probably needs to be emphasized was the need for and development of *systems* engineering. The principles of the c.r.t., photo-emission and scanning had been around for many years. What came about in that period of highly inspired research was the development of practical devices and their integration into a complete system that remains unchanged in principle to this day.

TELETEXT COLLOQUIUM

The rapid development of video data transmission – the BBC's Ceefax, IBA's Oracle and the PO's Viewdata systems, nowadays generally referred to as Teletext – is on a par with those early days when TV was originally being developed. Let's hope that the UK will complete the development, get regular transmissions confirmed, and reap the rewards of having got there successfully first. Unlike that bloody aeroplane, it's not taking thousands of millions of the public's money . . .

The current situation was brought out at a recent IEE colloquium. Amongst the points emphasized was the importance of a receiver's signal circuit performance. The tuner, i.f. strip and detector must be designed to high standards if the data is to pass through without errors being introduced and the subsequent display resolution is to be adequate. John Chambers of the BBC Research Department commented that the i.f. response should be substantially flat up to the full 5MHz bandwidth, the tuning accuracy needs to be around 100kHz, a synchronous detector is desirable and the video response also needs to be uniform up to 5MHz. These are exacting requirements not often met – quite deliberately since practical TV designs have to involve a certain amount of compromise if they are to be economical at the same time – in current TV chassis. He suggested the use of surface-wave filters in the i.f. strip to provide the necessary bandpass characteristic. The aerial and its installation are also important.

The c.r.t. presents further problems. The various new types of colour c.r.t. and the tendency to change to 110° deflection with colour tubes makes stringent demands on the scanning and convergence circuits if the lettering is to remain focused and is not to change colour from one side of the screen to the other.

Mullard and Texas Instruments both contributed to the colloquium on the decoder side. Mullard have produced a complete decoder with just three 24-pin i.c.s, the digital sections using LOCMOS technology while the video sections employ bipolar technology. Texas have produced a seven i.c. decoder using a variety of technologies – low-power Schottky TTL, I^2L, and n-channel MOS. The company also has available for little over £100 (one off) a development decoder module using 14 i.c.s on a printed board.

Meanwhile BREMA (the British Radio Equipment Manufacturers Association) has completed, in conjunction with the Research Bureau Limited, a comprehensive market research project into the possible future demand for TV sets incorporating Teletext facilities. The results are said to be "encouraging" and "to confirm earlier optimism of the ultimate success of Teletext".

VIDEO

Philips have now launched on the market the new version of their VCR, Model N1501. The use of improved, chromium dioxide tape in the cassettes now gives the heads a life expectancy of 1,000 hours. There is also a self-cleaning action on the heads so that the time between cleaning the machine is now extended to 100 hours instead of the twenty hours previously.

RCA and Philips are both aiming to introduce videodiscs and players on the US market in late 1976. They anticipate a gradual build up of sales over the period 1977-78 before a mass market develops.

TRANSMITTER NEWS

The following relay stations are now in operation:

Arfon (Gwynedd): BBC-2 channel 44, BBC-Wales channel 51, at reduced power. Aerial group B.

Biggar (Strathclyde): BBC-1 (Scotland) channel 22, ITV (Scottish Television) channel 25, BBC-2 channel 28. Aerial group A.

Langholm (Scotland): BBC-1 channel 57, ITV (Border Television) channel 60, BBC-2 channel 63. Aerial group C/D.

Penicuik (Midlothian): BBC-1 (Scotland) channel 58, ITV (Scottish Television) channel 61, BBC-2 channel 64. Aerial group C/D.

Pitlochry (Tayside): BBC-1 (Scotland) channel 22, BBC-2 channel 28. Aerial group A.

St. Austell (Cornwall): BBC-1 channel 55, ITV (Westward Television) channel 59, BBC-2 channel 62. Aerial group C/D.

South Knapdale (Argyll): BBC-1 channel 57, ITV (Scottish Television) channel 60, BBC-2 channel 63. Aerial group C/D.

West Linton (Tweedale): ITV (Scottish Television) channel 23, BBC-2 channel 26, BBC-1 (Scotland) channel 33. Aerial group A.

All these transmissions are vertically polarised.

MOSFET I.F. PREAMPLIFIER

Graham HARRISON

THE usual answer to the problem of providing more gain for DX TV reception is to use an r.f. preamplifier, either at the aerial or at the set. Too much r.f. gain will result in cross-modulation, the effect generally occurring in the mixer stage, and it's an advantage therefore to have good i.f. amplifier sensitivity so that only one or two extra r.f. amplifier stages need to be used.

Originally, I employed a bipolar transistor i.f. preamplifier, but this just seemed to add to the noise. I therefore devised the dual-gate m.o.s.f.e.t. circuit featured here, which offers a number of advantages. With the Gain control VR1 set to minimum there is hardly any noise, while at maximum the signal can be brought up very strongly. If variable gain is not required, VR1 can be replaced by a fixed resistor of the same value. Current consumption is approximately 4·5mA from a 15V supply.

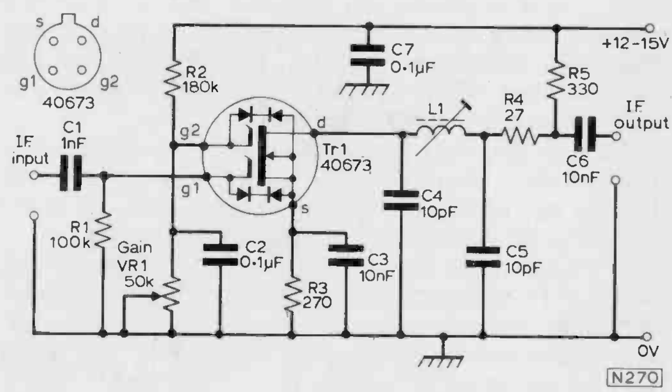


Fig. 1: Circuit diagram of the preamplifier. Although protection diodes are incorporated in the 40673, the usual precautions against build-up of static charge should be taken when handling and installing the device.

★ Components list

Resistors:		Capacitors:	
R1	100kΩ	C1	1000pF ceramic min. 250V
R2	180kΩ	C2	0·1µF disc ceramic
R3	270Ω	C3	0·01µF disc ceramic
R4	27Ω	C4	10pF polystyrene, 63V 5%
R5	330Ω	C5	10pF polystyrene, 63V 5%
		C6	1000pF ceramic min. 250V
All ½W 5%		C7	0·1µF disc ceramic

Miscellaneous:
L1 13 turns 38 s.w.g. enamel copper wire close wound at base of former. Former 3/16 in. diameter, slug tuned.
Tr1 RCA type 40673.

The preamplifier is incorporated between the tuner and the main i.f. strip. In my own receiver the v.h.f. tuner mixer valve acts as an additional i.f. amplifier on u.h.f. The i.f. preamplifier works on both systems therefore. The gain has not been measured but should be about 15-18dB. The tuning of L1 should be flat: adjust on a test card or for maximum noise with no signal. ■

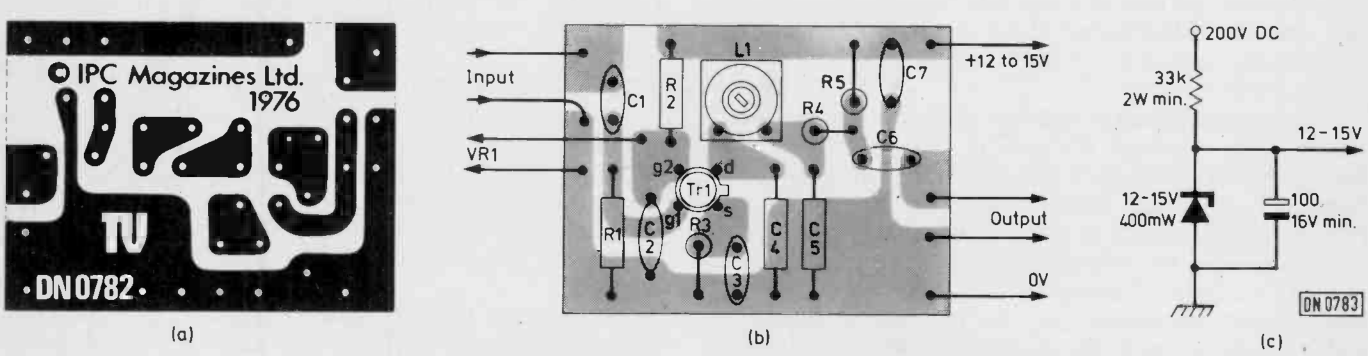
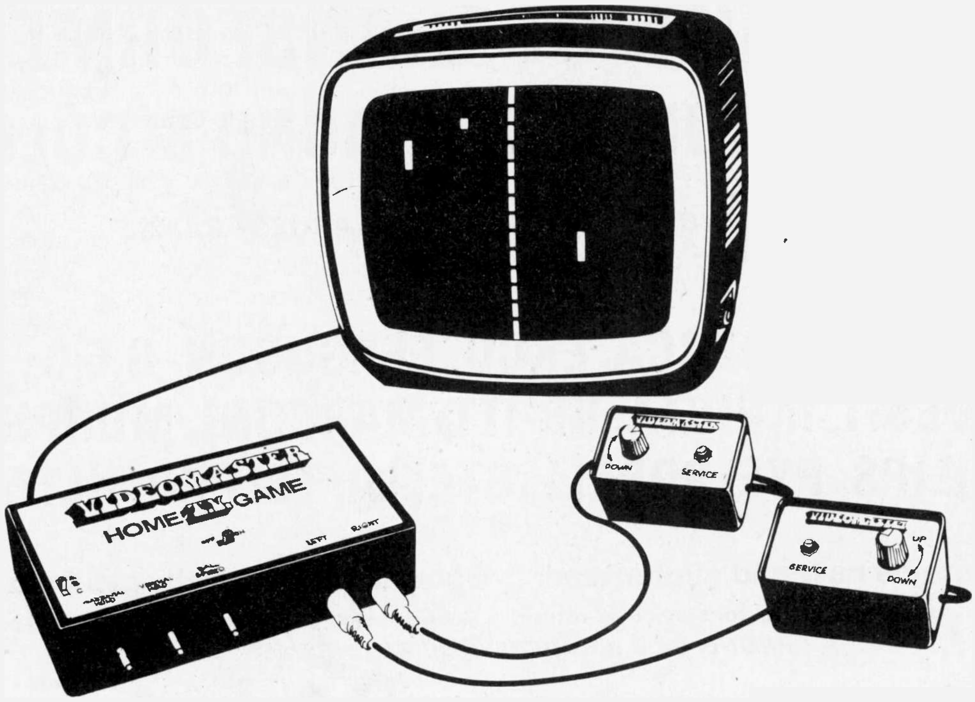


Fig. 2: (a) Track layout of a suitable printed board, drawn full size.
(b) Component layout and external connection details for the printed board.
(c) Deriving the required 12 – 15V supply from the 200V h.t. rail of a valved TV receiver.



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4545	4.5mm	66p
4550	5mm	66p
4555	5.5mm	66p
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LONG-DISTANCE TELEVISION

ROGER BUNNEY

IT already looks as if the new year could be an eventful one. Our Australian friends have been experiencing an excellent Sporadic E (SpE) season, with double-hop signals in plenty reaching into Band III and 2,000 mile signal paths quite common, and with a hint of trans-equatorial skip! Since sunspot activity is still at a very low level, I feel that we too can look forward to a good season, starting perhaps in the second week of May. In the early 60s the main SpE season was often preceded by a good opening in mid-April, so it may pay to prepare for activity from then onwards. Certainly there have been excellent Tropospheric conditions during the past few months – it'll be some time before this happens again!

We have just recently reported on the first amateur reception of satellite television, and this too can give us something to think about. I'm hoping to construct a suitable receiver using commercial gear and surplus TV components, and if this leads to success a full report along with details of the equipment will be given.

In anticipation of an eventful year then I suggest checking out aerials and cables and preparing new preamplifiers before the beginning of April.

Monthly Report

January provided a few surprises. An SpE opening on New Year's day brought in good signals from Scandinavia and Iceland at many locations. There was another opening on the 5th, into Eastern Europe, but unfortunately most of the reception was of programme material – apparently originating from Czechoslovakia and Poland. Following the Tropospheric opening immediately after Christmas, further signals were seen on the 28th (Ian Beckett, Buckingham, reports Czechoslovakia chs. R9 and R10), and on January 7th and 8th there were signals at both v.h.f. and u.h.f. from West Germany, East Germany and Switzerland. There have been good signals from the Luxembourg ch. E7 and E21 transmitters. Rather surprising this, because up to the past couple of months these signals have been very elusive. The Quadrantids Meteor Shower on the 4th didn't produce many signals here – the 3rd was more productive in fact. Others who were on at the right times logged reasonable signal pings reaching up to Band III however. As in previous columns I'm once more omitting the log since the month has not been eventful and there's plenty of other news to report.

Satellite Reception

Steve Birkill (Sheffield) has reported further developments following the exciting news last month of his reception of TV transmissions from the ATS-6 satellite. As a result of improvements to his equipment better signals have been received, as the accompanying photographs show (compare with those last month). A photograph of his 5ft dish is also included. Steve calculates that taking account of path loss, off-beam loss and his aerial and receiver gains he is working with signal levels of around $0{\cdot}35\mu V$ into 50Ω.

This information was passed on to Hugh Cocks in Devon. He has attempted reception using a vertical Group C/D Multibeam array feeding a conventional DX-TV receiver (i.e. one with the usual a.m. video detection) via preamplifiers. On the 7th Hugh 'phoned to say he had noted a blank raster plus syncs, no video modulation but with a rapid hum effect on the screen. After a couple of minutes he tuned to the video buzz, donned headphones and climbed his mast to adjust the aerial. The buzz changed to a sharper note, indicating the presence of some form of video modulation, then cut-out. Hugh has subsequently noted other low-level signals from his vertical MBM aerial, all of which shows that something can be received using even rudimentary equipment. Plans for an f.m. video demodulator are on the stocks and as a result improved results are expected shortly. Steve suggests that the reason for the video demodulation experienced by Hugh is that some form of f.m. detection is taking place along the rising skirt of the vision i.f. response curve, i.e. slope detection.

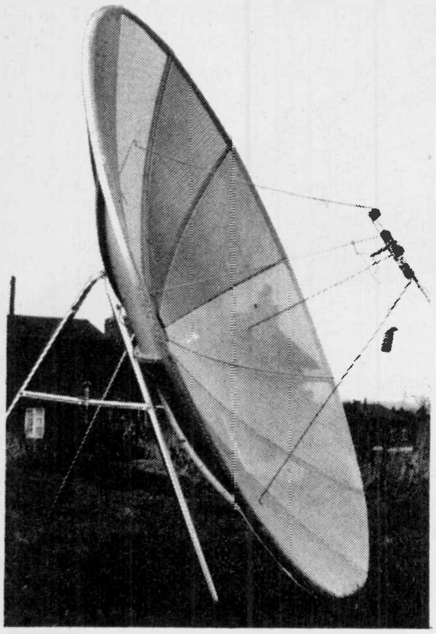
News Items

Czechoslovakia: The new 600ft tower for the Bratislava transmitter is now in operation.

We understand that the Krasov transmitter recently mentioned is indeed the ch. R10 outlet at Plzen, covering Western Bohemia. The reason for the new transmitter is that the original one was destroyed during the Soviet intervention in 1968. It's located near the Ochsenkopf transmitter (across the border in Austria).

The CST-2 network is to expand considerably during the next year or two. Peter Vaarkamp has kindly sent us the following official list: Pardubice ch. 22 600kW; Klatovy ch. 22; Prague City ch. 24 100kW; Kosice ch. 25 600kW; Prague ch. 26 1,000kW; Bratislava ch. 27 1,000kW; Namestovo ch. 29 100kW; Poprad ch. 30 600kW; Brno ch. 29 600kW; Plzen ch. 31 600kW; Liberec ch. 31 100kW; Ostrava ch. 31 600kW; Banska Bystrica ch. 31 600kW; Usti nad Labem ch. 33 600kW; N. Jicin ch. 34 100kW; Susice ch. 35 100kW; Zilina ch. 35 1,000kW; Brno City ch. 35 100kW; Jesenik ch. 36; Cheb ch. 36 100kW; Frydek ch. 37 300kW; Sokolov (Jachymov) ch. 38 300kW. All transmissions to be horizontally polarised.

We understand that a transmitter is now in operation at Krasne (Eastern Bohemia) with an e.r.p. of 600kW.



Steve Birkill's five foot diameter dish for reception of the ATS-6 satellite.

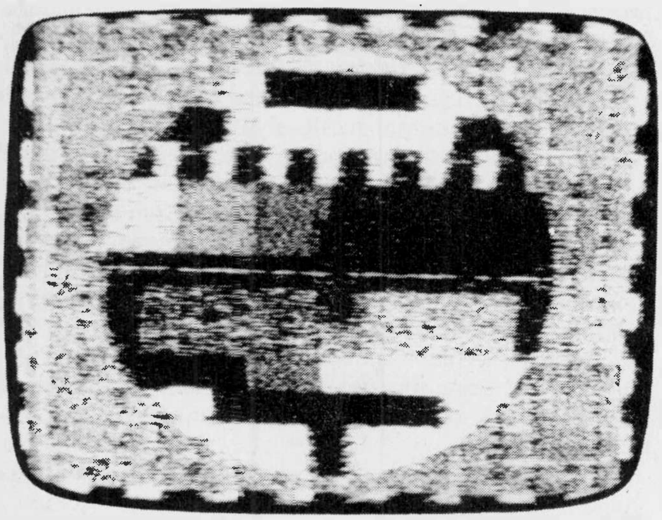
West Germany: The American Forces TV is to commence colour transmissions at the end of 1976 using the US system – NTSC, 525 lines, 60 fields. The studios are at Frankfurt. The ARD first programme is now transmitted from over 73 main outlets and 1,213 relays, the ZDF second programme from over 88 main outlets and 1,475 relays, and the ARD-3 service from over 88 main outlets and 1,474 relays. There are 64 transmitters operated by the armed forces.

France: The PM5544 card is now being used by the first network, with identifications "TDF" and "TF1" at the top and bottom respectively.

Hungary: There is a new first chain u.h.f. transmitter in operation at Csavoly, in the south near Baja. The channel is R28. The Hungarian PM5544 pattern now carries a digital clock just below the identification.

Incidentally DFF (East Germany) is also now carrying a digital clock on the pattern.

In brief: The Japanese NEC company is to install a new transmitter at Jemiolow, Poland, to give TVP-2 coverage of the Zielona Gora and Gorzow area. A third programme will be relayed in due course. The USSR news agency Novosti reports that there is a new 1,000ft transmitting tower at Tallinn, with arrays for four programmes. Angola commenced a TV service last October. Ghana TV is to go colour within the present decade now that the coverage of the country is considered to be adequate. The Benue Plateau TV service (Nigeria) commenced colour transmissions at the end of last year: communal colour TV viewing centres are being established throughout Kano state for the programmes from Kaduna.



The PM5544 test card received from ATS-6

From Our Correspondents . . .

We have received a number of letters from Australasia describing the events there during the past few months – and a hectic time it seems to have been! Nicholas Earley (Beaumaris, Victoria) received colour transmissions from several stations within a 1,000 mile range. Robert Copeman (Sydney) excelled himself with reception via SpE of the Auckland, New Zealand TV2 ch. 4 outlet, a distance of over 1,300 miles. As far as we know this is a "first": congratulations! NZ ch. 4 is on the same frequency as the European ch. E5/R6. The spread of f.m. radio broadcasting into the frequency spectrum already occupied by TV stations is causing severe fringe area problems in Australia.

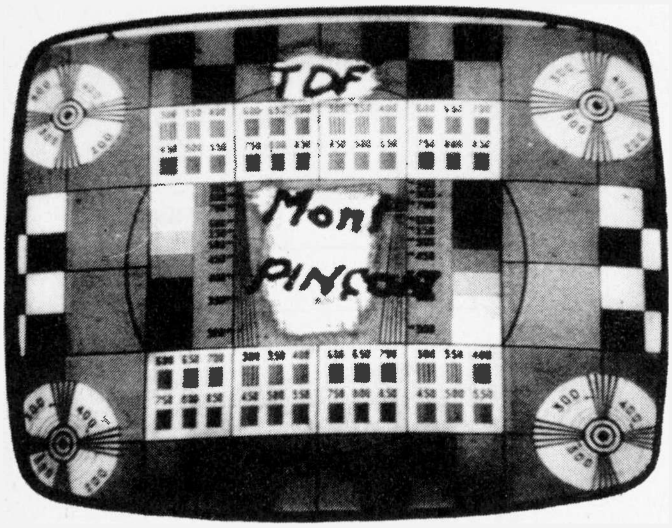
Anthony Mann (Applecross, Western Australia) received Johore Bahru, Malaya ch. E3 during the early evening: I suggest that this is via F2/Spread F since it's on a north-south path. A photograph of test card G from Gunong Sempah, Malaya shows the typical multipath signal reception obtained with this mode of propagation – we hope to feature it shortly. Anthony comments that there is a tendency for such openings to occur during the late afternoon/early evening, particularly on days when there is a relatively high solar flux (at least three or four units above the flux counts on the preceding and following days) and with high sunspot activity: these conditions favour reception along a north/south path. Another favourable situation is on a day when there is a geomagnetic storm – the solar flux counts on these days is immaterial. Such a

Fair quality signal reception from ATS-6, showing the principle reception area for the project.

Above photographs courtesy Steve Birkill.

LONG-DISTANCE TELEVISION

LONG-DISTANCE TELEVISION



An unusual test card – Caen ch. E28, northern France – received by David Martin in Shaftesbury.

A typical transmitter identification from West Germany.

storm often brings in Malaya. Anthony also carries out monitoring using a converter feeding a Trio Model 9R59DS. This gives vastly improved sensitivity over a TV receiver so that the video buzz can be detected at very low levels.

Back in the UK David Martin (Shaftesbury) has received the Caen transmitter (North France) using a modified test card – see photograph.

Coaxial Cable Feeders

The use of good quality coaxial cable between the aerial and the receiving equipment is of paramount importance for weak signal reception enthusiasts. When one considers that using the best quality low-loss feeder available there can be a signal loss at 850MHz of almost 6dB over a 100ft run the installation of a feeder has to be undertaken with great care. Peter Jones, technical manager of Aerialite Ltd., wrote an interesting article on the subject in the September 1974 issue of *Electrical and Radio Trading* and has allowed us to summarise below some of the points he made there.

A halfwave dipole was generally used to receive the original BBC transmissions. This has an impedance across the terminals of almost 75Ω, and consequently cables were manufactured to match this figure while in turn the input circuits of the receivers were designed to match this impedance. In the Americas however and many parts of Europe, 300Ω ribbon feeder became standard and is still widely used, though there is a tendency to change to coaxial cable due to installation problems and high losses under certain conditions.

The halfwave dipole is a balanced device, and connection to it of an unbalanced coaxial cable tends to result in a current flow along the surface of the outer conductor of the coaxial feeder at the connection to the dipole terminals. The signal currents produced in this way are fortunately highly attenuated, and are rarely of high value after a distance of two wavelengths. These out-of-balance currents have little effect at u.h.f., but at v.h.f. and in particular in Band I the problem is more serious and has been known to cause instability in the receiver's front-end stages. One means of reducing the problem is to use a balun at the dipole terminals. This usually consists of a quarter wavelength of conductor through which the current flows instead of flowing along the outer conductor of the coaxial feeder. Baluns are still fitted to Jaybeam Band III and u.h.f. arrays, though other aerial manufacturers have mostly discontinued using them.

continued on page 311

Table 1: Aerialite Coaxial Cables

	Inner conductor			*Cable diameter (mm)*				*Nominal attenuation, dB/100 metres*				
Type	*No. of wires*	*Wire diam. (mm)*	*Polythene dielectric*	*Over dielectric*	*Over outer conductor*	*Overall*	*Capacitance (pF/metre)*	*50MHz*	*100MHz*	*200MHz*	*650MHz*	*850MHz*
4202	7	0·25	Cellular	3·25	3·85	5·10	56	7·2	10·2	14·5	27·1	31·4
4203	1	1·12	Cellular	5·10	5·70	7·25	56	5·2	7·4	10·4	19·6	27·8
4204	7	0.20	Aeraxial	3·12	3·73	4·80	56	8·3	11·7	16·6	30·5	35·2
4205	1	1·25	Aeraxial	5·00	5·60	7·15	57	4·6	6·5	9·2	17·2	19·9
4206	1	0·71	Aeraxial	3·12	3·73	4·80	59	7·1	10·0	14·2	26·2	30·2
4207	7	0·25	Aeraxial	3·12	3·72	5·00	57.5	7·1	10·0	14·2	26·2	30·2
4209	1	1·40	Aeraxial	5·80	6·40	8·00	56	4·0	5·7	8·0	14·8	17·0
4244	1	1·00	Aeraxial	4·95	5·56	7·09	56	5·6	7·9	11·2	19·7	23·6

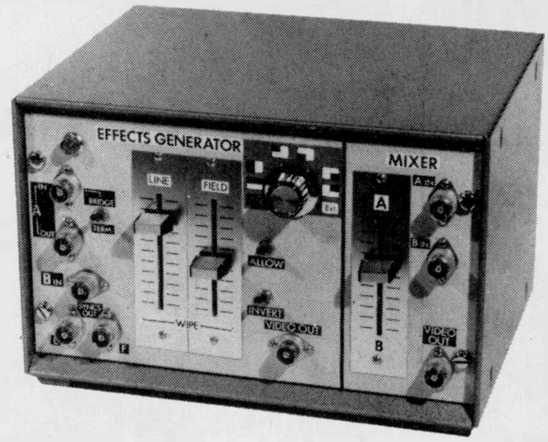
The nominal impedance of all these cables is 75Ω. The velocity constant (air equals unity) varies between 0·78-0·8, i.e. the velocity of propagation of the signal along the feeder is less with a material dielectric than with air as the dielectric.

Video Effects Generator

A TV PROJECT

PART 1

E.A.PARR, B.Sc C.Eng MIEE



THIS unit is designed for use with two CCTV cameras and provides the following effects:

- Horizontal wipe.
- Vertical wipe.
- Square corner-to-corner wipe in any direction.
- Switchable square insert in any of the four corners, size adjustable.
- Simple switching between two cameras.
- Fades.

The unit can be used with either 1V or 1·5V peak to peak composite video signals. It works on the composite video signals from the cameras and requires no drives from an external sync pulse generator. It is however essential that the line and field oscillators of the two cameras are locked, either by coupling the scan oscillators or by driving them from a sync pulse generator. The unit itself derives its own sync pulses from one of the incoming video signals, and these sync pulses are brought out to sockets so that they can be used to drive the other camera if required.

The fader is a separate circuit from the wipes and insert generator, providing greater flexibility in operation. It also means that each unit can be built separately if not all the facilities are required. Either random interlace or full 2:1 interlace sources may be used.

The unit falls naturally into four parts: Sync separator, Timing logic, Video mixer, Fader. Each will be described separately.

Sync separator

The sync separator derives line and field sync pulses from one of the incoming video signals, its circuit is shown in Fig. 1. The video signal at the base of Tr10 is at about 5V above the zero volt (0V) line, as we shall see later. Tr10 is a simple emitter follower, its output being coupled by C8 to Tr11 base, which is held about 0·5V negative with respect to its emitter by the potential divider D10, R24, R23. Hence Tr11 is normally (only just) turned off. The negative-going sync pulses turn Tr11 on, giving positive pulses at Tr11 collector. These are inverted and tidied up by the Schmitt trigger IC1a to give the line sync pulses. Actually these are mixed line and field syncs, but this does not affect the circuit.

The mixed syncs are also fed to Tr12 base, turning Tr12 off for each sync pulse. The collector of Tr12 is slugged by C9, so the collector potential can rise only during the longer field sync pulse. The resulting somewhat rounded field sync pulse is again inverted and tidied up by IC1e. Both sync pulses are brought out to sockets for external use, and are also fed to the timing logic circuit.

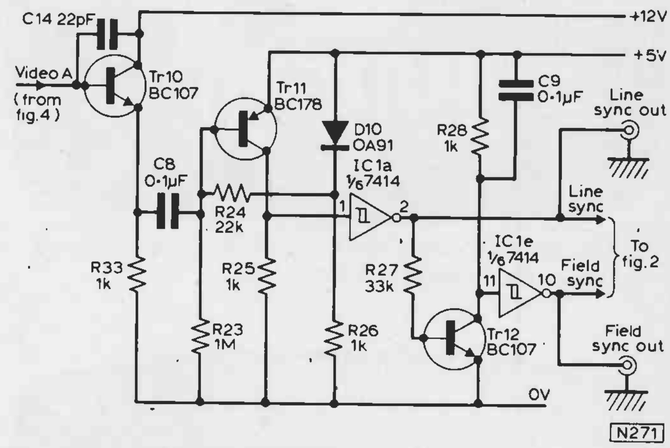


Fig. 1: The sync separator circuit, providing line and field rate pulse trains for internal and external use.

Timing logic

The timing logic circuit (Fig. 2) produces the digital signals that switch the two incoming video signals. Timing is controlled by IC2, a dual monostable. One monostable (IC2a) is fired by the line sync pulse. Its period can be varied from about 10μs to about 60μs by means of VR1. This controls the horizontal position of the changeover in the wipes and inserts. Preset VR3 (or R29) and R30 are adjusted to give the correct limits of the period so that the ends of travel of VR1 correspond to the left-hand and right-hand sides of the screen.

Similarly IC2b is fired by the field sync pulse, and its period can be varied from about 1ms to about 20ms by VR2. Preset VR4 (or R31) and R32 are similarly adjusted so that the ends of VR2 correspond to the top and bottom edges of the screen. The two monostable outputs are inverted by IC1b and IC1f to give complement and true outputs for each monostable.

At this point it is necessary to remind ourselves of the timing of a TV signal. Because a TV signal is sequential, any point on the screen can be defined by two times, one starting from the field sync pulse and the other from the line sync pulse. Thus the centre of the screen is 10ms from the field sync pulse and 32μs from the line sync pulse.

Similarly we can define areas of the picture. If we say "all the signal less than 32μs from the line sync pulse", we mean the left-hand side of the screen. More importantly, if we say "all the signal that is less than 32μs from the line sync pulse AND more than 10ms from the field sync pulse", we mean

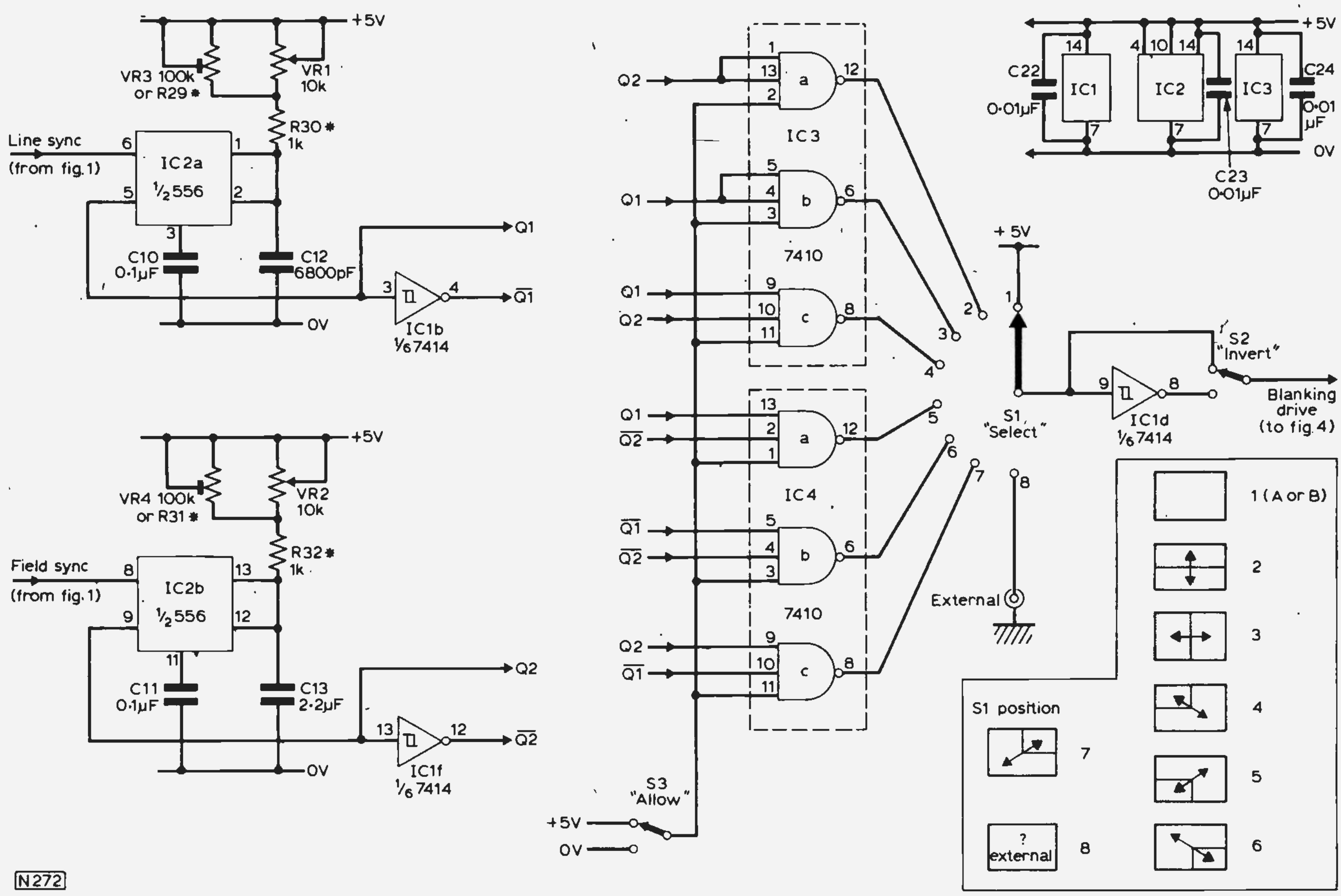


Fig. 2: The timing logic, which generates blanking pulses to drive the video switching circuits of Fig. 4. The components marked with an asterisk will be discussed in the second part of this article, to appear next month.

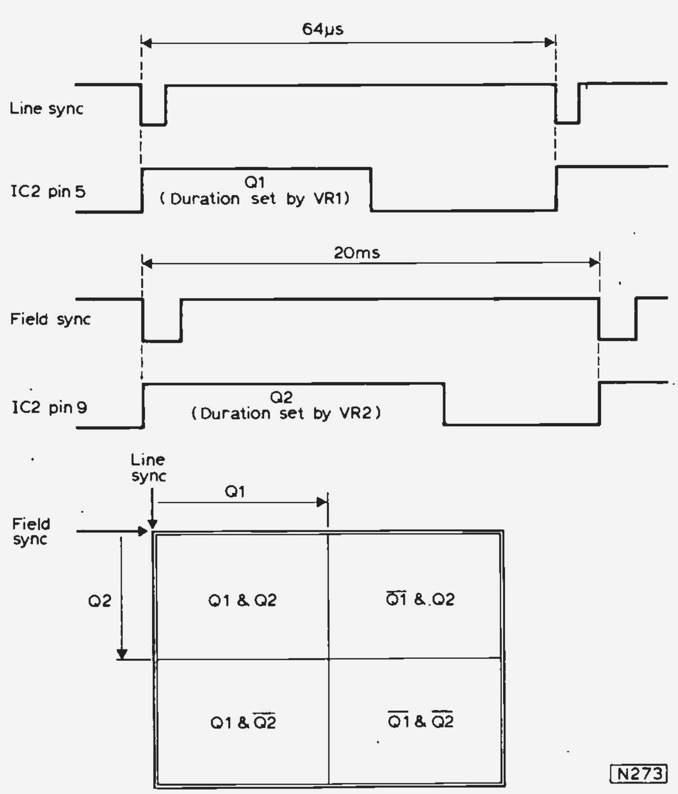


Fig. 3: Waveforms and corresponding screen areas for the timing logic circuit.

the bottom left-hand corner of the screen. It follows that by suitable choice of times, we can select any area of the screen we require.

In our simple generator, we can select six areas, these are:

Vertical split	(Q1)
Horizontal split	(Q2)
Top left	(Q1 and Q2)
Bottom left	(Q1 and $\overline{Q2}$)
Bottom right	($\overline{Q1}$ and $\overline{Q2}$)
Top right	($\overline{Q1}$ and Q2)

The position of the changeover can be continuously varied by means of VR1 and VR2 to give wipes.

The gating of these selections is done by the triple 3-input NAND gates IC3 and IC4. An "Allow" signal gates the selection, so that an insert can be switched in or out without the necessity of wiping in from the corner each time. The required control signal is selected by S1, and true or complement selected by S2, the "Invert" switch. This allows A inserted over B or B inserted over A to be selected. The resulting signal is called the blanking drive and is used to switch between the two video signals in the video mixer. Timing waveforms for the logic are shown in Fig. 3.

Video mixer

The video mixer does the switching between the two incoming video signals, and is controlled by the video blanking drive from the timing logic. The circuit of the video mixer is shown in Fig. 4, where it will be seen that

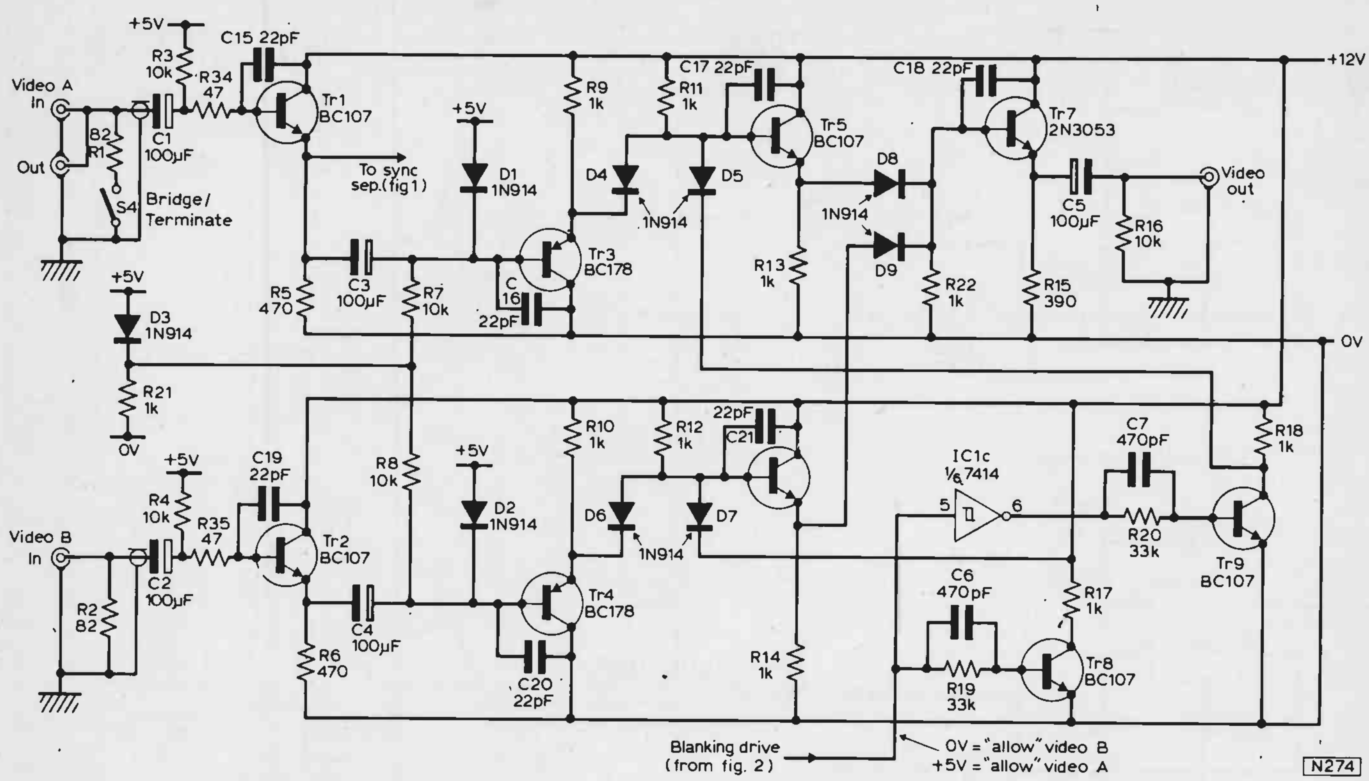


Fig. 4: Circuit of the video mixer, producing an output which is switched between Video A and B, controlled by the timing logic. Note that the feed to D7 cathode should be taken from the collector of Tr8, i.e. the opposite end of R17 to that shown in the drawing.

there are two identical circuits from the video input sockets up to D8 and D9. Therefore only channel A will be described.

The incoming video is matched by R1, which can be switched in or out by means of S4 depending upon whether it is desired to bridge or terminate the line, and is passed to the base of Tr1 via C1. Tr1 is a simple emitter follower and serves to buffer the incoming video from the d.c. restoration circuit which follows. The base of Tr1 is returned to +5V via R3, and the emitter therefore sits just below this potential. The feed to the sync separator (Fig. 1) is also taken from this point.

A crude d.c. restoration is accomplished by D1 and R7, and at Tr3 base the signal should be sitting with the bottom of the sync pulses at about 4·2V. This d.c.-restored signal is passed by Tr3 to the cathode of D4, part of a two-diode OR gate whose output is the lower of the two signals presented to it. The cathode of the other diode, D5, is connected to the collector of transistor Tr9, which is controlled by the blanking drive. If Tr9 is turned off, the signal at Tr5 base will be the d.c.-restored video. If Tr9 is turned on, the signal at Tr5 base will be zero volts. Thus turning Tr9 on and off will block or pass video A via emitter follower Tr5 to the anode of D8.

Similarly video B is passed or blocked by Tr8 being turned off or on, and the resulting signal appears at the anode of D9. Note that the blanking signal is inverted by IC1c before being passed to Tr9. When Tr8 is on, Tr9 is off and vice versa. It follows that video A is passed when video B is blocked, and video B passed when video A is blocked. Diodes D8 and D9 form another OR gate, but in this case the output is the *higher* of the two signals at the inputs; that is the video which is unblanked. This signal, which will be a mix of video A and B as selected by the blanking drive, is passed via emitter follower Tr7 to the video output socket. Waveforms for the video mixer are shown in Fig. 5.

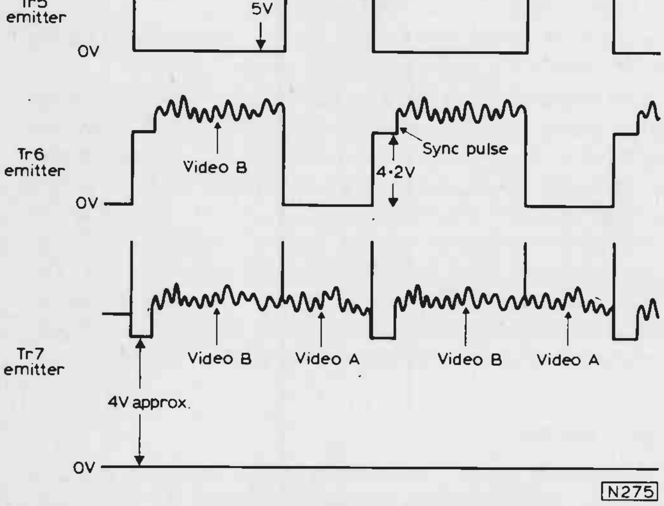


Fig. 5: Typical waveforms for the video mixer circuit.

Fader

The fader acts in a similar fashion to an audio mixer; two video sources are mixed and both appear on the screen at the same time, one usually being "brighter" than the other. A continuously variable control adjusts the relative

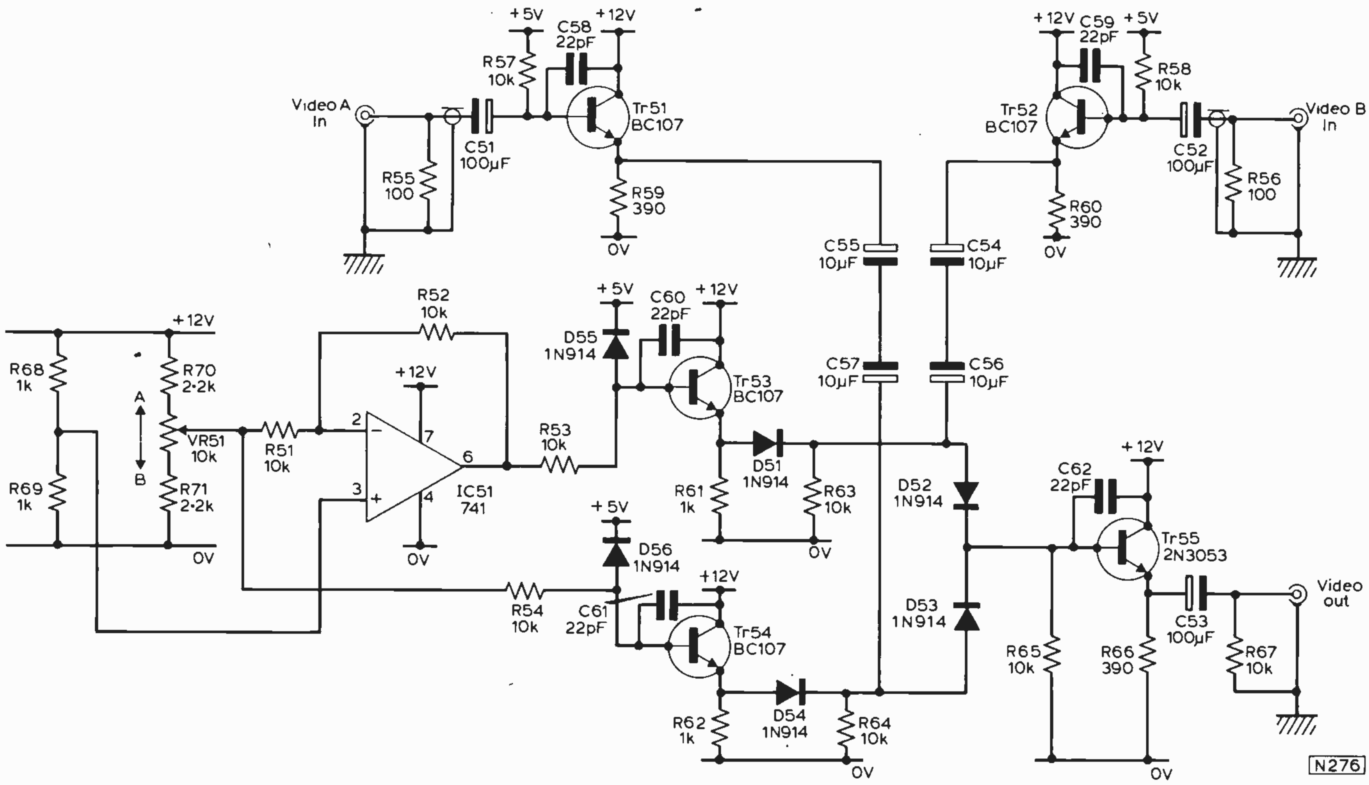


Fig. 6: Circuit diagram of the fader unit, which is electrically separate from the video mixer.

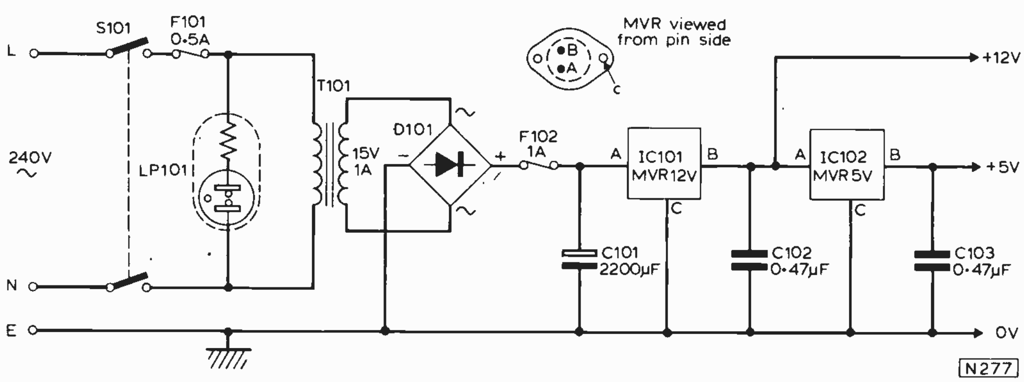


Fig. 7: Stabilised power supply unit for the video mixer and fader.

brightness of the two signals. The circuit is shown in Fig. 6, and apart from its power supply requirements is completely separate from the wipes and insert generator described above. Thus either part may be built on its own, though in each case the scan waveforms of the two video signals must be locked.

Potentiometer VR51 is the fader control, the voltage at its slider being variable between approximately two and ten volts. IC1 is an operational amplifier whose gain is set at unity by the values of R51 and R52. Its non-inverting input is connected to +6V, hence when VR51 slider is at, say, +7V the amplifier output is at +5V. As the voltage on Tr53 base is rising, that at Tr54 base is falling, both voltages being set by VR51. If preferred, these two base voltages could be derived from one dual potentiometer with its tracks connected in opposite senses across the 12V supply. The two wipers would be connected to R53 and R54.

The voltage at Tr53 and Tr54 bases is prevented from rising above 5V by diodes D55 and D56, thus ensuring that the d.c. level of the output remains constant. The d.c. potentials at Tr53 and Tr54 emitters are used to clamp the two video signals coming via emitter followers Tr51 and Tr52, the d.c. restoration being accomplished by D51 and D54.

The two d.c.-restored signals appear at the anodes of D52 and D53, which will pass the higher of the two voltages to Tr55 base. Unlike the effects generator however, this is not an exclusive A OR B action. If VR51 is at its mid position, both clamping potentials will be the same and it will be the highest video voltage that will appear at Tr55 base, corresponding to the brightest part of each picture. This gives the effect of the two pictures being superimposed on each other. As VR51 is moved away from its centre position one or other signal will predominate (i.e. appear brighter) until at either end of VR51 only one signal will be present. Tr55 is an emitter follower, providing the necessary matching to the low impedance cable.

Power supply

The circuit diagram of the power supply is shown in Fig. 7. Two positive supply rails are required for the unit, 12V for general purposes and 5V for the logic. For simplicity and convenience these are obtained from two integrated circuit regulators.

TO BE CONTINUED

Service Notebook

G.R.WILDING

No Colour

Hitachi sets don't give much trouble but a few weeks ago we had to deal with a Model CNP190 which gave a perfect monochrome picture but no colour. Our first move of course was to over-ride the colour killer. In these and similar Hitachi models this is done by applying about 4V from a small battery to point J on the signal board. As can be seen from Fig. 1, this action applies forward bias to the delay line driver stage TR32. The result was normal colour, so the next step was to find out why the colour-killer transistor TR28 wasn't working. The arrangement used here is a little unusual. TR28 is non-conductive on monochrome since its emitter, biased by the potential divider R546/R547, is negative with respect to its base. There is zero voltage at point J therefore and no turn-on bias for the delay line driver transistor. On a colour transmission the ident signal appears across the secondary of T503 and the negative-going half cycles cause TR28 to conduct. TR28 in effect acts as a rectifier, with its reservoir capacitor C561 charging to about 4V to give the turn-on bias – also to bring the 4·43MHz trap in the luminance channel into operation by forward biasing CR48 and thus returning it to chassis. CR15 prevents the voltage at J exceeding about 4V by clamping this point to the voltage at the junction R524/R523.

Our first suspicion was that the colour-killer transistor TR28 was faulty. Forward and reverse resistance checks across its junctions proved that it was in order however. When in doubt about the operation of a transistor, the easiest way of confirming that it is working is to change the forward bias applied to it – or to supply some if none is present – and to note the changed collector voltage (assuming that there is an appreciable resistive collector load). Thus for an npn transistor fed from a positive supply rail, connect a medium-value resistor from the transistor's base to the l.t. rail. In the case of a pnp transistor with its emitter fed from a positive l.t. rail, connect a medium-value resistor from the base of the transistor to chassis – the collector supply point. This was impractical here however since the transistor's base is returned to the l.t. rail via the secondary winding of T503.

We had to assume therefore that the transistor and its connections were o.k. and that the trouble was either zero or too little ident input. There are two ident amplifier stages, TR26 and TR27, TR26 being fed as usual with the ripple output from the burst detector circuit. On connecting an oscilloscope to the collector of the second ident amplifier transistor only a fraction of the correct 16V peak-to-peak output was found to be present. Further investigation showed that the ripple output from the burst detector circuit was normal, but that there was very little ident signal at the collector of the first ident transistor TR26. Since the voltages in this stage were normal, the only possibilities were a reduced value input coupling capacitor (C533), reduced value emitter decoupling electrolytic capacitor (C535, 22μF), or a fault in the collector tuned circuit. Naturally our first choice was the electrolytic, but a replacement gave only very slightly improved results. The culprit proved to be the 0·001μF input coupling capacitor C533.

Brightness Fault

There was a good picture on a Philips set fitted with the G8 chassis except that the brilliance level was too high while the brightness control had no effect. In these sets the brightness control and beam limiting actions are effected by the transistor (T220) which clamps the capacitively coupled luminance input to pin 5 of the TBA530 matrixing i.c. – see Fig. 2. The potential from the brightness control and the beam limiter circuit is applied to the base of this transistor. It was found that when the setting of the beam limiter threshold control was altered the brightness level changed, so it was clear that T220 was operational. The clamping pulses applied to the base of T220 are obtained from the collector of the inverter transistor T227. This transistor receives negative-going pulses from the line output stage at its base. It seemed likely that something was wrong in this stage, and our first suspect was diode D232. This proved to be in order however so we replaced the inverter transistor itself. After fitting the replacement and resetting the beam limiter threshold control normal brightness control action was obtained.

Intermittent Colour Troubles

The owner of a GEC Model C2040 hybrid colour receiver complained that the colour strength seemed to vary at times while

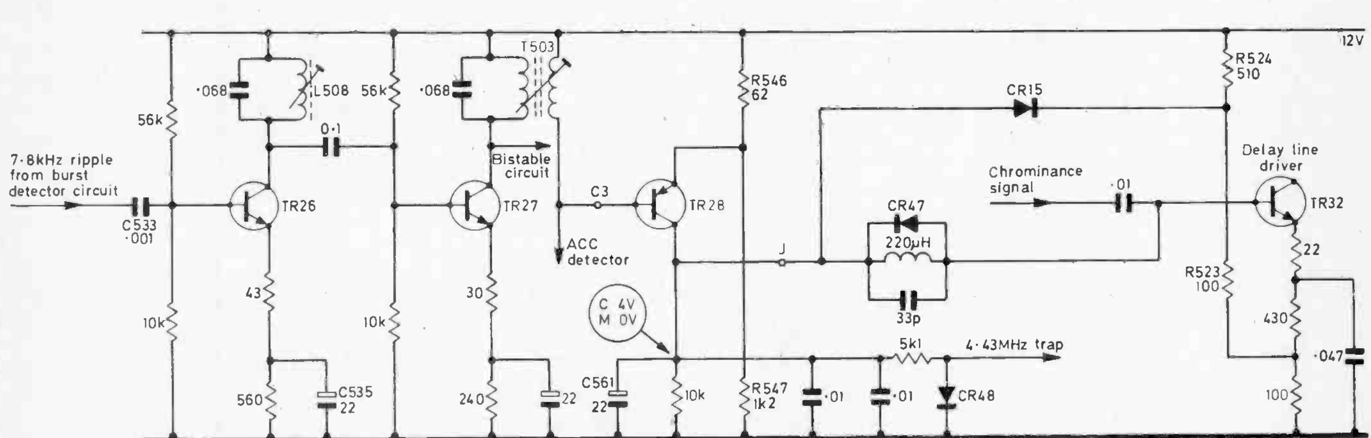


Fig. 1: Ident amplifiers (TR26, TR27) and colour-killer (TR28) stage, Hitachi Model CNP190.

Service Notebook 2

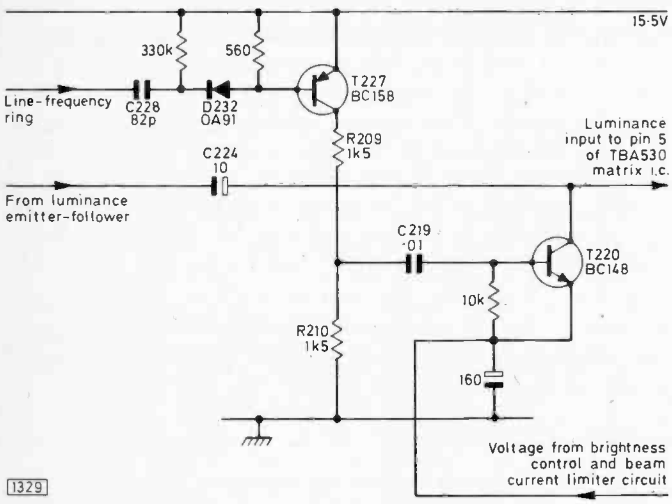


Fig. 2: Luminance clamp circuit used in the Philips G8 chassis. The clamp transistor is T220, which clamps the luminance signal fed via C224 to pin 5 of the TBA530 matrix i.c. A faulty clamp pulse inverter transistor (T227) was found to be the cause of excessive brightness. Faults in the beam limiter circuit used in this chassis generally result in a dark picture.

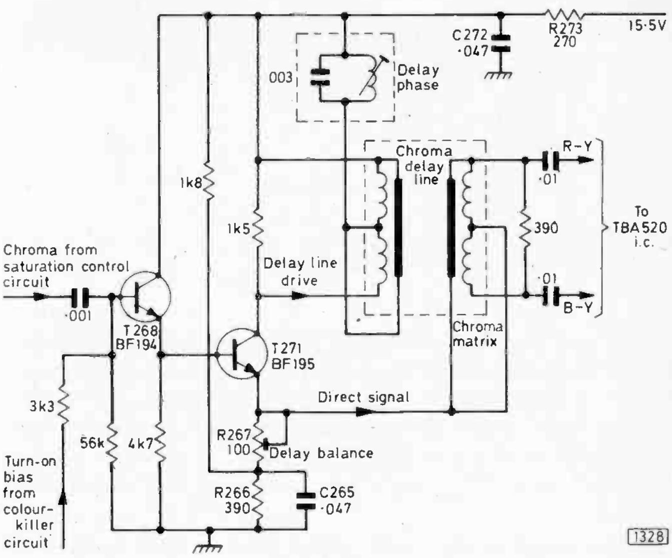


Fig. 3: The chrominance delay line and driver stage used in the Philips G8 chassis.

occasionally incorrect colours suddenly developed, flesh colours turning green. Retuning or channel changing would invariably cure the latter trouble however. The two symptoms pointed to the ident circuit giving either insufficient or varying output, since it provides the sync signal for the PAL switch circuit and the input to the colour-killer rectifier which in turn provides the chrominance channel turn-on bias. The set worked quite well during our first call, though the saturation level was somewhat below normal. As the ident coil in these models has been known to drift we readjusted this and then reset the colour-killer threshold control and the a.c.c. preset potentiometer. This brought the saturation level up to normal.

A few days later the owner reported that the faults had reappeared, so it seemed that there was a definite component fault somewhere rather than a case of misadjustment. The ident circuit used is the well-known Mullard design, with two transistors, a tuned amplifier followed by an emitter-follower buffer stage. Positive feedback from the emitter-follower to the tuned circuit – applied to the junction of the two series-connected tuning capacitors – results in a high-amplitude ident output. Our first move was to check the three diodes in the circuit, and as none of these had a particularly low forward resistance we decided to change them all. The two electrolytics were also changed since they looked somewhat dried up. The set then worked faultlessly for a day or so in the workshop, when the faults suddenly reappeared. It was found that the ident coil required readjustment again, so suspicion this time centred on the two tuning capacitors. These were replaced therefore and the coil again retuned. Following a long bench test and some weeks back in service no further trouble has been experienced.

In chassis of all types with a pentode line output stage incorporating a v.d.r. width stabilising circuit, insufficient width is commonly due to an increased value resistor in this circuit. As a result the pentode is biased excessively. These GEC models are no exception, the culprit invariably being the 1MΩ resistor R539.

When the focus on these sets is poor and the focus control seems to have only a limited range of adjustment, check the 10MΩ resistor R67 which feeds this control. It will almost certainly be found to have increased in value.

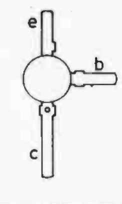
Slight Venetian Blinds

Slight Venetian blinds would develop intermittently in a set fitted with the Philips G8 chassis, the fault often being curable by a slight tap on the cabinet. This trouble is due to unbalance, either in amplitude or phase, between the direct and delayed chrominance signals fed to the matrixing circuit at the output of the chrominance delay line. Slight pressure on the chrominance panel around the delay line would usually bring on or cure the fault, so all soldered connections in the vicinity were remade. The trouble persisted however so it became clear that a faulty component was responsible. The circuitry involved is shown in Fig. 3. The direct signal input to the chrominance matrix is taken from T271 emitter while the delayed signal comes from T271 collector via the delay line. The phase of the delayed signal is set by the tuned circuit in unit 003, and the adjustment of this or the capacitor could have been defective. The amplitude of the delayed signal is set by R267 which controls the emitter feedback in this stage. All resistors seemed to be in good order so we decided to replace the two decoupling capacitors in the circuit, C272 which decouples the supply feed resistor R273, and C265 which decouples the emitter bias resistor R266. After doing this and readjusting the balance control R267 no further trouble was experienced.

SIMPLE U.H.F. AERIAL AMPLIFIER

Television, January 1976

We understand that not all BF262 transistors are colour coded in the way shown in Fig. 1 on page 131. The drawing here should be followed instead.



TV SOUND TUNER

M. A. HARRIS

THERE are several problems in getting good sound quality from a domestic television set. First, the output stage is usually a single-ended PCL82 or whatever of similarly (from a HiFi point of view) poor quality. Secondly, the loudspeaker is of small size – such as 5 × 3 inches – which is hardly in the HiFi class, neither is the box into which it is mounted.

One cannot easily (and safely) take a feed from the detector output to drive another amplifier, since the TV receiver's chassis is connected to one side of the mains supply in all but a few, and usually expensive models. This could be got round, of course, in one of several ways. After making sure that the TV chassis is connected to the neutral side of the mains, we could take a feed from across the volume control (or detector output) into a HiFi amplifier, thereby earthing the chassis AND the mains neutral! The Electricity Boards do not like this idea, and in any case, the circulating currents which could flow through the neutral – earth link in many districts could well defeat the object of the exercise by inducing an extremely loud hum. We could isolate the feed with capacitors, but to isolate 50Hz would mean a small value of capacity and next to no bass response, obviously. These are therefore not feasible solutions, and we must find some other way of achieving isolation.

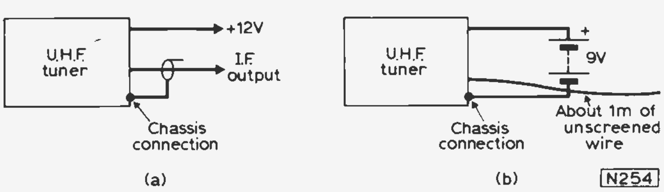


Fig. 1: (a) Transistor u.h.f. tuner connections "as supplied". (b) Connections required for testing and realignment.

A mains isolating transformer in the supply lead to the set would be one answer. However, such components are large, heavy, expensive and give off a magnetic field which would make a colour display very festive if mounted in close proximity. Using one of these would make a feed from the detector practicable. Alternatively, a small audio transformer with suitable insulation between primary and secondary could be connected across the detector output, giving signal coupling with mains isolation. In fact some sets, such as the Dynatron, do just this.

Separate tuner

One way round all these problems is to use a separate u.h.f. tuner, modified to shift the i.f. output from around 35MHz to around 102MHz, which can then be fed straight into the aerial circuit of a Band II f.m. radio receiver. In many cases the power required by the u.h.f. tuner can be taken from the f.m. set into which it is to work. The unit to be described uses a transistorised u.h.f. tuner, although there is no reason why a valved type should not be used. If the "parent" f.m. set is transistorised, then a valve u.h.f. tuner would require its own power supply, and it could be cheaper in that case to throw away the valve tuner and buy a surplus transistor one instead. For readers who may have a valved f.m. receiver, a few notes on using a valved tuner will be given at the end of the article.

Most transistorised u.h.f. tuners require between 9 and 15 volts (positive with respect to chassis), and at a nominal 12V require a current of about 7 to 10mA. For setting up purposes a 9 volt battery such as a PP3 or PP9 is quite adequate – in fact a permanent installation could run off one, although space somewhere would have to be found for an ON/OFF switch.

Modifications

The first step is to modify the tuning of the u.h.f. tuner, and to do this it has to be powered up. Transistor tuners usually come with three leads – i.f. output; +12V and chassis. Unsolder the i.f. output lead and attach about one metre (three feet) of single unscreened wire to the i.f. output pin. Unsolder the +12V lead and attach a 9 volt battery between that terminal and chassis. See Fig. 1.

Some tuners have mounted on them a small sub-panel carrying a preset potentiometer, a zener or v.d.r., and a high-wattage resistor. These tuners were designed to be powered from the h.t. line of a valved receiver. The large resistor, generally between 5k and 12kΩ, drops the h.t. of around 200V down to 12V and the zener or v.d.r. stabilises it. The preset potentiometer (with or without standoff resistors at one or both ends) sets the bias on the base of the r.f. amplifier stage, and thus acts as a "local/distant" control. For our purposes, initially at least, wind this preset up to maximum clockwise. Temporarily remove the zener or v.d.r. and connect the battery across the vacant terminals, see Fig. 2. If the tuner is to be used with a transistorised f.m. receiver, the zener and high-wattage resistor can be removed altogether.

Now we come to the tuning. All UK-system u.h.f. tuners are designed to give out a standard i.f. of around 35MHz, with the vision i.f. above the sound i.f. The signal is transmitted with the sound carrier above the vision carrier, and so the tuner's local oscillator will be working some 35MHz above the incoming frequency to beat with it and give the usual i.f. out. What we need to do is to increase this difference to around 102MHz. It does not have to be exactly 102MHz, anywhere in a quiet part of Band II will do. Broadcasting covers up to around 98MHz, and then there are public service mobiles above that up to about 100MHz.

If just the oscillator were altered there could be large tracking errors. What was done in the prototype was to move the oscillator up by about 30MHz, and move the other tuned circuits down by a similar amount, so providing the required 102MHz difference.

The physical layout of a typical u.h.f. tuner is shown in Fig. 3. Some have only three tuned circuits, the aerial input being untuned. There are four (or three) trimmers which are at the ends of the lecher lines in the tuner, and which from

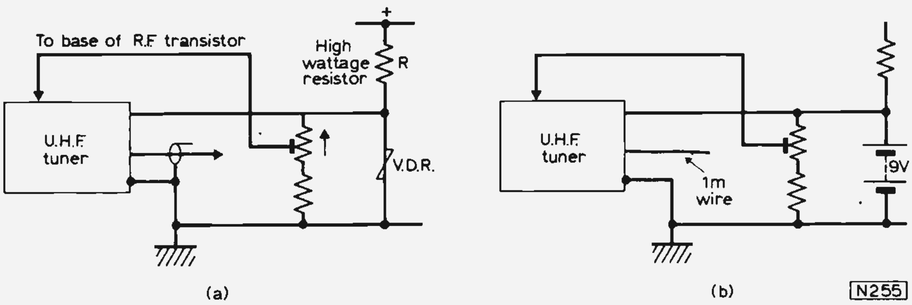
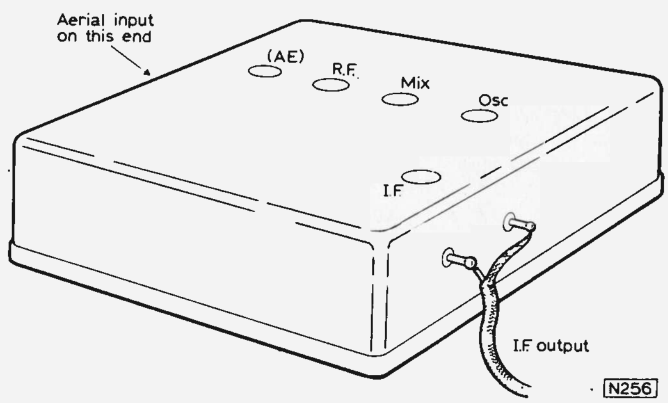


Fig. 2: Tuner with power supply components allowing operation from "valve" h.t. rails. (a) As supplied. (b) Modified ready for testing and realignment.

Fig. 3: Typical transistorised u.h.f. tuner physical layout.



the outside of the case appear as a row of four (three) recessed brass screws. These are quite often sealed with a rubbery compound of some sort, and it is a good idea to remove this carefully – a small sharp screwdriver will do the job. It should be easy to identify which trimmer is which with the aid of Fig. 3. There is one coil with a ferrite core and either a hexagonal or screwdriver type adjustment; this is the i.f. output coil, about which more later. Nearest to it is the oscillator lecher line trimmer, and in line with this and spread out across the case going away from the i.f. coil are three (two) more trimmers, all peaked to the same frequency.

Wind the wire soldered to the i.f. output terminal around the aerial input wire of the f.m. receiver, which should be tuned to 102MHz. Do not make a direct connection since many u.h.f. tuners have a small amount of d.c. on the output terminal. Connect a good TV aerial to the aerial socket or tags of the u.h.f. tuner. A really strong signal is essential because all the tuned circuits will be out of adjustment. Power up the tuner and rotate the tuning knob slowly until something is heard. A check with an ordinary TV set will help to identify what is being received.

Tuning

It will be noticed at this stage that the tuning is extremely critical, since there is no "intercarrier" principle at work here. In an ordinary TV set, the sound and vision carriers (at intermediate frequency) beat against one another at the detector to produce the 6MHz sound i.f. If the tuning is approximately correct there will be sufficient of both sound and vision to beat together; in other words the tuning is not that critical to get a sound output of some sort. With our modified u.h.f. tuner the sound i.f. is "on its own", as it were, and consequently the tuning is very critical. If the mechanical backlash of the u.h.f. tuner makes it very difficult to get the tuning spot on, get it as close as possible and use the tuning knob on the f.m. receiver as a fine tuner.

For the reception of just three stations, the use of a push-button u.h.f. tuner appears attractive at first sight. However, because of the problems mentioned above, it will generally be found necessary to readjust the tuning slightly each time the channel is changed. The push-button tuner is therefore not very practical in this application.

The presence of a signal means that the u.h.f. tuner is working, but the absence of a signal does not necessarily mean that it is not functioning. It may merely mean that the aerial signal is not strong enough to overcome the fact that the u.h.f. tuner is way out of adjustment. So if no signal is heard (and even when one is) unscrew the oscillator trimmer one turn and try again. Something should now be heard. Screw in the other three (or two) trimmers one turn and the signal should get a lot louder. If these trimmers peak when screwed in even further – say two or more turns – then the oscillator trimmer requires more adjustment. The idea is to unscrew the oscillator trimmer approximately the same amount as the other ones are screwed in, whilst maintaining maximum signal strength at the output.

When this has been done, set the u.h.f. tuner to receive the centre channel of the local three, and carefully peak all the trimmer adjustments. Any tracking errors between the four (or three) tuned circuits will then be averaged out over the two outer channels. When making these final adjustments, reduce the strength of the aerial signal, as otherwise the a.g.c. in the f.m. receiver will tend to mask changes in output level from the tuner. With the prototype, a half-metre (18in) length of wire was found to be sufficient as an aerial, but obviously there will be wide variations with locality.

Changing the i.f.

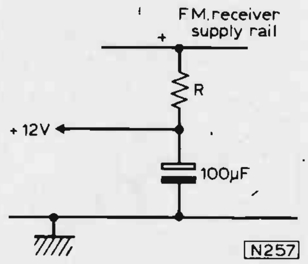
So far we have adjusted the trimmers in the u.h.f. tuner, and this can be done without taking the back off the tuner. The next step is to modify the i.f. output coil in the tuner, and for this the back has to be removed. There is only one i.f. coil, and so its identification should not be too difficult. It will be found that there are about fifteen turns on the coil, of which roughly one-third are to be removed. Count the actual number of turns fitted, unsolder the top end (as seen from the back), and cut off and discard the requisite number, then solder the free end to the vacant tag at the top of the coil.

Connect the battery to the tuner again and peak the i.f. coil (if it will) for maximum sound. If the peak is "coming" but the core is nearly out, remove another turn and try again. Obviously this cannot go on *ad infinitum* so do not remove more than half the original number of turns. The adjustment is by no means critical.

Power supplies

Now we come to the power supply arrangements. If possible, run the u.h.f. tuner off 12V and measure the current consumption. If this is not feasible, assume a current of 7mA and base your calculations on that. A transistor f.m. receiver will run off anything from 9V to 50 or 60V depending upon its design, and whether or not there is an output stage. There is also the problem of whether the supply is positive or negative with respect to earth. If the supply rail is positive then there is no problem. If the supply rail is negative, or for some reason you want to use a battery-powered f.m. receiver, a separate supply will have to be provided for the tuner. Assuming that the receiver is mains powered, it should not be too difficult to find the small amount of power required. A few minutes investigation with the aid of circuit diagram or testmeter should provide the necessary information.

Fig. 4: Deriving tuner power from an f.m. receiver with a positive supply rail.



If the receiver h.t. rail is positive, take its nominal value, assume a current of 7mA for the u.h.f. tuner, and work out the value of dropping resistor R required to produce 12V (see Fig. 4). The 12V rail should be decoupled with an electrolytic capacitor of 100μF or so, with a voltage rating at least equal to the f.m. receiver's h.t. rail, in case the tuner should be unplugged whilst the power is on, whereupon the voltage across the electrolytic will rise to the value of that h.t. rail. Connect everything up temporarily and measure the nominal 12V. If it differs much from the correct value, the dropper resistor will need to be changed. A $\frac{1}{2}$W component should be more than adequate here.

If the receiver h.t. rail is negative with respect to earth, its power supply is bound to take one of the basic forms shown in Fig. 5. If yours corresponds to Figs. 5(a) or (b) you are in luck; all that is required is to connect the circuit of Fig. 5(d) to the point marked "X". The diode D can be an OA81 or 1N4002 for receivers having supply rails up to about 50V, or an OA202 or 1N4003 for voltages above that. The electrolytic C should have a working voltage at least equal to the receiver supply. A dropping resistor arrangement similar to that of Fig. 4 will generally be required. This approach is not possible with the circuit of Fig. 5(c). If your f.m. receiver is like this then you will unfortunately need to make other arrangements, either using a separate transformer or a permanent battery supply.

A valved f.m. receiver will have a high value of h.t. at switch-on, especially if it has a semiconductor rectifier, which will drop as the valves warm up. The 12V rail will therefore need to be stabilised by means of a zener or v.d.r., as in Fig. 2(a). If the u.h.f. tuner is ex-equipment it could well have these components already fitted, although the value of the dropper resistor may have to be altered if the f.m. receiver's h.t. rail is very different from the 200V generally used in TV sets. To calculate the required resistor value, first measure the h.t. voltage of the f.m. receiver. Assume a standing current of 10mA through the zener or v.d.r., add to this the 7mA or so of the u.h.f. tuner, and Ohm's law will give you the resistor value. This will need to be a 5W (or possibly larger) component.

F.M. Receiver input

It is necessary to provide the f.m. receiver with an extra aerial socket of some sort for the u.h.f. tuner output to feed into. A light capacitive coupling to the main f.m. aerial input is all that is required, and so any problem of mismatching of the f.m. aerial to its receiver does not arise. It is convenient to feed the 12V supply to the u.h.f. tuner down the same piece of wire that the signal comes in on. This means that the only connection required between the u.h.f. tuner and its "parent" f.m. set is a single coaxial cable. The supply is inductively coupled at both ends, and the signal capacitively so, see Fig. 6. The two inductors can consist of a few turns of thin self-supporting wire, or alternatively any r.f. choke could be pressed into service. The capacitors at each end are 10pF, though the one at the f.m. receiver end can sometimes be replaced by a few turns of insulated wire wrapped around the existing lead from the f.m. aerial socket to the aerial input coil, see Fig. 7.

Some f.m. receivers already have a socket of sorts that can be used, in the form of a 300Ω aerial input, as well as the more usual 75Ω coaxial socket. Spare 300Ω type aerial plugs are available from a number of HiFi accessory suppliers, and from RS Components. Alternatively standard 2mm banana plugs can be used. Obviously, steps must be taken to ensure that the plug(s) are inserted the right way round, or the d.c. supply to the tuner will be reversed.

Final adjustments

Setting up is very simple. Connect up the receiver to the u.h.f. tuner, set the "local/distant" control on the tuner to maximum and switch on. Tune the f.m. receiver to a quiet part of the band around 100 to 104MHz, and tune the u.h.f. tuner to the centre channel of the local three. Since the sound i.f. is not set well down the vision i.f. response, as it would be in a normal television i.f. strip, there is every chance that there will be some vision buzz on sound. This can be removed by turning down the "local/distant" control

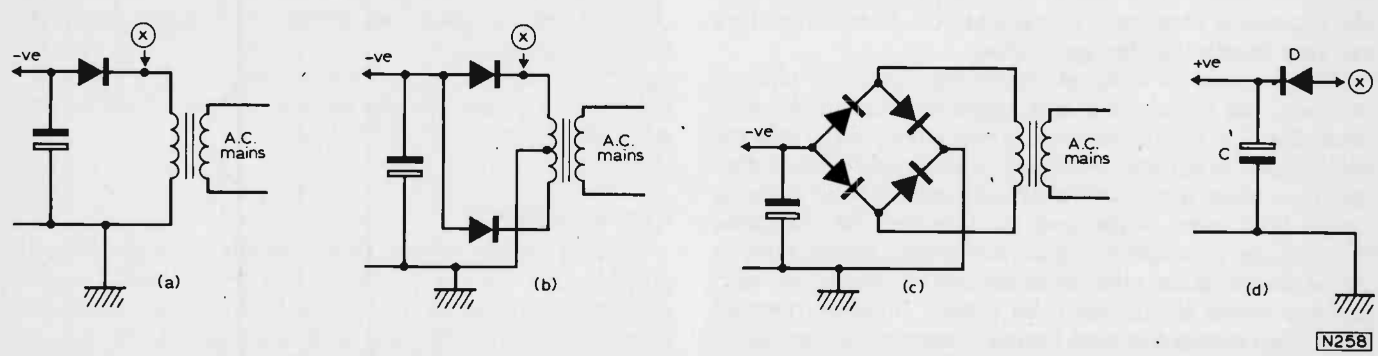


Fig. 5: Three possible basic power supply arrangements for an f.m. receiver with a negative supply rail – (a) half-wave; (b) full-wave; (c) full-wave bridge; (d) Circuit for deriving power for the u.h.f. tuner from the arrangements (a) or (b).

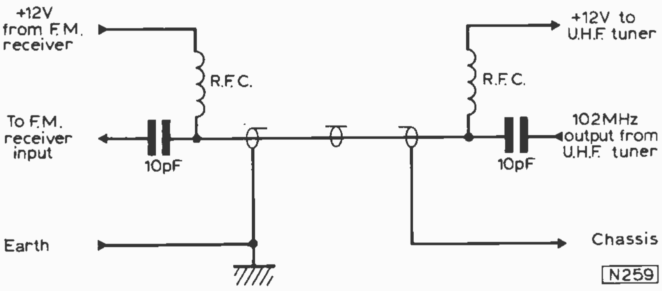


Fig. 6: Circuit arrangement for running power to the u.h.f. tuner via the signal coaxial cable.

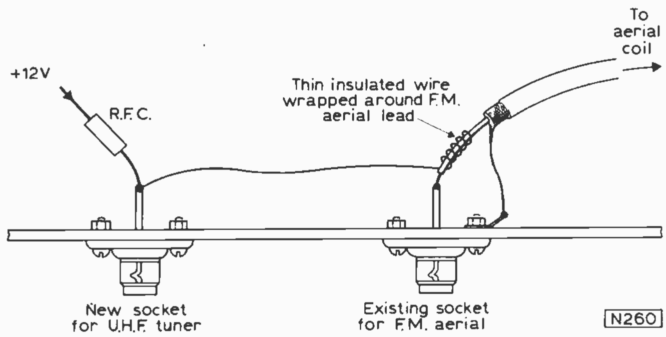


Fig. 7: Coupling the u.h.f. tuner output to the f.m. receiver aerial input circuit.

until it disappears – too much will give rise to a background hiss – or by fitting an aerial attenuator. Alternatively a smaller aerial could be used to reduce the amount of signal pick-up; perhaps a loft aerial.

The prototype has now been in use for about two years and has given no trouble at all. As an added bonus, it enables sound recordings to be made from the television channels without the TV set being switched on.

Using a valved tuner

A valved u.h.f. tuner can be used if desired, though this is really an economical proposition only if the "parent" f.m. receiver is valved also, and is able to provide the necessary power supplies. The method of alignment of the tuner remains the same as before.

As h.t. and l.t. must be provided, there is no point in passing d.c. along the coaxial output cable since extra wires will be needed anyway, although if the f.m. receiver has one side of its heaters earthed, it would be possible to use double screened coax. This has one inner and two separate, isolated coaxial outers, and so both h.t. and l.t. could go down the same cable.

Valved u.h.f. tuners invariably use a PC86 and a PC88 with their heaters wired in series, requiring a supply of 7·6V at 300mA. Using new valves, the tuner will operate at somewhat reduced efficiency from a standard 6·3V heater winding, but elderly valves are unlikely to have sufficient emission. The h.t. required is in the order of 170V at about 20mA. As before, the h.t. volts of the f.m. receiver must be determined and a value for the dropping resistor worked out.

The sort of socket required on the f.m. receiver to carry the signal, heaters, h.t. and earth can be something like a DIN socket. Avoid the 180° DIN 5-way type because, sooner or later, a piece of audio equipment will get plugged into it with disastrous results. Use one of the other 5-way types or a 6-way DIN. ■

next month in Television

● DIRECT-READING CAPACITANCE METER

This simple battery-powered design, based on the use of an NE555 timer i.c., gives direct indication of capacitance values from a few picofarads up to 10μF. A d.c. test voltage is used, allowing the measurement of polarised capacitors and the capacitance of reverse-biased semiconductor junctions.

● SERVICING THE TANDBERG CTV2-2 CHASSIS

The Tandberg CTV2-2 chassis is in many ways typical of the latest generation of large-screen, 110° deflection continental colour receivers, with a switch-mode power supply and making extensive use of i.c.s. W.S.J. Brice describes the various faults he has encountered.

● AERIAL PERFORMANCE

Roger Bunney and Ian Beckett have been investigating the relative performance of various well-known u.h.f. aerials. Their results form an interesting follow-up to Pat Hawker's recent articles.

● SMALL PICTURE AND RELATED FAULTS

Lack of height, bottom cramping and other forms of non-linearity, and field sync problems are common faults with older TV sets. John Law provides a comprehensive guide to the causes of such faults.

● FIELD TB CIRCUIT FOR THE PIL TUBE

Recent solid-state chassis use a wide variety of field timebase circuits. As an example of some of the latest techniques S. George investigates the circuit used in the Korting 55636 chassis, which is fitted with a PIL colour tube.

● WHICH PATTERN?

E. Trundle's test equipment survey next takes a look at the various patterns available to the service engineer.

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CEEFAX/ORACLE reception techniques

Steve A. MONEY T. Eng. (CEI)

PART 10

THE earlier articles in this series have dealt with the basic techniques required for decoding, storage and display of a text page from a CEEFAX/ORACLE transmission. Apart from this basic page display there are one or two additional features available in the full teletext system. In this the final article of the series these additional facilities will be described and the required techniques to deal with them explained.

Page types

The specification for the broadcast teletext system provides for the transmission of three different kinds of page which are defined as types A, B and C.

Type A pages are the normal simple pages where the page is selected by a three-digit decimal number from 000 to 799. The first digit of this number is the magazine code which is sent with every row of text, whilst the other two digits are the page number sent out during the page header row. To select a type A page the viewer selects the required three-digit page number using thumbwheel type switches or a keyboard associated with the decoder unit.

Most of the pages in a transmission will be sent out in number sequence and the whole series of pages carried on the channel will be repeated every half minute or so according to the number of pages being transmitted. At the moment the BBC with a magazine of less than 100 pages uses the same magazine number for all of the pages on the channel. On the other hand ITV with a selection of about 150 pages uses several magazine numbers but only some of the pages of each magazine.

It would be possible to send out 800 pages of text on one channel by using all of the magazines but the delay time between selecting a page and the display of that page on the screen would be as much as three minutes. As anyone who has waited in a bus queue will know, three minutes can seem like eternity when one is just waiting and such a delay would be unacceptable to the average viewer. In practice magazines are likely to be between 50 and 200 pages to give reasonable access times.

Some pages, such as the index, are likely to be selected more frequently than other pages. To reduce the access time for such pages it is usual to insert repeats of these out of sequence during the transmission of the rest of the magazine. Thus an index page might be sent out at ten-page intervals during the transmission. In this way a viewer selecting the index would get an almost immediate display of the index instead of having to wait for the rest of the magazine to be sent out.

The information presented on type A pages may either remain the same all day or be updated, from time to time, during the day as new information comes in.

Rotating pages

Sometimes there may be several pages of text dealing with the same topic, such as sports results. These could be given separate page numbers in the normal way and be sent out as type A pages. The viewer would then have to select the pages in sequence in order to read all of the information and several pages of the available magazine space would have been used up. An alternative approach is to allocate one page number to the whole set of pages of information and then to send out the different pages of text in sequence using that same page number.

Pages sent out in this fashion are defined as type B and referred to as "rotating" pages. Each page would be sent for a period of perhaps a minute or so to allow the viewer sufficient time to read the text and then the next page in sequence replaces it on the display. The whole set of pages might be repeated every ten minutes or so. Now the viewer merely selects one page number and the series of pages of text are presented automatically at intervals without any further action from the viewer. The number of pages and the period of display would be determined by the editorial staff at the transmitting end.

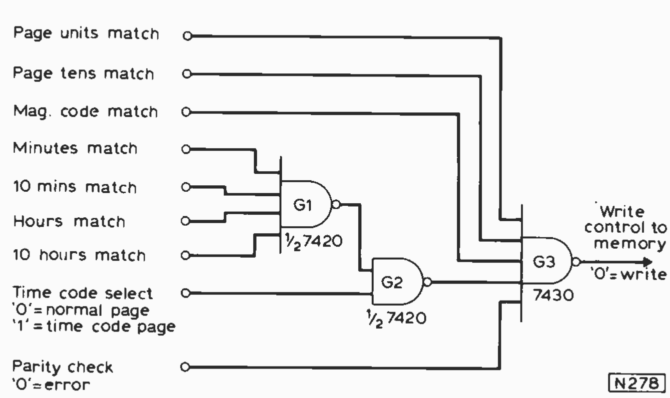


Fig. 55: Decoding logic for time coded type C pages.

As far as the decoder is concerned the type B pages will appear to be exactly the same as the normal type A pages although for a correct display some precautions may need to be taken to ensure proper operation of the page memory.

To reduce transmission time and allow faster access to the selected page any blank rows which occur at the bottom of a page may be omitted from the transmission. If there are several blank rows at the bottom of the new page then the corresponding rows in the page memory would not be over-written and the data from the previous displayed page would be retained. This unwanted data would now be displayed at the bottom of the new page of text. To get round this problem a special "clear page" command would normally be sent out before the data for the new page. This clear page command is controlled by the unused bit of the tens of minutes word in the page header row. When this control bit is set to 1 the decoder memory must be completely cleared ready for the new page of text to be written in. Normally this clearing process can be carried out during the next display scan by writing 0s into each memory location as it is selected for display.

Time coded pages

A further method of increasing the number of pages that can be sent out over a single channel is to make use of the time code in the page header row as part of the page address. In this way it becomes possible to have up to 1440 different editions of a particular page of text during a 24 hour transmission period.

The page identifier now consists of both the normal page number and the time code. Thus we might select page 152-1235. The decoder will now accept the particular set of text for page 152 which is received during the one minute period between 1235 and 1236. During the following one minute period the transmission for page 152 will have a different set of text which could be selected by using the page code 152-1236. Pages which are coded and used in this way are defined as type C pages.

Time coded type C pages allow for the possibility of a select now and display later type of operation. In fact the selected page might be stored during a TV programme and then displayed at the end of the programme, provided that the time code occurs during the programme period. To ensure the reception of correct data the time coded page may be sent out as many as four times during the minute following the selected time. If the time code is not used the decoder will treat the type C page like a type A page.

To select a time coded page an additional four-digit thumbwheel switch is needed in the decoder unit to deal with the time code part of the page address. On decoders using a keyboard entry system it will be necessary to key in a further four digits after the page number. Normally a switch on the decoder will be used to control whether the unit is to select a time coded page or a simple page.

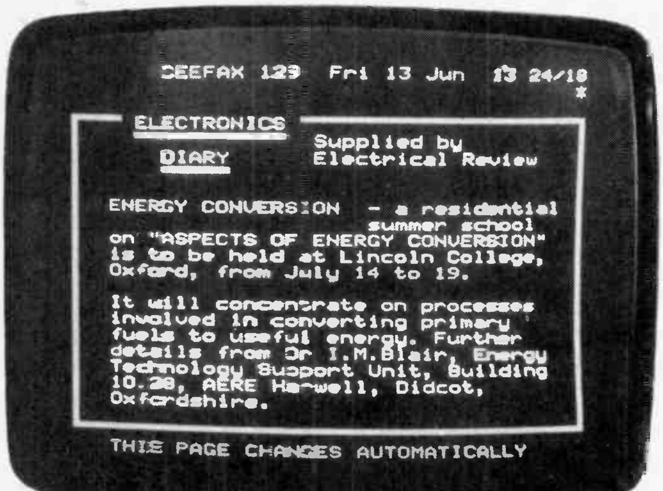
A typical arrangement for the selection of type C time coded pages is shown in Fig. 55. The four detected time code words are compared with the selected numbers on the time code switches in the same way as the page codes were compared as described in Part 3 of this series. The four time code match signals are then gated together in gate G1 which produces a 0 output when the complete time code matches. This signal is next passed to gate G2 where the selection of the type of page required is carried out.

If the second input of gate G2 is set at 0 its output will go to 1 irrespective of the state of the time code match and any page with the correct page number will be selected and stored regardless of its time code. This is the normal type A

BITS				B7 → B6 → B5 →	0 0 0	0 0 1	0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
B4 ↓	B3 ↓	B2 ↓	B1 ↓	COLUMN → ROW ↓	0	1	2		3		4		5		6		7	
0	0	0	0	0	NUL	DLE			0		@	@	P	P	—		p	
0	0	0	1	1	ALPHA RED	GRAPHIC RED	!		1		A	A	Q	Q	a		q	
0	0	1	0	2	ALPHA GREEN	GRAPHIC GREEN	"		2		B	B	R	R	b		r	
0	0	1	1	3	ALPHA YELLOW	GRAPHIC YELLOW	£		3		C	C	S	S	c		s	
0	1	0	0	4	ALPHA BLUE	GRAPHIC BLUE	$		4		D	D	T	T	d		t	
0	1	0	1	5	ALPHA MAGENTA	GRAPHIC MAGENTA	%		5		E	E	U	U	e		u	
0	1	1	0	6	ALPHA CYAN	GRAPHIC CYAN	&		6		F	F	V	V	f		v	
0	1	1	1	7	ALPHA WHITE	GRAPHIC WHITE	'		7		G	G	W	W	g		w	
1	0	0	0	8	FLASH	CONCEALED DISPLAY	(		8		H	H	X	X	h		x	
1	0	0	1	9	STEADY		)		9		I	I	Y	Y	i		y	
1	0	1	0	10	END BOX		*		:		J	J	Z	Z	j		z	
1	0	1	1	11	START BOX	ESC	+		;		K	K	←	←	k		¼	
1	1	0	0	12			,		<		L	L	½	½	l		‖	
1	1	0	1	13			—		=		M	M	→	→	m		¾	
1	1	1	0	14	SO		.		>		N	N	↑	↑	n		÷	
1	1	1	1	15	SI		/		?		O	O	#	#	o			

N279

Fig. 56: Revised symbol coding for teletext, currently in use on BBC1 and shortly to be tested by the IBA.



Type B "rotating" pages can be used for all sorts of information – a few examples are shown above.

Photographs by courtesy of G.E.C. Hurst Research Laboratories, Wembley.

page operation. If the input to G2 is set at 1 then the page will only be accepted if the time code and the page code match simultaneously. From gate G2 the signal is gated with the match signals for the Page Tens, Page Units and Magazine code. These signals are also gated with the parity check signal to produce a Write control line for the memory unit. Thus only the correct page will be written into the memory. Once stored a time coded page remains in the memory until a new page is selected.

Revised symbol coding

Since the earlier articles in this series were written a revised version of the specification for the broadcast teletext system has been drawn up. This new specification incorporates a number of minor changes designed to improve the service and based upon the experience of transmission tests carried out over the past year. Whilst the main part of the original version produced in late 1974 is retained, some changes have been made in the character code table. The revised version is shown in Fig. 56. It will be found that some useful fraction symbols have replaced slash and bracket symbols in the earlier coding and the positions of some other symbols have been altered. Decoders which use a character ROM with the ASCII or ISO7 character set would still display letters, numbers and most of the other signs correctly but the revised signs will be shown incorrectly. For a correct display a new ROM containing the symbols of the revised code will be required. Since the changes are minor however, the majority of teletext data displayed will be correct even with an ISO or ASCII character generator.

Changes in the function of some of the control codes in the first two columns of the table have been made which might have more serious effects. Here the alphanumerics shift codes have been moved into column one and some small changes are needed in the shift code detection logic to give correct operation. A revised arrangement for this logic is shown in Fig. 57. Here the basic logic is more or less the same as before but the input signals have been changed around (see Fig. 43 in the January issue). Bit 5 is now used to select either the graphics or alphanumerics mode whilst bits 4, 6 and 7 are used to identify the shift command codes. Colour selection is unaffected but identification of colour change codes now uses the combination 000 of bits 7, 6 and 4.

One or two additional control codes have been added to the table. These codes are normally used in the control of computer data terminals and it seems likely that they have

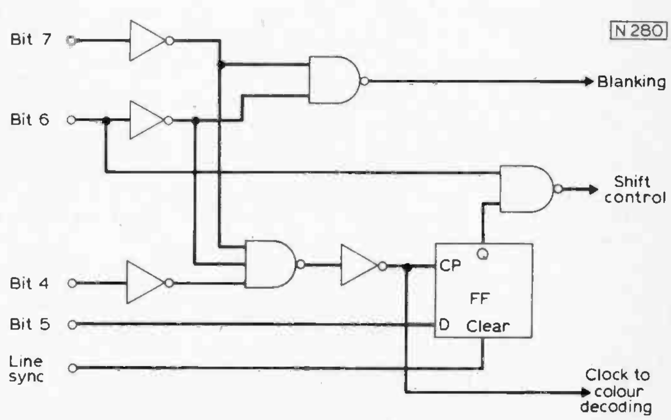


Fig. 57: Shift logic for use with the revised symbol code.

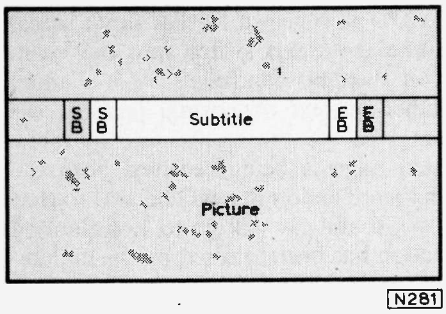


Fig. 58: Arrangement of a subtitle display, showing position of SB (Start Box) and EB (End Box) commands.

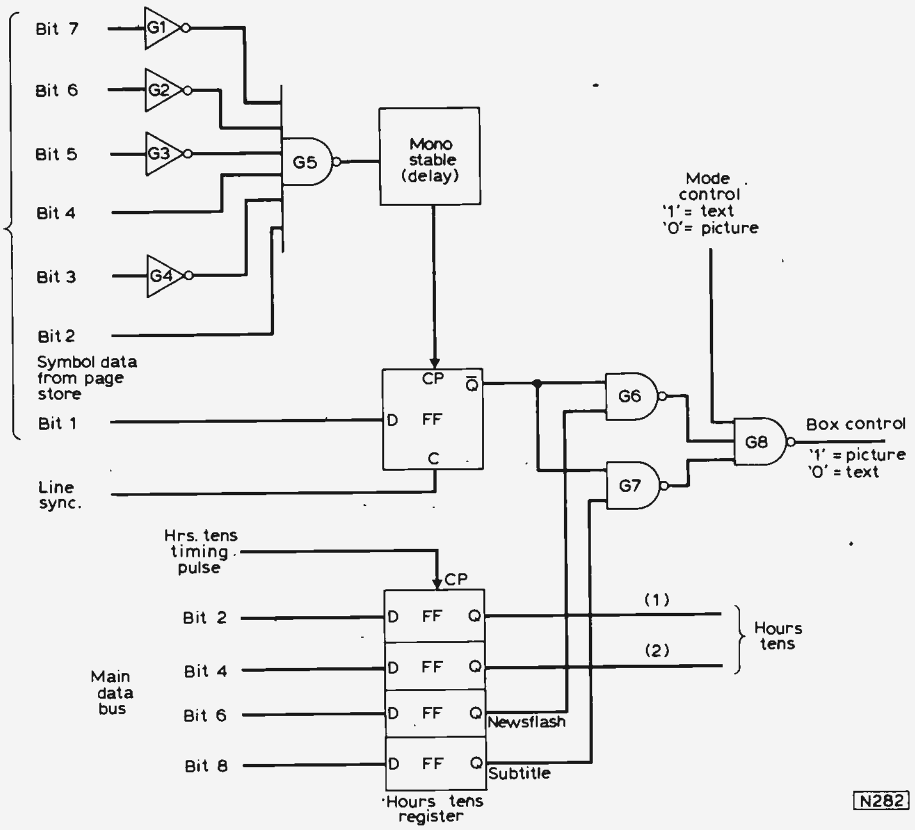


Fig. 59: Box control logic circuitry.

been included to provide compatibility with the Post Office Viewdata system.

At the time of writing the BBC are transmitting the new code on one television channel whilst the older code continues to be used on the other channel. ITV have not yet announced their plans to change to the new coding and for the present ORACLE uses the older coding. By autumn 1976 it is expected that all CEEFAX and ORACLE services will be using the revised specification.

Boxed displays

Normally the text display is presented on the screen in place of the normal television picture. A switch on the decoder unit can be used to select whether picture or text is displayed. It would be possible to superimpose the text on top of the picture but usually this produces a confused display which makes the text difficult to read.

For the display of subtitles and newsflashes it is convenient if the text can be inserted into a blanked out "box" in the picture area. This type of display can then be controlled by using the Start Box and End Box commands from the symbol code set.

A boxed type display can only be used on certain special pages used for subtitles or newsflashes. These pages are identified by means of a pair of control bits in the page header row. The two bits for this purpose are the unused message bits in the tens of hours word. The third message bit in this word identifies a "newsflash" page when it is set at the 1 level. For a "subtitle" page the fourth message bit of the tens of hours word is set at 1.

To display a subtitle a pair of Start Box commands is inserted into the text row just before the subtitle text. In the decoder under normal conditions the picture will be switched off to open the box at the point after the first Start Box command. Two commands are sent to provide some protection against interference when the first command might be lost due to an error in the code.

After the Start Box commands the text is displayed on the screen in place of the normal picture. To close the box a pair of End Box commands are inserted into the row of text. Once again the operation is arranged to occur after the first command and at this point in the line scan the picture signal is restored to the screen.

When more than one row of text is to be inserted into the picture the box must be opened at the start of each row of text. At the end of each row of text the box is closed automatically so that if the full row is used for text there will be no need for the pair of End Box commands at the end of the row. Fig. 58 shows the general arrangement for a short subtitle. Logic which might be employed to detect the box commands and produce a control signal for switching the display between picture and text is shown in Fig. 59.

The combination 000101 of bits 7, 6, 5, 4, 3 and 2 is detected using gates G1 to G5. This code indicates that the command being received is a box control code. The output from gate G5 is used to trigger a monostable which in turn generates a delayed clock pulse for the control flipflop FF. The data input to this flipflop is driven from bit 1 of the code word. When this bit is at 1 in a box command the flipflop is set and the box is opened. An End Box code has a 0 in this bit position so the flipflop is reset and the box is closed. The $\overline{Q}$ output from the flipflop is used to generate a control signal for a video switch circuit which selects either the normal picture or the text display.

To ensure that the box is closed at the end of each row of text the line synchronising pulse can be used to reset the box control flipflop directly. Since the same set of symbols will be repeated for each of the ten scan lines making up a row of text the box control line must be switched on and off during each line scan as the row is displayed.

The newsflash and subtitle page identification bits in the Tens of Hours word are gated with the output from the control flipflop using gates G6, G7 and G8. This ensures that the box control signal can only be passed through to the video switch when either a subtitle or newsflash page is

Boxed displays can be used for Newsflashes or Subtitles, and can be displayed against a dark or light background.

Photographs by courtesy of G.E.C. Hurst Research Laboratories, Wembley.

to be displayed. Gate G8 can have a further input signal applied which will force the video switch into the video position. This line can then be controlled by a manual switch to select whether teletext or normal pictures are displayed on the screen.

When a normal text page is being received both the subtitle and newsflash identification bits will be at 0 so that the outputs from gates G6 and G7 will go to 1. Assuming that text display operation has been selected by the manual switch all three inputs to gate G8 will now be at 1. This gives a 0 at the output of gate G8 which in turn sets the video switch into the text state.

When a subtitle or newsflash page is being received and the decoder is set to provide boxed displays the page header row will not be presented on the screen. The format of the header row is the same for all pages and does not include any box control commands so the display will remain in the picture condition. If the box control logic is disabled the subtitle or newsflash page will be displayed in the same way as other pages of text.

Video switching

A changeover switch circuit must be provided in the video amplifier circuits of the receiver if teletext is to be displayed. For box displays this switch cannot be manual since it must be controlled by the decoder. The arrangement of this video switch will depend upon the video circuitry used in the display receiver.

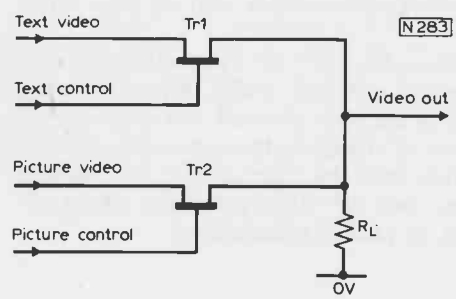


Fig. 60: A video switch using two f.e.t.s.

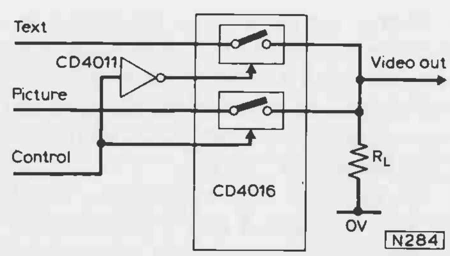


Fig. 61: A video switch using the CD4016 CMOS integrated circuit.

A simple way of providing an electronic changeover switch for the video is to use field effect transistors in series with the picture and text signals as shown in Fig. 60. When one of the f.e.t.s is turned on the video signal applied to it will pass through to the following video amplifier. If the f.e.t. is turned off it effectively isolates the input signal because the series impedance is very high. The control circuit is arranged so that when one f.e.t. is turned on the other is turned off thus producing a changeover switch. Now if Tr1 is on, the text will be displayed whilst if Tr2 is turned on the normal picture is displayed.

A CD4016 CMOS integrated circuit could be used for the changeover switch. This device contains four separate f.e.t. switches in one package and could be used to make

continued on page 321

TV TEST PATTERNS & SIGNALS

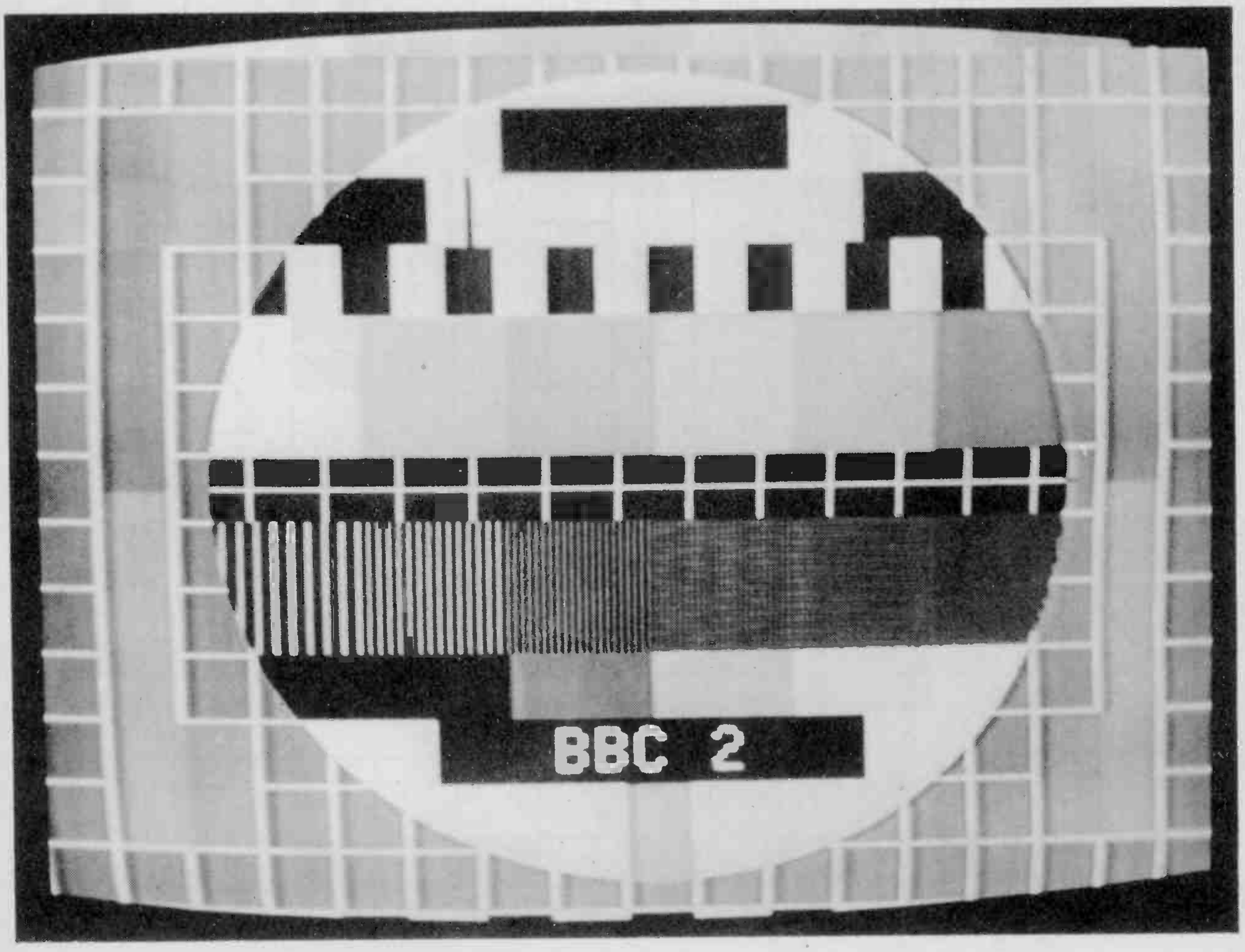
PART 1

8-PAGE SUPPLEMENT 'TELEVISION' APRIL 1976

IN a previous supplement (October 1974) we dealt with test card F. This card has now been superseded to some extent by the all-electronic Philips PM5544 pattern – which the BBC transmits in a slightly modified form as test card G (not to be confused with the earlier test card G which is a variant on the old test card C).

The basic PM5544 pattern is widely used by manufacturers, large scale service depots, and, as readers to Roger Bunney's columns will appreciate, by many broadcasters world wide. It is designed to give a comprehensive check on all aspects of a colour TV system, and the first part of this supplement details its facilities.

In modifying the pattern to become the new test card G the BBC have retained many of these facilities, changed some to correspond with test card F, and removed others considered to be too critical to pass undistorted through the system or to be displayed in domestic conditions. Test card G is radiated from regional centres when links are not available, and may be networked if the test card F generator is not in use. How it differs from the basic PM5544 pattern is dealt with later.



An off-air photograph of Test Card G. The vertical stripe pattern of the Sony Trinitron tube is clearly visible.

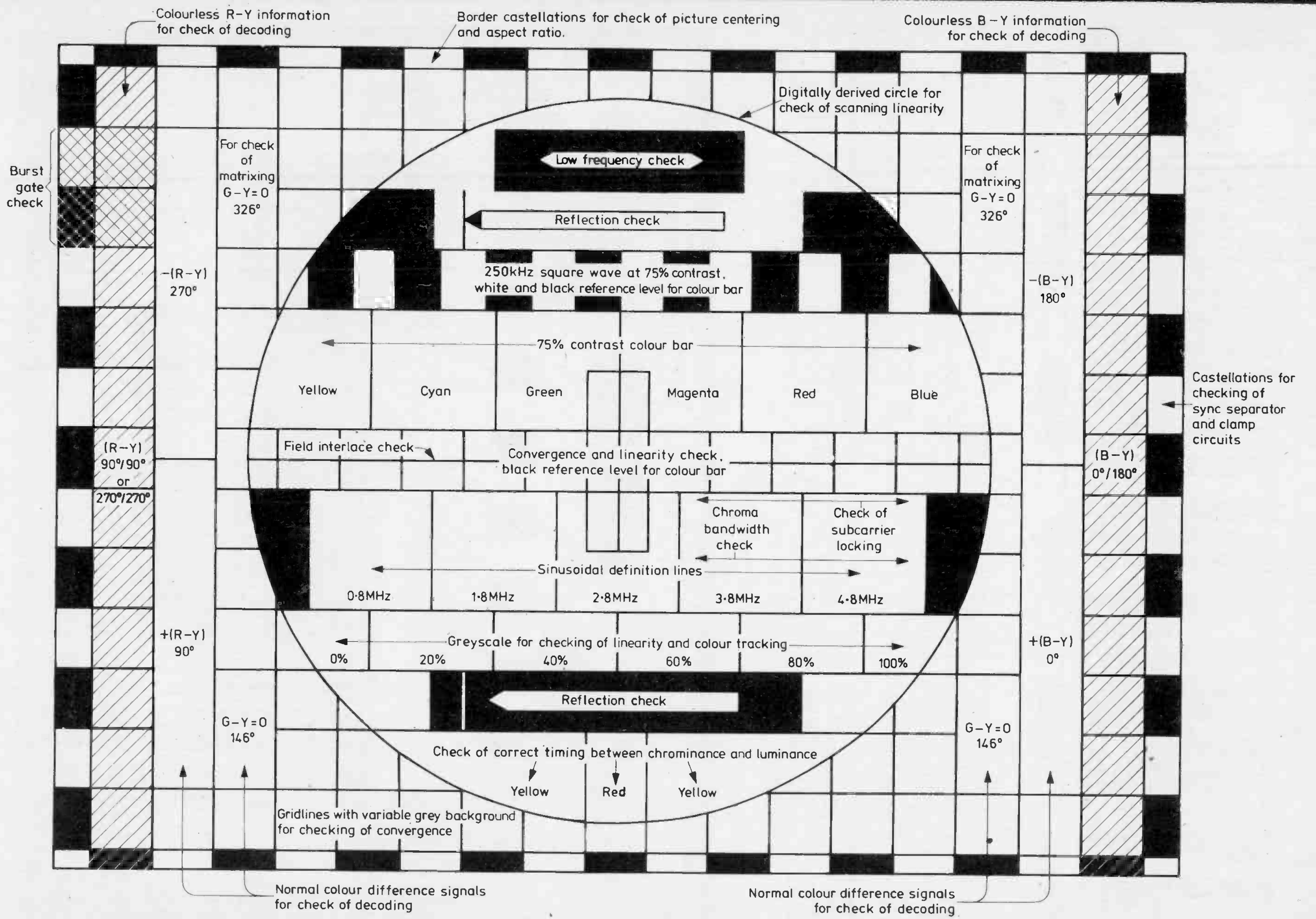


Fig. 1: The basic PM5544 test card, with features identified.

The basic PM5544

(see Fig. 1)

LUMINANCE CHECKS

Aspect ratio and picture centring

The castellated border provides accurate picture centring. The side borders are wider than those at top and bottom, and with current receivers correct setting-up is achieved when the inside edge of the castellations is just visible within the picture area of the tube.

Picture Geometry

The centre circle, electronically generated in four quarters, is stable and accurate. Used in conjunction with the background crosshatch, it enables precise settings of timebase amplitude and linearity to be made.

Convergence

The crosshatch, in conjunction with the horizontal centre line and centre cross, is for use in checking static and dynamic convergence. The horizontal bars are two scanning lines each, and with the vertical lines 230ns wide (just over 2T) equal resolution of the pattern in both planes is possible with the set correctly on tune and the contrast and brightness set to give an over-contrasted picture.

Line Sync

The side castellations extend from black to white, to provide the conventional "cogging" check on line sync.

Field Sync

Top and bottom castellations provide tne most critical conditions around the field sync pulse. A novel interlace check is given by comparing the thickness of the horizontal crosshatch lines with the thickness of the horizontal centre line.

The crosshatch lines are a pair, one from an odd field above one from an even field. The centre line is a pair with the field sense reversed, i.e. top line even, bottom line odd. Pairing or poor interlace will show as a difference in thickness between the centre line and the others.

Grey scale

In the lower part of the circle is a grey scale of six steps at 0%, 20%, 40%, 60%, 80% and 100% contrast respectively.

FREQUENCY RESPONSE

Low-frequency response

In the top of the circle is a black "letter-box" on a white background. Smearing of the right-hand edge denotes poor l.f. response. A similar block lower down may also be used, but it could be overlaid by a station identification alphanumeric.

Reflections

In the white block below the "letter-box" is a black needle pulse of 230ns duration. Similarly in the black block below the grey scale is a similar white needle pulse. These provide a visual check on reflections and can be used with an oscilloscope for more precise evaluation.

Transient response

Just above the colour bar is a train of 250kHz squarewaves, limited to 75% contrast to reduce quadrature distortion (as well as for the matrix test which follows). These squarewaves permit checks on overshoot, preshoot, ringing, etc.

Resolution and bandwidth

The definition bars above the grey scale are fully modulated sinewaves on a mean grey background and correspond to frequencies – from left to right – of 0·8, 1·8, 2·8, 3·8 and 4·8MHz respectively. The frequencies are offset from even megahertz to avoid sound buzz. Being sinusoidal instead of squarewave the lines do not have sharp edges.

COLOUR CHECKS

Delay line circuit phase and gain adjustments

On either side of the circle is a pair of coloured "brackets". The left-hand one has positive and negative (R–Y) in the upright part, the right-hand one has positive and negative (B–Y) in the upright part. The little boxes which form the top and bottom corners of the brackets are at phasors 326° and 146°, i.e. at a point where (G–Y)=0.

Between each bracket and the castellated edge is a vertical strip of the crosshatch pattern which contains "colourless" information. The left-hand of these strips has *unswitched* (R–Y), and the right-hand one *switched* (B–Y). If there is no error in the system and the signal is being decoded correctly there will be cancellation of these signals and the bars will be the same grey as the background, free from tints.

If there is an *amplitude* error in the delay line/matrix circuit in the decoder (i.e. misadjustment of the direct signal amplitude) alternate lines of different colours – Hanoverian blinds – will appear in these two "colourless" end sections.

If there is a *phase* error (e.g. delay line input coil off tune) Hanoverian blinds will appear in the *coloured* (R–Y) and (B–Y) strips adjacent to the colourless ones as well as in the cyan and magenta strips of the colour bars.

Reference oscillator phase

If the decoder 4·43MHz oscillator is not correctly phased to the incoming burst the synchronous detectors will switch on late or early with respect to the delay line outputs and the colourless information will not cancel right out, throwing up a tint at either side of the pattern. This tint will be blue or green on the left, and pink or yellow on the right. If there is a common oscillator phase adjustment both tints will tune out together. If there are two separate adjustments, tune (R–Y) for a neutral right-hand bar and (B–Y) for a neutral left-hand bar.

Colour balance/drive controls

The colour bars on the standard PM5544 pattern are EBU bars (see later), i.e. 75% contrast, 100% saturation, as used by the IBA. These bars are directly beneath the 75% squarewave train used for transient checks.

To set up the colour-difference stages optically, first obtain a good grey scale then turn off the two appropriate guns (depending on your set) leaving only one colour displayed, e.g. blue. When the saturation and drive controls are correctly set the blue colour bar block will be of the same intensity as the adjacent black 250kHz squarewave block. Repeat the process with the other two guns, i.e. red and green. This is adjustment by eye.

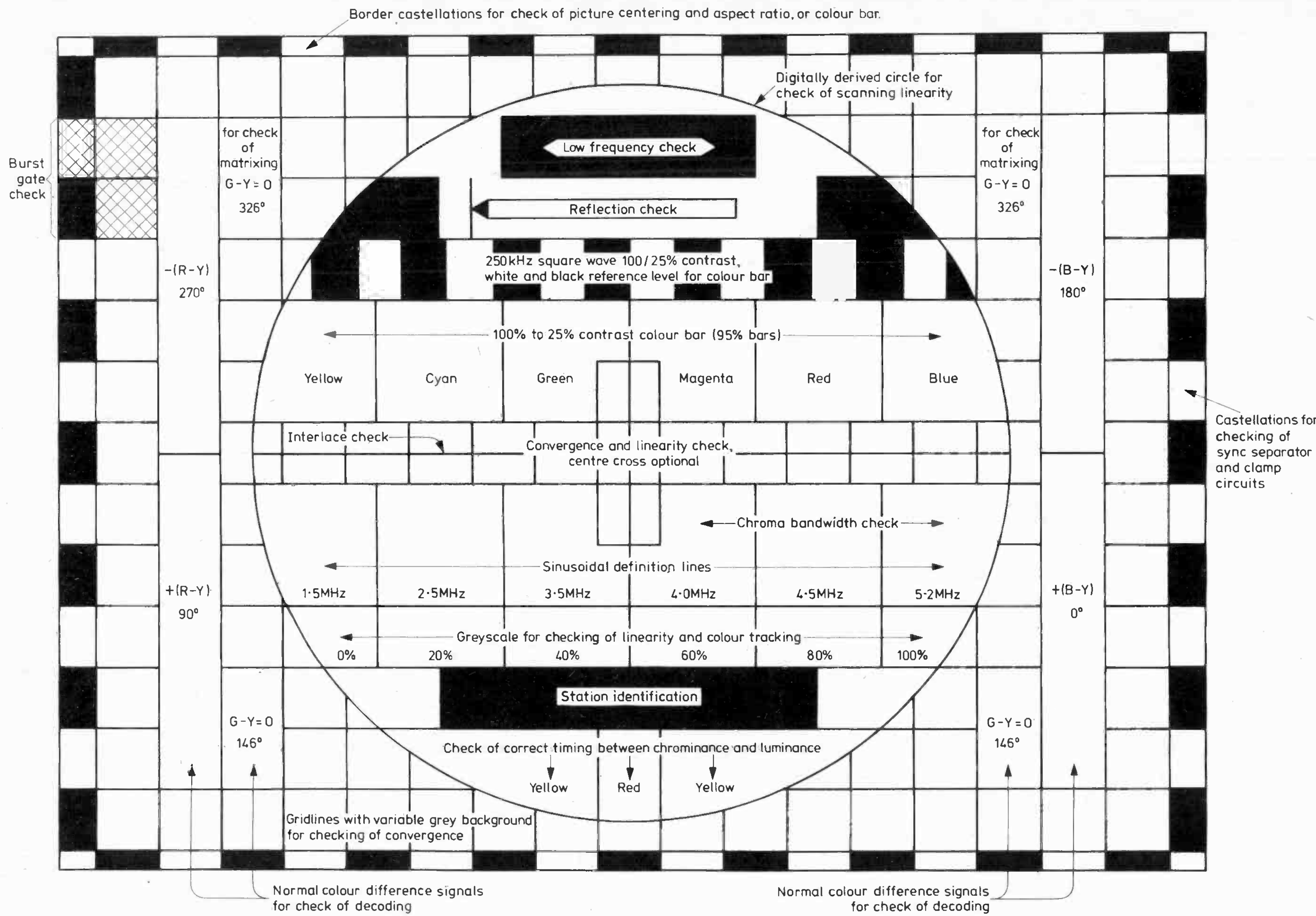


Fig. 2: The modified PM5544 – Test Card G – used by the BBC, with features identified.

The basic PM5544

(continued)

Using an oscilloscope, a further check can be made at the colour-difference outputs at line rate by looking at the contents of the first and last three vertical sections of the pattern.

Assuming that the delay and phase adjustments previously described have been correctly carried out, precise cancellation should be seen on the scope.

In the (B–Y) output there should be no signal in the two left-hand sections.

In the (R–Y) output there should be no signal in the two right-hand sections.

In the (G–Y) output there should be no signal in the third and antepenultimate (third from the end!) sections.

Colour fit

At the bottom of the circle is a yellow "cheese" with a 2μs red centre block. This red block is immediately above the centre bottom square of the crosshatch if the luminance-chrominance delay is accurate.

Colour bandwidth

The 4·43MHz colour subcarrier will produce moiré patterns, or "twinkle", in the 3·8 and 4·8MHz definition bars. Any asymmetry of the chrominance channel bandwith will show as unequal resolution of the moiré patterns.

Burst gating

The colourless information in the second and third blocks down of the left-hand vertical bar extends through the castellations to the start of the picture. If the burst gating is out to the extent that picture information gets through, altered colours and desaturation will occur horizontally to the right of these blocks.

The basic PM5544 pattern contains other useful features which are mainly the concern of broadcasters but are mentioned here out of general interest.

The information inside the circle may be replaced by a slide or caption.

A check on subcarrier locking is made by observing the moiré pattern in the definition bars. If the oscillator is locked to line frequency the moiré pattern is stationary.

For picture line-up purposes the lower square of the centre cross may be made 3% "blacker than black".

Test card G

(see Fig. 2)

As previously stated, there are a number of differences between the BBC's test card G and the basic PM5544 pattern. These are detailed below, in the same order as before.

Aspect ratio and picture centring: as PM5544.

Picture geometry: as PM5544.

Convergence: The vertical lines of the crosshatch grid are band limited, and may not therefore resolve equally with the horizontal lines without a little detuning. The central vertical line (centre cross) may be missing.

Line sync: as PM5544.

Field sync: as PM5544.

Grey scale: as PM5544.

L.F. response: as PM5544.

Reflections: As PM5544, except that the needle pulse is band limited.

Transient response: The 250kHz squarewaves extend from 25% contrast to peak white instead of from black level to 75% contrast.

Resolution and bandwidth: There are six frequency gratings, not five, and these are the same as on Test card F, namely 1·5, 2·5, 3·5, 4·0, 4·5 and 5·2MHz from left to right. They are sinewaves to 71·4% picture amplitude.

Delay line phase and delay: No test. The colourless information in the two end bars is not radiated.

Colour oscillator phase: No test, for the same reason.

Matrixing: Although the test is identical in method to the PM5544, the colour bars are 100-0-100-25 (95%) bars (see later) to match the 250kHz vernier (see transient response). Matrixing may be performed optically therefore, but due to desaturation oscilloscope checks may not be as precise.

Colour fit: No difference except that the red block is on a higher luminance pedestal.

Colour bandwidth: The colour moiré patterns should be visible in the last three blocks of definition bars. They will normally be most pronounced in the 4·5MHz block.

Burst gating: As PM5544. A block of colourless information extends through the castellations from the second and third crosshatch squares down from the top on the left-hand side. This small amount of unswitched R-Y could be used in an emergency to check phase and delay errors.

Top castellations: These may or may not be radiated. At times the electronically superimposed 95% colour bars take their place.

Colour bars

Reference has been made in the foregoing to "EBU bars" and "95% bars" on the assumption that the reader is fully aware of the difference. On looking back however the writer can find no previous references in the magazine to colour bar parameters, and a basic explanation is therefore given below.

Basic conception

If we apply three different squarewave signals of 100V peak-to-peak amplitude between the grids and cathodes of the three guns in a colour c.r.t. it is possible to display an eight bar pattern containing all three primary colours (red, green, blue), all three complementaries (yellow, cyan, magenta) and black and white. Although variations are possible, the convention (see Fig. 3) is to use one squarewave at line frequency for green, two squarewaves at line frequency for red and four squarewaves at line frequency for blue.

All the squarewave signals start positive, so the left-hand bar is white. All end at zero, so the right-hand bar is black.

Turn the colour off on a set displaying the colour bars and you are left with a grey-scale staircase of unequal

Colour bars (continued)

step heights. Why? Well, the recipe to produce white from the three primaries is approximately 0·6V green + 0·3V red + 0·1V blue = 1V white. So, reading from left to right the colour bar comprises:

White	=G+R+B,	i.e. a luminance content of 0·6+0·3+0·1=1V
Yellow	=G+R,	i.e. a luminance content of 0·6+0·3=0·9V
Cyan	=G+B,	i.e. a luminance content of 0·6+0·1=0·7V
Green	=G,	i.e. a luminance content of 0·6=0·6V
Magenta	=R+B,	i.e. a luminance content of 0·3+0·1=0·4V
Red	=R,	i.e. a luminance content of 0·3=0·3V
Blue	=B,	i.e. a luminance content of 0·1=0·1V
Black	=O,	i.e. a luminance content of 0=0V

The idealised waveforms to bring this state of affairs about are shown at the left in Fig. 3. A standard 1V of signal contains 0·3V of sync pulse, so that the three squarewaves producing maximum possible saturation are 0·7V peak-to-peak. This type of colour bar waveform is called "100% bars", and we did say it is an idealised waveform with both contrast and saturation at 100%. Its use is confined to video circuits, for it is impossible to transmit and receive it without introducing a lot of distortion.

A glance at the top left-hand waveform of Fig. 3, showing the encoded sum of the three sets shown below, reveals that the chrominance content of the first three colour bars goes above peak white whilst the chrominance content of the last three colour bars extends into the sync region.

The US way of fixing this problem, which was around long before we started with colour, is to use 75% bars. All the parameters bear the same relationship to each other as with 100% bars but the maximum contrast is limited to 75% of the total for peak white. In adapting the bars to our own requirements the BBC and the EBU (together with the IBA) have gone their separate ways.

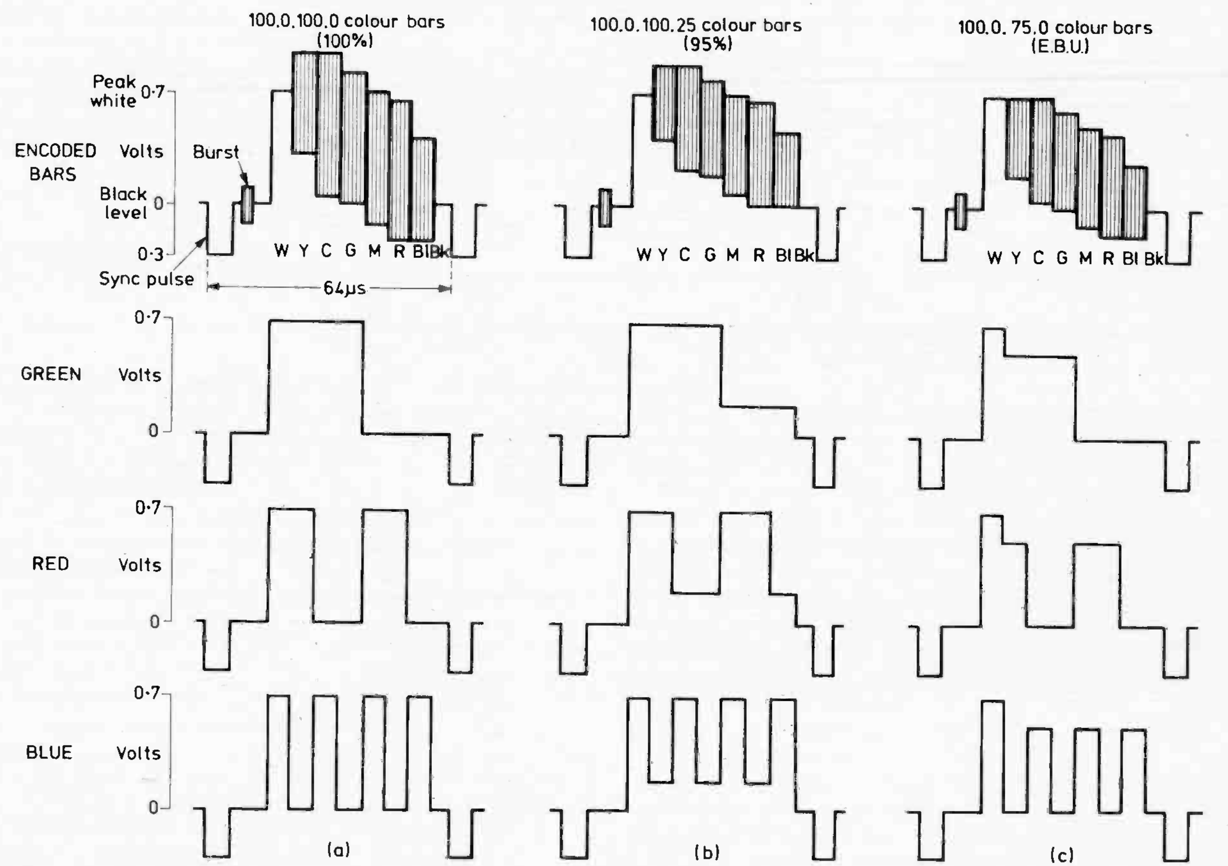


Fig. 3: The three common sets of colour bars:
(a) 100% bars, the top one being the encoded sum of the three simple squarewaves of primary colours beneath it. These bars are distorted in modulation, as two go above peak white and zero carrier, whilst two others drop well below the black level.
(b) 95% bars as used by the BBC. No bar drops below black level, and with those above peak white there is still some residual carrier.
(c) EBU bars used by the IBA. No bar is above peak white, but two descend a little into the sync pulse region.
The four cypher numbers describe the bars more fully. The first number is peak contrast, the second minimum contrast, the third peak colour and the fourth minimum colour, all as a percentage of peak white.

The BBC opted for bars that have a maximum value corresponding to peak white and a minimum value of 25% of peak white. These, when encoded and weighted, pass through the transmission system without distortion, and add up to peak white for the first bar. You will notice that the yellow, cyan and green bars go above peak white, but only to a maximum of 17 5%, and since peak white represents 20% residual carrier on our 625-line system there is still a little in hand before clipping must occur. Similarly, no encoded bar goes below the start of the sync pulse.

When decoded, these bars can be 'scoped out on a set to provide the conventional three equal amplitude squarewave signals we discussed at the beginning. Set against this, the colours appear (and are) somewhat desaturated.

The EBU bars follow the US convention of reducing the contrast to 75%, with the exception of the first bar which remains at peak white. This type of bar waveform produces untidy squarewaves when decoded, restricting their usefulness in the field, but gives a more natural reproduction on the screen of a set. Notice that no chrominance signal component goes above peak white, but that the chrominance component on the magenta, red and blue bars drops below black level.

In all cases the peak-to-peak burst signal amplitude when radiated is equal to the sync pulse height. This does not mean that you will see it like that, owing to the roll-off of the i.f. curve in a practical receiver. This roll-off normally starts at about 3·7MHz from the vision carrier.

Also, capacitive effects in the demodulator circuit attenuate the higher frequencies. If the burst signal does come out equal to the sync pulse height the set is probably off tune.

Whichever type of bar waveform you are using the chrominance content is substantially the same. Thus the familiar "cotton reel" waveform in the decoder will be similar from either the BBC or the IBA.

Pattern generators

It cannot be expected that the pattern generators used for servicing will be capable of producing saturation depths or complex corrections of the order of those given above. You may be able to pick a 100% bar waveform from the video socket, but some compromise must be expected in the output from the r.f. socket due to shortcomings in the modulator and the use of double-sideband modulation. The output should closely follow the 75% bar formulation used in the US. Measurements taken on a number of pattern generators show that, despite undermodulation, the phase and amplitude relationship of the colour components of the bars seldom exceeds 5% error, enabling them to be used as reliable tools for all decoder work.

Vertical interval test signals (VITS)

In addition to the test patterns – test card F, the PM5544 pattern and the colour bars – transmitted to help with the testing and adjustment of domestic TV receivers there is a fourth pattern which is always present – during the field flyback blanking period (referred to as the "vertical interval"). The Vertical Interval Test Signal, which began life as the Pulse and Bar waveform and is still called just that by many engineers, is there primarily for the benefit of the transmission authorities but if correctly used can provide a wealth of information for any engineer with a first class oscilloscope.

The signal has always been something of a mixed blessing, as there are many domestic receivers whose field flyback blanking circuits are unable to cope with it, so that it is left stuck over the top of the picture to annoy us. It has now been joined by Ceefax and Oracle, the two Teletext signals, which annoy even more because they "twinkle", and by transmission coding signals.

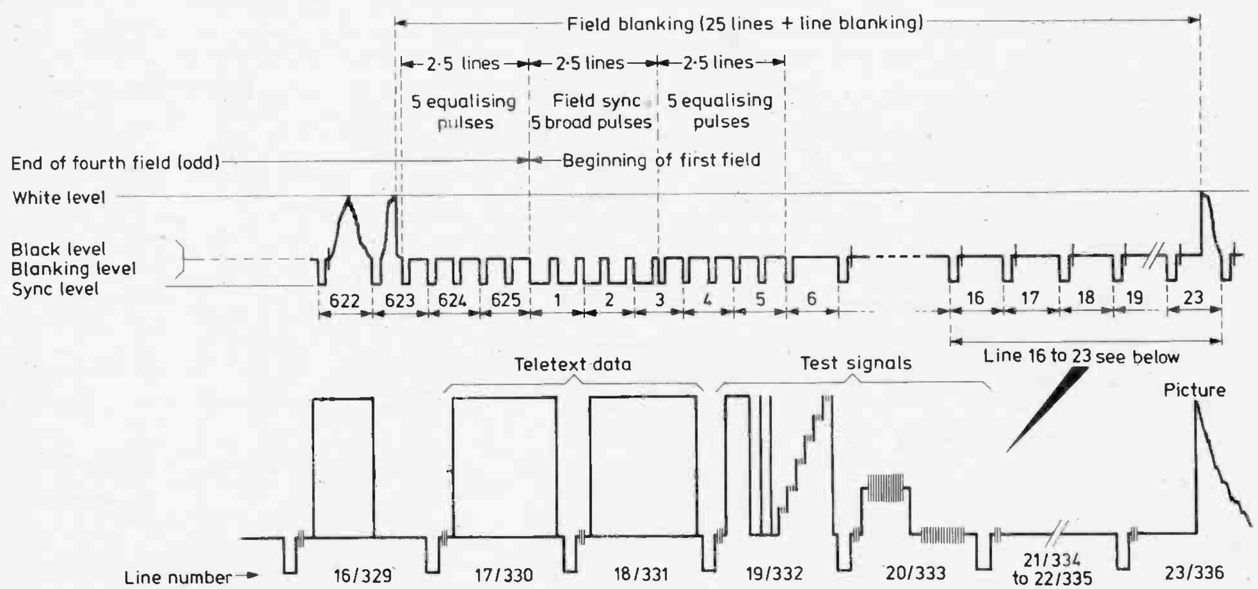


Fig. 4: The field blanking interval, reproduced from the joint BBC/IBA specification. The inset shows in detail the lines used for v.i.t.s. Note that the line count starts from the leading edge of the field sync pulse proper.

VITS (continued)

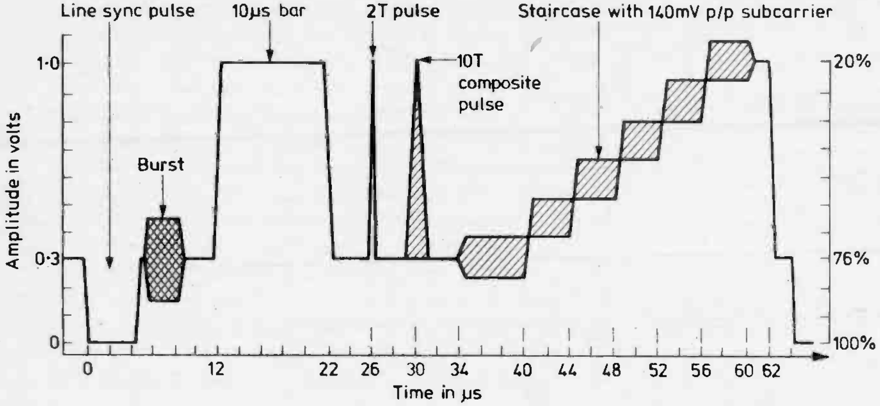


Fig. 5: The signal on line 19, which contains the most tests.

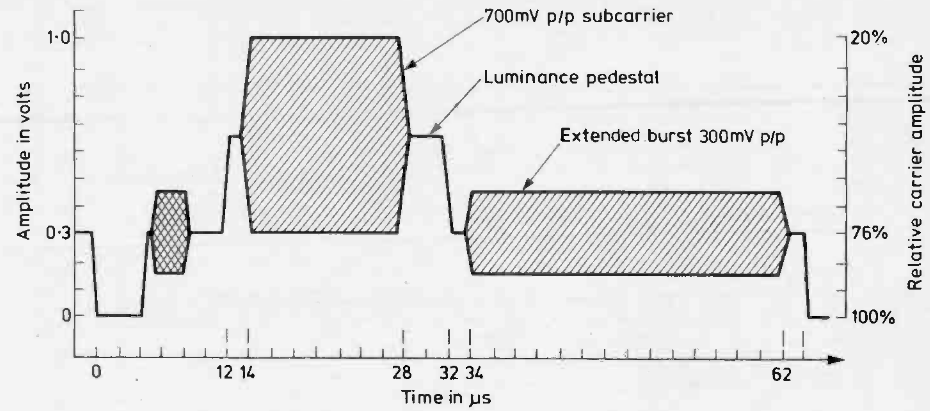


Fig. 6: The signal on line 20, containing only two chroma tests.

The writer would bet that for every reader who wants to use the vertical interval test signal there are three who are simply curious to know just what it is all about, so with these in mind we shall keep it simple. First the answers to a few questions.

Why is the signal needed?

Most networks may be called upon to radiate programme material at any or all hours of the day and night, making it impossible to allocate regular servicing periods. Dynamic checks now take the place of regular maintenance periods and for this purpose a constantly available test signal regardless of the content of the programme being radiated at the time is necessary. Additionally, more and more transmitters run unattended and must be constantly monitored at some central point to assure the quality of their output. All these requirements can be met by using test signals inserted in the vertical interval.

What do they check?

Quite an impressive list:– luminance gain; K ratings; chroma/luminance gain equality; chroma/luminance delay equality; differential phase; differential gain; Line-time nonlinearity; chroma/luminance crosstalk; signal-to-noise ratio.

Where do they come?

The field blanking period (Fig. 4) occupies 25 lines, the first $7\frac{1}{2}$ of which are taken up by the equalising and sync pulses. The original purpose of the remainder was to black out the picture during the field flyback, but since the system began advances in receiver design have meant that the set has usually accomplished this function in a substantially shorter time. The last few lines of the blanking period thus sit out of sight on top of the picture doing nothing. International agreements now permit broadcasting authorities to use the last seven of these lines for the insertion of various signals. In the following list we will refer only to the number of the line in the first field of the interlaced pair: in doing so we imply that the corresponding line of the second field carries the same signal. For example, a signal on line 17 would also appear on line 330 etc.

For international use the allocation of lines is:
Line 16 broadcasters' internal communications.
Lines 17 and 18 international test signals.
Lines 19, 20 and 21 national or local test signals.
Line 22 is a "quiet line" for noise measurements.

In the UK lines 17 and 18 are used for the transmission of the Teletext data systems Oracle and Ceefax, and so far there is no signal on line 21. The test signals we are concerned with are on lines 19 and 20.

What are they?

The signal on line 19 (Fig. 5) is the most complex. In examining it bit by bit from left to right we start at the time reference point which is the beginning (downswing) of the line sync pulse. First come the line sync pulse, and the back porch with burst. These are those of the transmission going out at the time – so if it is monochrome the burst will be missing (or often in practice just a trace). Next there is a 10 microsecond bar at peak white, followed by a needle pulse of 2T duration of the same amplitude as the bar. Following this appears a 10T composite chrominance and luminance pulse the total amplitude of which is the same as the other two. Finally there is a five-riser staircase, on each tread of which is superimposed a chrominance subcarrier of approximately half burst amplitude.

On line 20 (Fig. 6) there are only two signals. The first is a full amplitude block of chroma subcarrier sitting on a wider luminance pedestal at 50% amplitude. The second is an extended burst of chroma subcarrier occupying the same line time as the staircase on line 19.

In Part 2 next month we will take a detailed look at these various signals: their usefulness will then become apparent.

FOREIGN SET FAULTS

DEWI JAMES

Sony's Gate Controlled Switches

Some novel circuits, and devices, are used in recent Sony models. A Model KV1810UB Mk. I came in with the symptoms no sound, no picture, tube heaters not alight and the mains fuse F601 open-circuit. On examination a low-resistance path was discovered between the 130V h.t. line and chassis. After valuable minutes were spent tracing this line through, we eventually found that both the chopper Q603 and the line output device Q510 were short-circuit. These devices have been developed by Sony who refer to them as gate controlled switches. They are four-layer (pnpn) devices and are similar in structure to a thyristor. Their mode of operation is somewhat different however in that whether they conduct or not depends on the bias applied between the gate and cathode connections. In this respect they are more akin to a transistor.

The circuit through Q603 and Q510 (both type SG608) is shown in Fig. 1 – attempting to follow the official circuit diagram "cold" can be a nightmare. Should the symptoms we were confronted with occur Sony recommend the following procedure. First measure the resistance between the anode and cathode of the chopper Q603 – positive meter lead to the cathode and negative meter lead to the anode. If the reading is less than 7kΩ check Q603 (see Fig. 2). If the reading is greater than 7kΩ measure the resistance between the anode of the line output GCS Q510 and chassis – meter positive to chassis and negative to the anode. If the reading is less than 9kΩ Q510 should be checked.

In our case both GCSs were completely short-circuit, making diagnosis relatively simple.

The Mk. II version of the chassis uses type SG613 GCSs in these positions. In the latest 20in. Model KV2000UB an SG613 is retained as the line output device but a transistor shunt chopper circuit is used to provide the regulated power supply. In general we have found these sets to be extremely reliable. The only criticisms we have is that the Sony circuit diagrams seem to be unnecessarily convoluted and that removing the back can be something of a trial. Since the latter is an infrequent operation however the drawback seems forgivable.

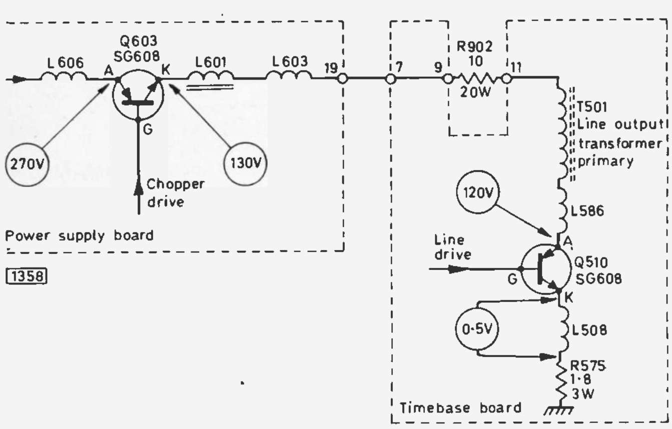


Fig. 1: Path of the 130V line from the power supply regulator GCS Q603 to the line output GCS Q510, Sony Model KV1810UK. Various other feeds are taken off en route.

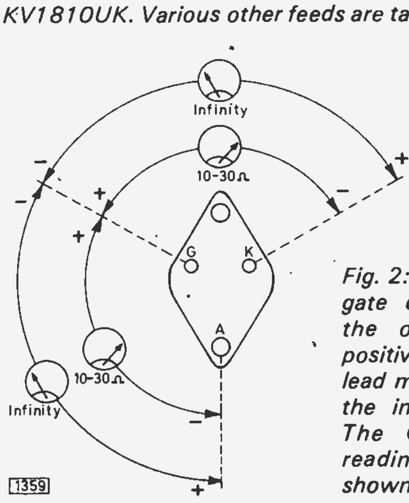


Fig. 2: Ohmmeter checks on a gate controlled switch. Use the ohms ×1 scale. The positive and negative meter lead markings shown indicate the internal battery polarity. The GCS is defective if readings other than those shown are obtained.

No Picture

A 12in. Elizabethan Model T12 mains/battery portable came in with the complaint sound but no picture. The set uses a conventional series regulator power supply circuit and a transistor line output stage with series efficiency diode (see Fig. 3). On examination we found that the 12V

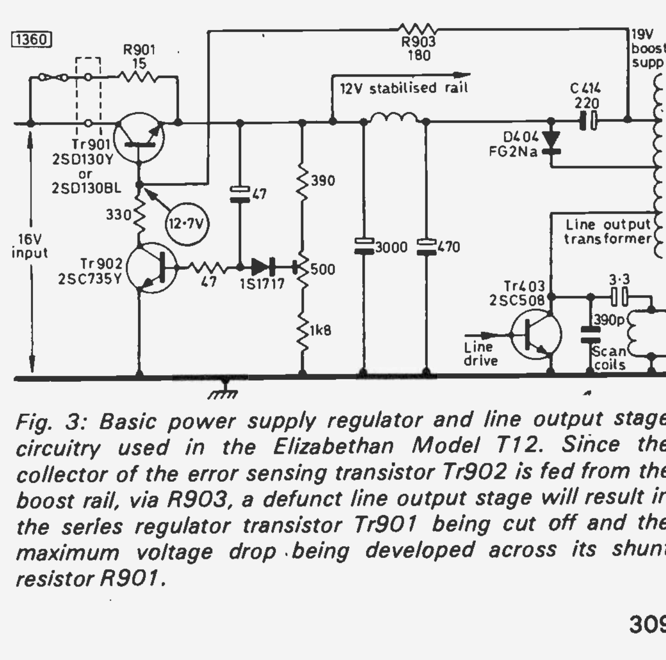


Fig. 3: Basic power supply regulator and line output stage circuitry used in the Elizabethan Model T12. Since the collector of the error sensing transistor Tr902 is fed from the boost rail, via R903, a defunct line output stage will result in the series regulator transistor Tr901 being cut off and the maximum voltage drop being developed across its shunt resistor R901.

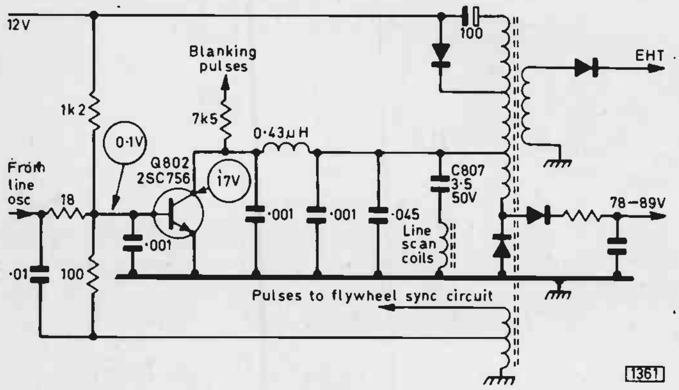


Fig. 4: Basic line output stage circuit, Sony Model TV720UK. Unusually for a solid-state line timebase, there is no driver stage between the line oscillator and the output stage.

rail was present but that there was zero voltage at the collector of the line output transistor (Tr403). Replacing the efficiency diode D404 restored normal results.

Single Bright Vertical Line

The Sony 7in. monochrome portable Model TV720UK is a set we don't come across very often. The one in question was brought in and on test displayed a single bright vertical line. The customer mentioned that there had been a bang immediately before the fault occurred, but we could see no visible signs of damage. Since the e.h.t. was present and the voltages on the line output transistor were substantially correct there was little that could be at fault other than the scan coils or the 3·5μF coupling capacitor C807 (see Fig. 4). The latter was found to be open-circuit and on removing it we could see a smallish hole where the "bang" occurred.

In a seaside tourist area such as ours, we are inundated during the summer months with requests to repair faulty mains/battery portables. The fault is usually associated with the battery having been connected the wrong way round, or the set having been dropped. In a well designed set incorrect battery polarity usually has no effect other than a blown fuse: on some of the not so well designed, usually cheaper, sets the effect can be disastrous.

Comprehensive Line Output Stage Failure

The Indesit Model T12L is a 12in. mains/battery portable featuring an unusual switch-mode power supply regulator on mains operation. The circuit was described in a recent *Teletopics* (December 1975). One set we came across recently had gone wrong quite comprehensively: the e.h.t. rectifier D406 was burnt up, both the chopper transistor Tr902 and the line output transistor Tr408 were short-circuit, and the line output transformer T402 had to be replaced (see Fig. 5). The thermal link R909 and the fuses didn't appear to have provided any protection.

Dead ITT FT110

An ITT Feathertouch colour set fitted with the FT110 110° chassis came in completely dead – even the c.r.t. heaters were cold. As a recent leader said, gone are the days when a fault such as this simply meant an open-circuit mains dropper: this chassis is one of those in which a switch-mode regulated power supply which forms part of the line timebase is used (see Fig. 6), and a dead set can be one of the most difficult faults to diagnose and cure with such an arrangement. Measurements in the power

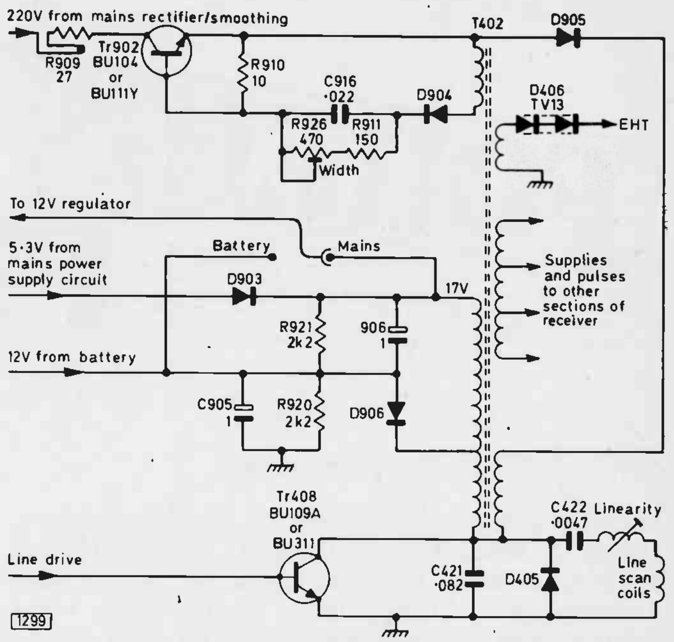


Fig. 5: The basic line output stage and mains supply regulator circuit used in the Indesit Model T12.

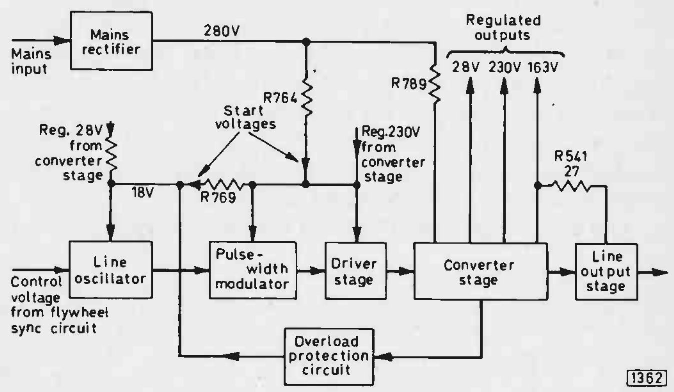


Fig. 6: Block diagram of the regulated power supply/line timebase circuit used in the ITT Model FT110.

supply/line timebase area revealed that while the 280V supply from the mains rectifier was present there was no 163V output from the converter stage and the overload protection circuit was in operation resulting in a very low, pulsing supply to the line oscillator stage instead of the correct 18V. After much head scratching and perspiration we discovered that the 27Ω 9·5W wirewound resistor R541 via which the 163V supply is applied to the line output stage was open-circuit, though the line output stage itself appeared to be in order.

Low Brightness, Colour OK

A Sony Model KV1300UB was brought in with the complaint of very low brightness, colour o.k. By advancing the c.r.t. first anode control VR701 a viewable picture could be produced, though with flyback lines visible. This indicated that something was wrong with the c.r.t. blanking/biasing arrangements. We decided to take a look at the brightness/beam limiter circuit. The arrangement used is shown in Fig. 7 and it will be seen that the brightness control sets the bias applied to the base of the luminance driver transistor Q153 – there is d.c. coupling from this point through to the c.r.t. cathodes. The beam limiting transistor Q152 shunts this point, its degree of conduction being set by the voltage developed across

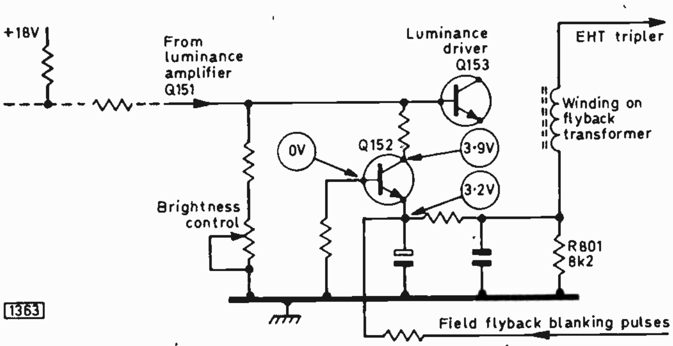


Fig. 7: Simplified circuit of the beam limiter arrangement used in the Sony colour portable Model KV1300UB. Field flyback blanking is also carried out at this point.

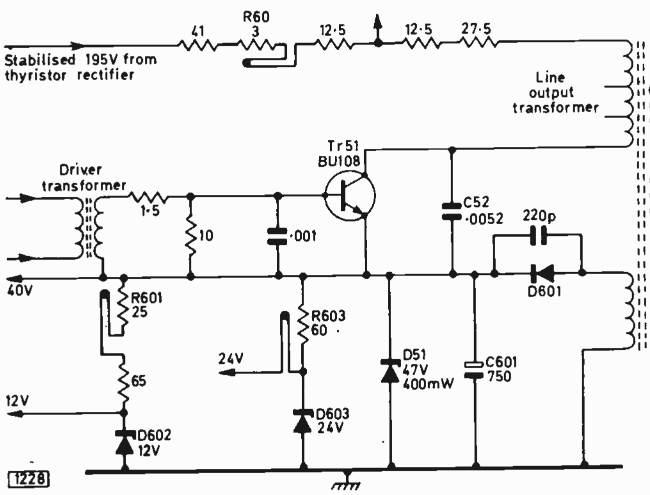


Fig. 8: Line output stage used in the GEC C2110 series.

R801. Since R801 forms the e.h.t. circuit earth return, excessive beam current will result in the voltage across it rising and in consequence Q152 will conduct more, reducing the bias applied to Q153. In our case the beam limiter transistor turned out to be defective, a replacement curing the fault.

PAL Sony Set

More recent Sony colour receivers incorporate PAL decoders, though with some individualistic touches as you'd expect from this firm. A Model KV1810UB came in with such severe blinds that the bistable switch had clearly stopped. The fault was traced to one of the cross-coupling speed-up capacitors (C363) in the bistable circuit. This had developed a leak so that the bistable remained biased in one state.

Dead GEC C2110

We don't get only foreigners of course. Recently we had in a GEC colour receiver, Model C2110, which is fitted with the solid-state chassis. The thermal fused resistor R60 in series with the output from the thyristor stabilised power supply circuit had disintegrated, removing the h.t. supply to the line output stage. Since the chassis uses the anti-boost technique, i.e. the other supply rails are obtained from the line output transistor's emitter circuit (see Fig. 8), these supplies were also missing. It was no great feat to discover that the line output transistor had gone completely short-circuit. In doing so however it had temporarily applied the 195V h.t. across the 40V line, with the result that the 12V zener diode D602 had gone short-circuit, the thermal fused resistor R601 offering no protection. The other zener diodes, D603 and D51, were unharmed.

LONG-DISTANCE TELEVISION

continued from page 293

The characteristic impedance of a cable is determined mainly by the distributed inductance of the inner and outer conductors, and the distributed capacitance between them. Provided the cable is terminated by a similar load impedance, the impedance remains 75Ω. Under these conditions standing-wave reflections are attenuated.

The main cause of signal loss in cables at v.h.f. is the resistance of the feeder: the thicker the conductor, the greater its conductivity. The signal currents flow largely along the surface of the conductor: silver plated conductors would be ideal, but due to the cost we generally find copper used. The use of a solid, single inner conductor results in less signal loss than with a stranded inner conductor.

The dielectric between the inner and outer conductors is also important – especially as frequency increases. Solid polythene has a dielectric constant of 2·28 compared to a value of unity for air. For a given spacing between the inner and outer conductors, the higher the dielectric constant the greater the cable capacitance per metre. For a given outer conductor diameter, if the 75Ω characteristic impedance is to be maintained using solid polythene dielectric then the inner conductor will have to be of small diameter. This increases the signal attenuation of course. The problem can be overcome by modifying the dielectric material so that its dielectric constant is reduced. This must be done in such a way that the support given to the conductors, and the constancy of the spacing, are maintained.

One way of achieving this is to use an extrusion process: by introducing a nitrogenous organic compound into the raw polythene a cellular form of polythene – "foamed polythene" – with a dielectric constant of just under 1·5 is produced. Other approaches include the use of a helical polythene thread structure, and the web structure used in Aerialite Aeraxial and other cables. Foam and web polythene dielectrics are used as standard at u.h.f., since the losses with solid polythene would be prohibitive.

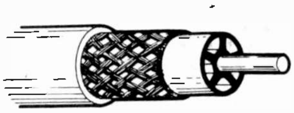


Fig. 1: Cutaway view of air-spaced coaxial cable, note the webbed dielectric.

Coaxial cable is manufactured to exacting tolerances and when being installed should be treated with care – haphazard fitting can result in considerable signal loss. For example, don't pull the cable sharply, especially if it is kinked: this could lead to the inner puncturing the dielectric and shorting to the outer conductor. When using webbed cable in particular it's essential to ensure that there is no possibility of moisture ingress (I usually block the aerial end with a smear of Vaseline, while similarly smearing the connections to avoid electrolytic corrosion etc.). Avoid sharp bends and where possible free-hanging loops. A sharp bend can produce a sudden impedance variation which in turn will set up a standing-wave pattern and result in signal loss. Sharp stapling can also produce standing waves due to pressure from the staple on the cable. Cables must be stapled at regular intervals, but if the distance is equal to a half wavelength at a wanted frequency the successive build-up of standing waves can result in signal cancellation. This can double the normal loss for the cable used, even over a relatively short length.

Table 1 lists the coaxial cables for TV use available from Aerialite, and their specifications. The 4205 is the old Aerialite type 499 and the 4209 the old type 500 cable.

TV RECEIVING AERIALS

PART 2

Pat HAWKER

Aerial Installation

As important as selecting a suitable aerial is good installation. Many viewers within the service areas of u.h.f. transmitters are watching poor pictures. In a number of cases this is due to the very real problems of urban shadowing, where tall buildings create pockets of poor signal strength and multiple reflections. But some viewers suffer from the results of lack of skill or indifference on the part of those installing their aerials. Many viewers do not appreciate the quality of the pictures that can be achieved on modern receivers off-air and accept poor results as all that can be expected.

Perhaps the most common problem is that picture quality differs on different channels, and that too little care is taken to avoid ghosting or unbalance on one or more of the channels. One wonders how many viewers will satisfactorily receive the fourth channel when it finally opens without further adjustment of their aerials.

Standing Wave Patterns

Unless an aerial is in the clear, preferably above roof level, there is almost certain to be a pronounced standing-wave pattern due to reflections. This does not necessarily prevent good reception, but it does make the exact position of the aerial very critical. A movement up or down, or side to side, can make a tremendous difference: the usual recommendation is that in the presence of a standing-wave pattern the aerial position should be checked carefully while moving the array within a "box cube" of about 3ft or 1m sides. This is much facilitated by the use of a cranked arm aerial support. Unfortunately, even when an aerial has been correctly and carefully installed the standing-wave pattern may change due to building work or the growth of foliage, and the aerial then needs further adjustment.

Reflections and indirect and multipath reception often vary with frequency. As a result the different channels can be differently affected. This problem also arises when, as is sometimes the case in urban shadow areas, a reflected rather than a direct signal has to be received. Although good results can occasionally be achieved in this way the approach should be avoided wherever possible since the results will prove variable – for example with changing weather conditions. In areas where standing-wave patterns exist it is important to mount the array with sufficient rigidity to avoid vibration of the elements.

Standing-wave patterns, rather than attenuation of the signal, are a problem with aerials mounted in the roof or loft space.

For all these reasons an aerial mounted clear of the roof is likely to prove the least critical and most satisfactory, though there are many occasions when this cannot be done.

Practical Points

A number of bodies have issued guidance or Codes of Practice for aerial installation work. In general terms these emphasise the need to use good materials and cables. It is worth noting that many aerial failures are due to breaks in the conductor at the fixing screws, where the wire has been "nicked" during wire-stripping while making the installation. Make sure that the aerial connection is weatherproof. It is important to avoid poor joints and "tailing" at connection boxes and wall outlets. Coaxial plugs should be soldered to the feeder cable rather than relying on a push-fit which may give a satisfactory connection initially but can later deteriorate. The feeder must be secured at intervals to prevent wear due to abrasion: the staples should not be driven home too hard since this can damage the cable or cause reflections. Other points to watch when installing coaxial feeders are to keep bends as gentle as possible – a bend *radius* of five times the cable *diameter* is an absolute minimum – and to avoid sharp tugs on the cable. These can produce kinks in the centre conductor, resulting in severe mismatch or even short circuits to the outer. Extra care should be taken on the higher Band V channels.

Preamplifiers

In very difficult areas a low-noise masthead amplifier will usually more than eliminate the degradation of signal-to-noise ratio caused by feeder losses. Such amplifiers can provide 10-20dB gain with very low noise factor. Care is required however to ensure that the signal-handling capability (dynamic range) of the amplifier is sufficient to be able to handle, without cross-modulation or intermodulation, all the signals in the locality. Masthead amplifiers can prove a problem when it is required to receive a distant weak signal in the presence of a strong local signal (which may even be a Band II v.h.f./f.m. radio station).

Ghosts

When u.h.f. television began, many installation engineers were relieved to find that ghosting was usually less of a problem than had been experienced at v.h.f. More recently however this problem seems to have become rather more prevalent, often affecting only some channels. Here again this is often a result of standing-wave patterns, and an aerial raised above the roof level may effect a cure. The lack of side lobes (not just a good "front-to-back ratio") with a log-periodic aerial is a considerable help in reducing ghosts arriving along different bearings to the required signal. In rough terms, ghosts are perceptible when the unwanted signal exceeds about −34dB of the wanted signal for path differences of 0·6μS or more, −29dB for less than 0·6μS.

Lightning

While the lightning hazard represented by a television or radio aerial is very slight indeed in the UK, it has to be recognized that where the aerial forms the highest metallic point of a building there is always the possibility of a direct strike. Most authorities recommend that the outer sheath of a feeder cable should be permanently earthed prior to its entry into a building, though it has to be admitted that this practice is not common. Lightning protection is more important in an isolated homestead than for example in a modern structure where lightning currents will usually be passed to earth through the steelwork or metal services. Earthing the outer braiding may prevent damage to the receiver in the rare event of a direct strike: viewers should be advised not to attempt to touch feeder cables during a thunderstorm.

Final Adjustment

The positioning of an aerial array can be initially carried out using compass bearings or sightings of the transmitting mast, but final adjustment should be done while checking the picture on all channels: this is more important in situations where there are likely to be pronounced standing-wave patterns.

The Future

Relatively few major developments have taken place in u.h.f. aerials or aerial installation practice since the start of three-channel u.h.f. broadcasting in 1969. The standard Yagi arrays and the related though more complex multi-director arrays on a single boom have provided a range of aerials that meets most requirements: deficiencies are more often due to unsatisfactory installation than to basic aerial design. This is borne out by evidence that installations tend to be significantly better in areas outside the recognized service areas than just within the coverage contour. A small minority of viewers well beyond their local service area is prepared to use large arrays, approaching 100 elements, in conjunction with masthead amplifiers: for the enthusiast who seeks extra programme choice rotators and remotely-tuned preamplifiers are available.

There is relatively little incentive therefore to develop novel types of u.h.f. aerial. For a given weight or size the Yagi generally provides the optimum gain, though it often has poor side-lobe performance and its bandwidth means that four aerial groups are required. As noted earlier other possibilities exist but are only seldom used, with the exception of the log-periodic aerial and more recently the use of stacked dipoles with large reflectors (to provide a narrow vertical acceptance pattern) and specially shaped reflectors in conjunction with backward-firing techniques. Little use for example has ever been made of slot techniques or wire aerials although both these are feasible.

For the broadcasting authorities the reluctance of viewers to install aerials of the correct group and polarisation when local relays are brought into service is disappointing, and may call into question the extent to which "gap-filling" should be extended.

The future also includes, in the period beyond about 1985, the proposed re-engineering of the v.h.f. bands for 625-line colour services. This will provide scope for the development of miniature aerials in order to avoid the need for large arrays on the roof tops. For Bands I and III the "active" aerial (in which a matching amplifier is designed as an integral part of the aerial) and dielectric loading (in which the elements are coated with special ceramics) could both provide v.h.f. aerials of compact dimensions.

Range of Low-power Relays

In general terms *in the absence of hills and other obstructions* the typical ranges of low-power relays at recommended service levels are:

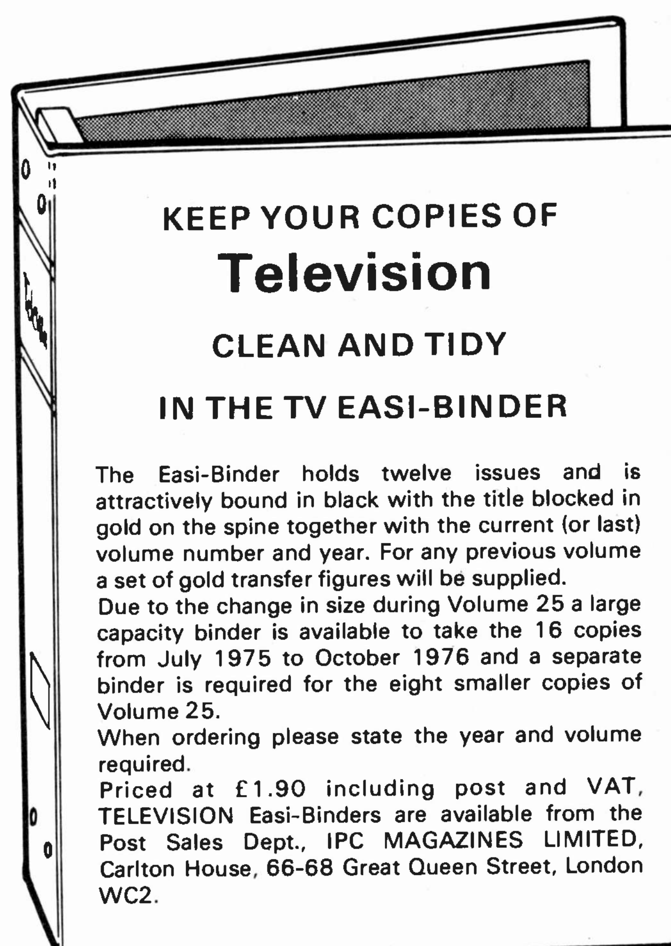
1000 watts e.r.p. (1kW) .... 14 miles
100 watts e.r.p. (0·1kW) .... 4·4 miles
10 watts e.r.p. (0·01kW) .... 1·4 miles

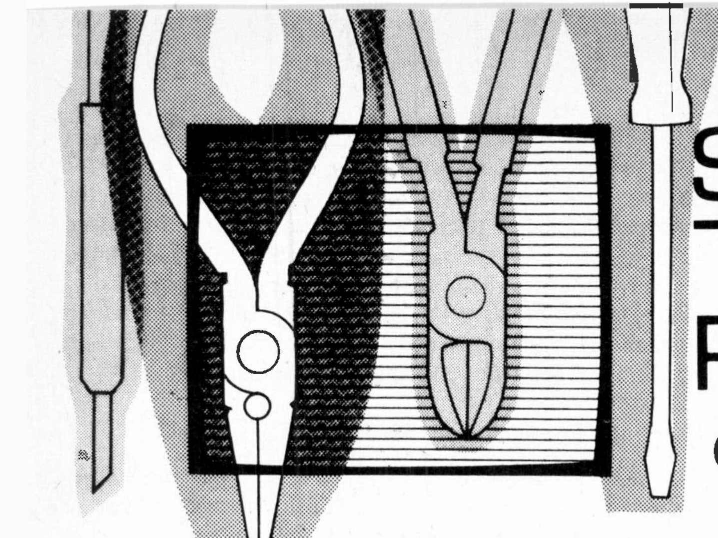
Since a number of relays stations use directional transmitting aerials the e.r.p. in some directions may be a lot less than towards the intended service area. Stations are rated at maximum e.r.p. towards the target areas. For a given e.r.p. the range on a high Band V channel will be less than on a Band IV or a low Band V channel.

UHF Channels

There are 44 u.h.f. channels available in the UK, with nine groups of interleaved channels and the remainder forming non-standard groups mostly in conjunction with part of the allocation of a standard group.

Typical allocations are n, n + 3, n + 6 and n + 10 or n, n + 4, n + 7 and n + 10. ■





SERVICING TELEVISION RECEIVERS

GEC PORTABLE MODEL 2114 JUNIOR FINELINE

L. LAWRY-JOHNS

THE GEC Junior Fineline Model 2114 is a pretty little portable which functions as well as it looks and is fairly easy to service when it decides to be naughty (pretty little things are often naughty, aren't they?). Designed for mains/battery operation, the receiver is supplied ready for mains – the battery unit is not included and has to be obtained separately. It functions on u.h.f. (625 lines) and features a four pushbutton tuner of the mechanical type.

Access

To get at the innards one removes the four screws (two top, two bottom) from the rear of the cabinet shell with the receiver face down on a soft surface. The shell then lifts off to expose most parts, taking with it only the aerial socket which slips out of its slot quite easily. Nearly all servicing can be done without further dismantling, save for one or two items.

The first is the mains input power unit under the bottom centre. This is held by four 4BA headed PK screws. It's the unit that will most certainly have to come off, not only to gain access to the underside of the main panel but because of the fact that it holds the item which is most likely to give trouble, the bridge rectifier. Now before we start screaming about this let's get the basic power supply out into the open and understood.

Mains Input Circuit

The idea of the power unit is to transform the normal household 230-240V mains supply down to the 12V (approximately) which is what the supply would be when the set is operated from a battery. Even this output is not applied direct to the rest of the set but is passed through a series regulator circuit whose job it is to keep the voltage at a steady figure (more of this later).

Thus the mains supply is first applied to transformer T401, via a supply fuse and the on/off switch. The fuse is a 250mA delay type and the rating of this should not be exceeded. The secondary winding of the transformer supplies a bridge rectifier (D402) which takes the a.c. input and hands out d.c. pulses to the reservoir capacitor C401 whose job is to smooth out the ripples. This electrolytic capacitor is quite happy to do this provided the rectifier behaves itself and doesn't start leaking a.c. through.

Ripple

And now we come to the bitter bit (there was no way of stopping it . . . but we don't sing that sort of song here). It does leak, and the capacitor cannot cope, and the supply is therefore heavily rippled resulting in a hideously distorted picture – the newsreader's eyes are on the left side and his bow tie on the right with a nice dark hum bar between. He also hums instead of speaks.

Now when one first meets this sort of hanky-panky one is inclined to pounce on the poor old electrolytic and accuse it of drying up on the job, and indeed if another capacitor is shunted across it things do look decidedly better. But if you're going to fall for this one you deserve to be rewarded by exactly the same symptoms when the new capacitor is installed on its own. If touched, the rectifier (that's the funny looking thing with four legs sticking out) will be found to be hot and you would think that the fuse would fail. Generally it doesn't, and the only remedy is to replace the rectifier.

If the correct replacement is to hand, two can be fitted in parallel to give increased reliability. One may have to look around for alternatives however. Keeping an eye on the

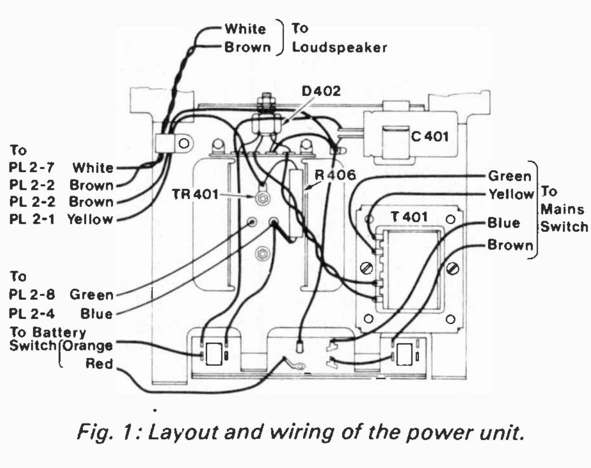


Fig. 1: Layout and wiring of the power unit.

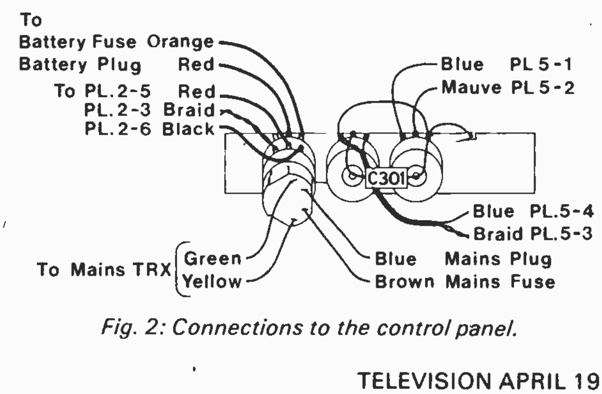


Fig. 2: Connections to the control panel.

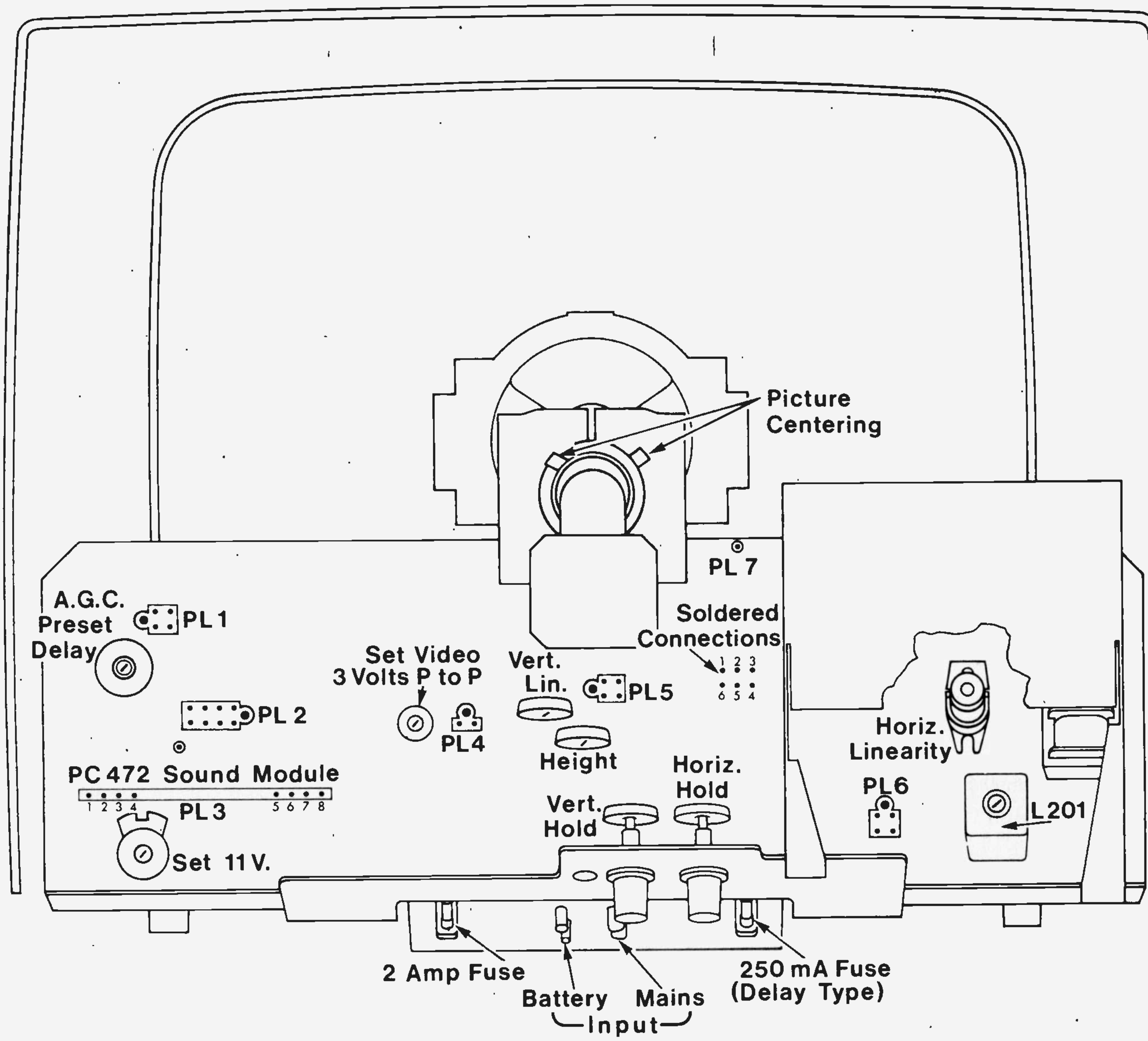


Fig. 3: Rear view of the receiver, with the cabinet back removed.

current requirement, one can use several types of alternative. As there is plenty of space we have often used two BY164s with their legs entwined. Once we used three Rect 65As which ran pleasantly warm, but four BY127s in bridge formation is probably the most common answer when the right bridge is not around.

Having said all this let's hasten to add that the rectifier could be absolutely innocent and C401 could be the culprit. But then the rectifier would not be hot, so there isn't a great deal of room for confusion.

Power Supply Regulator

Two items on this power section that we haven't so far mentioned are the regulator transistor TR401 (AD149) and its parallel resistor R406 which is also a 10Ω safety cut-out. This is across the emitter and collector of the regulator transistor, which shunts the resistor to an extent adjusted by the control action at its base. The control circuitry is not on the power unit but is on the main panel.

If there is one bit of advice we would offer above all else on this and other similarly regulated receivers it is first to ensure that the regulator output voltage is as specified. Many portables have been dispatched and when plugged into a 240V mains supply operate with a supply line in excess of the specified figure (11V in this model). It should be realised that this line voltage is applied not only to the timebases but also to the tube. It is frequently stressed that a higher voltage than specified can damage the line output transistor and associated components. This is quite true, but it should also be appreciated that the emission of the c.r.t. can rapidly deteriorate if its heater is overrun.

Unfortunately the preset regulator control (P401 here) is often looked upon as a picture size control, and is used to cover up a slight defect in scanning. The control must never be adjusted in this manner. A voltmeter should be placed across the line (say PL2-1 to chassis) and the control adjusted for a reading of 11V.

It should be noted that the audio output i.c. (type SN76013ND) is supplied from the unregulated line. This means that there are a couple of points on the main panel at somewhat above 11V. In addition there are the much higher voltages derived from the line output stage, and one should not be surprised to find say 245V at a couple of points (feed to the brilliance control, c.r.t. first anode etc.), a 100V supply to the video output stage and a supply of about 20V to the i.f. stages.

This is why we advised checking the line voltage at a

VOLTAGE AND CURRENT DATA – GEC MODEL 2114

Test Conditions

At 240 volt a.c. input. Measured with a 20,000Ω/volt meter and a 10K resistor in series at point being measured. Signal attenuated to just lock the time base.

* Voltages marked with asterisk vary appreciably with applied signal.

Ensure that L.T.2 at TR401 Collector is set at 11 volts by P401 before commencement of measurements.

Transistors

Transistor		Function	Collector (V)	Base (V)	Emitter (V)	Collector (mA)
TR1	BF180	R.F. Amplifier Tuner UTP70	16·4	2·1	1·4	3·6
TR2	BF181	Mixer/Oscillator Tuner UTP70	20·0	2·2	1·5	2·7
TR101	BF196	1st I.F. Amplifier	17·8*	1·6*	0·9*	9·2*
TR102	BF197	2nd I.F. Amplifier	15·6	4·8	4·1	4·4
TR103	BF197	Final I.F. Amplifier	15 0	1·7	1·0	9·7
TR104	BC158	A.G.C. Delay Switch	2·0*	3·8*	1·6	0
TR105	BC148	A.G.C. Amplifier	1·6	2·1*	1·5	8·6
TR106	BC148	Video Emitter Follower	20·0	5·3	4·8	8·7
TR107	BF178	Video Output	82·0*	3·4*	2·8*	3·5
TR201	BC158	Sync Separator	2·3*	10·7*	11·0*	0·6
TR202	BC154	Field Multivibrator	5·1	4·8	5·5	16
TR203	BC154	Field Multivibrator	2·5	12·8	11·0	0·07
TR204	BC208	Field Amplifier	4·8	0·5	0	0·22
TR205	BC208	Field Drivers	10·5	5·2	5·5	2·2
TR206	BC154	Field Drivers	0·3	5·2	5·5	2·0
TR207	BC116	Field Output	7·6	10·5	11·0	60·0
TR208	BC324B	Field Output	3·2	0·3	0	95·0
TR209	BC148	Line Phase Splitter	10·6	−2·0	0·6	1·0
TR210	BC148	Line Reactance	11·0	1·6	1·3	3·6
TR211	BC148	Line Oscillator	8·0	0	0·3	50
TR212	BC337	Line Driver	16·0	0·3	0	38
TR213	BD160	Line Output	25·6	0	0	970
TR401	AD149	11 Volt Stabiliser	11·0	13·6	14·0	1000
TR402	BC338	Difference Amplifier	13·6	5·6	5·0	20

Integrated Circuits

Sound Module (PC471/2)

TBA480Q or TBA120: Sound I.F. Amplifier/Demodulator/Audio Preamplifier SN76013ND/07: Audio Amplifier/Output.

Pin Numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TBA480Q	1·5	3·0	3·0	4·4	4·3	9·5	0·6	6·7	9·5	9·1	9·5	—	2·8	2·8	2·8	0
TBA120	0	2·0	0	0	3·7	2·1	3·7	6·0	3·7	2·1	9·5	0	2·0	2·0		
SN76013ND/07	—	6·7	0	—	—	6·7	0	0	1	14	0	—	—	0	6·4	6·8

These are average voltages.

Additional Voltages

A.G.C. volts (measured at TP1) 2·1V*

Line Output Transformer Outputs:
+ end of C235 (HT2): 245V. Total line current: 0·85mA.
+ end of C234 (HT1): 100V. Total line current: 20mA.
+ end of C237 (Boost) 25·6V. Total line current: 60mA.
− end of D211: zero.

Cathode Ray Tube (e.h.t.). **Do not Measure with Spark Gap Instrument:** 12·5kV.

Total 11·0 volt line current: 1·4A.
Voltage at junction of R134, C146: 20V.
Voltage at junction of R130, C145: 9·5V.
Voltage at junction of R142, C144: 13·8V.

C.R.T. Voltages:
Cathode: 27·0V (varied by brightness control), Grid: Zero, A1: 225V, A3 (focus): 110V, E.H.T. (see above), Heater: 11V.

D.C. Resistance Readings (Approx.) in Ohms

Scan Coils	Line—0·5	Field—12
Mains Transformer	Primary—60	Secondary—0·25
Line Driver Transformer	Primary—30	Secondary—0·3
Sine Wave Coil (Pins 4 and 6)	2	

specified point. If all this sounds too obvious to you, you're probably well versed in solid-state circuitry. Many are not however so we'll press on so that no one is left out.

If it's found that the line voltage is high at the collector of the AD149, and that adjustment of P401 has little effect, the likely reason is that the AD149 has a collector-to-emitter short. This is easily checked by disconnecting the collector (or emitter) lead and applying an ohmmeter "positive" (red) lead to the emitter, "negative" lead to the collector. There should be no reading. If there is risk of confusion, disconnect the base also and apply the simple ohmmeter check for a pnp transistor: i.e. when the "positive" probe is applied to the base pin, there should be a low reading with the "negative" probe to either the collector or the emitter but very high readings with any other connections, e.g. collector to emitter. If there is a fairly low reading collector-to-emitter the transistor must be replaced.

If this transistor is in order check back to the BC338 regulator driver (TR402) to ascertain why this is turned on so hard. The suspects here are the transistor itself and the zener diode D401 (which could be open-circuit).

If C403 becomes open-circuit a large amount of hum will be introduced: if it goes short-circuit the regulator output voltage will fall as TR401 is then cut off.

If any of the above is wrong, don't phone us, we'll phone you!

The Sound Stages

The 6MHz sound i.f. and quadrature detection is carried out (usually) by a TBA120Q i.c. This is pretty well trouble free except for the possibility of dry-joints around its many connections and the probability that the quadrature coil L199 will require a slight tweek of its core when the sound becomes distorted. On rare occasions the chip itself may be found defective (stacks of response from the output, none from the input, when checking by signal injection – with the 9·5V supply intact at pin 11), and it is possible that a squirt of freezer may restore signals for a brief moment – this is not always so however. Weak sound with the core of L199 having no effect is the result when C190 goes open-circuit.

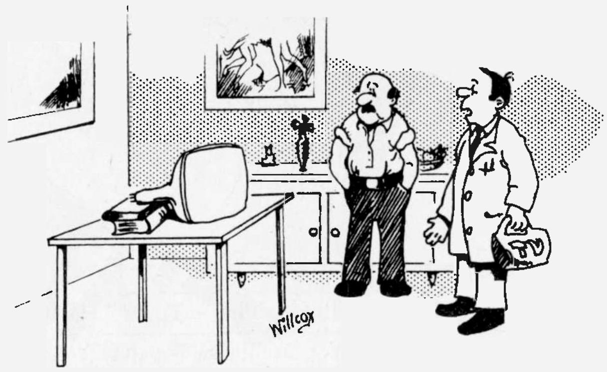
The output of this chip is taken via the volume control to the SN76013ND audio chip (we shudder when we write this, because of our experiences with it and similar chips in unit audios). It has proved to be quite reliable in this model, probably because the supply voltage has been kept down to about 14V (pin 10). Whilst it can fail in this model, it is essential to check the supply, the input and output before condemning it.

Distortion is more often caused by a rubbing speech coil in the loudspeaker than by faults in the audio chip and its circuitry (always assuming that L199 is properly set).

So we can't say a lot about the sound stages except for the advice always to check the supplies and the associated electrolytics, and ensure that the soldered connections are good. Note that there are alternative sound boards, one with the above mentioned TBA120Q i.c. and the other with a TBA480Q. The pin voltages differ, and this must be remembered before getting down to it with your trusty meter and your anxious heart.

The IF Strip

The tuner output is taken to a separate board on which are mounted the response shaping filters. Don't touch these unless you really have to, and then try to avoid disturbing the alignment.



"I know it would be nice to have a picture straight away, but that's one of the snags with our instalment system."

The i.f. amplifier consists of three stages, the first of which is controlled with forward a.g.c. A BF196 (TR101) is used in this stage and it is a relief to know that there is no control coupling between this and the subsequent stages – such an arrangement does tend to confuse us simple souls when we are delving into the i.f. circuits of some other receivers.

IF Strip Fault-finding

When we are faced with what appears to be a fault in the i.f. strip (as denoted by lack of signals or very weak signals) we like to start at the final i.f. stage and work back. The main reason for this is that the final stage takes the larger signal swings and thus works that much harder and would appear to be more prone to failure. On the rare occasions when we are right, the lack of voltage at the emitter is enough to send us hot foot on the trail of a suspected open-circuit base-emitter junction, confirmed if there is a positive reading at the base. If TR103 and TR102 are doing their job, one has to look at TR101 with a different approach.

Whilst lack of emitter voltage could denote a faulty BF196, and this is not uncommon by any means, it could also mean that there is no base voltage. If this is so one has to have a look at the a.g.c. circuitry, where such possibilities as a shorted C108 are to be investigated. It doesn't take long to check this and the BC148 (npn) and BC158 (pnp) transistors.

On the other hand the emitter voltage of TR101 could be high, showing that it is passing too much current. This could be due to one of a number of causes. TR101 could be short-circuit, in which case its base voltage may well be lower than its emitter voltage. Alternatively its base voltage may be high, and this is where we get cagey. We have to confirm that this high voltage is actually coming from the a.g.c. circuitry. So we take the base voltage of TR101 and compare this with the voltages at TP3 and then TP2. The higher the voltage, the nearer you are to the cause of the trouble.

Disconnect the aerial and bear in mind that the a.g.c. detector diode D102 rectifies the signal strength (sync pulse tips) and applies a negative voltage to TR105 to drive this to cut off and thus raise its collector voltage. This is filtered and passed as the control potential to the base of TR101. So this point is where the positive voltage comes from if TR101 is in order. There is a bit more to it than this, due to the delay transistor which controls the a.g.c. applied to the tuner, but that's the general idea.

CONTINUED WITH FULL CIRCUIT NEXT MONTH

AC THEORY
A step by step approach

Ian SINCLAIR

Part 6

Amplitude modulation is not the only method of making a carrier convey information. Phase modulation has already been mentioned and FREQUENCY MODULATION is also used. Both phase and frequency modulations are ANGULAR modulations which can be carried out on a carrier whose amplitude is kept constant. In phase modulation, the phase angle by which the carrier is shifted is proportional to the amplitude of the modulating signal, and the *rate* at which the phase is shifted is the frequency of that signal. In frequency modulation, the rate at which phase is shifted (change of frequency) is proportional to signal amplitude, the rate of change of frequency (which is the rate of change of *rate of change of phase*) varies at the frequency of the modulating signal.

What is the main advantage of angular modulation for broadcasting?

Since electrical interference affects only the amplitude of a received carrier, f.m. and p.m. are immune to most interference. Rapid phase changes caused by atmospheric effects are usually negligible.

One disadvantage of angular modulation is that it requires a greater bandwidth to carry the same signal at the same signal-to-noise ratio than does amplitude modulation. Not only do we have sidebands of frequencies which are the sum and difference of the carrier and signal, but sidebands which are the sum and difference of carrier and twice signal frequency, carrier and three times signal frequency, etc. The amplitudes of the sidebands depend on how much change of phase of the carrier (or rate of change of phase) is permitted in the modulation; generally we allow at least twice the bandwidth allocated to an amplitude modulated signal; often we allow much more than this.

Frequency modulation is not used for video modulation in our system of TV. In what system is it used?

In the SECAM colour system, standard in France and adopted by many eastern European countries, the colour-difference signals are transmitted using f.m. The satellite transmissions to India use f.m. for the vision signals and f.m. is likely to be adopted generally for s.h.f. TV transmissions.

So far we have considered the effects of two sinewaves together. Many years before radio or TV were dreamed of, the mathematician Fourier studied the shapes of the waves obtained by adding sinewaves together in different amplitudes and phases.

Curiously enough, this work was prompted by the results of experiments on heat flow. He found that any wave shape, any repeating pattern, could be thought of as the sum of a large number of sinewaves. One wave, the FUNDAMENTAL, would have the same frequency as the wave shape being analysed, the others were of simple multiples of this frequency in a series.

There is a special name for waves whose frequencies are simple multiples of one frequency. What is it?

They are called HARMONICS.

If, for example, we add a sinewave to a wave of twice its frequency, in phase, we get a distorted pattern of the kind shown in Fig. 1. The shape of this pattern will change if the phase of the second harmonic (as the twice-frequency wave is called) changes. If the complete wave is passed through a circuit which changes the phase of each wave by a differing amount, the shape of the complete waveform is changed.

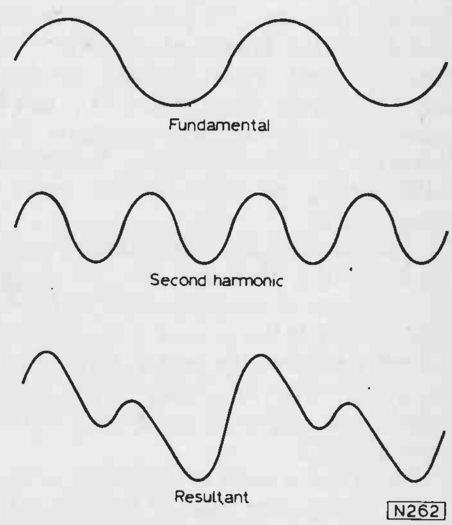


Fig. 1: Result of mixing a fundamental and second harmonic, in phase.

Any normal phase shifting circuit using *R* and *C* or *R* and *L* will do this; this kind of distortion is called PHASE DISTORTION.

What sort of response would a circuit have to have to avoid phase distortion?

Either no phase shift at any frequency, or a phase shift which increases in direct proportion to frequency.

Fourier's ideas are of great importance, for they enable us to predict the behaviour of various waveforms. A squarewave, for example, is a mixture of the fundamental and all its *odd* numbered harmonics, alternately positive and negative, see Fig. 2; a triangular wave has a series of odd numbered harmonics, all positive; a full-wave rectified sinewave has components of all frequencies, alternately positive and negative.

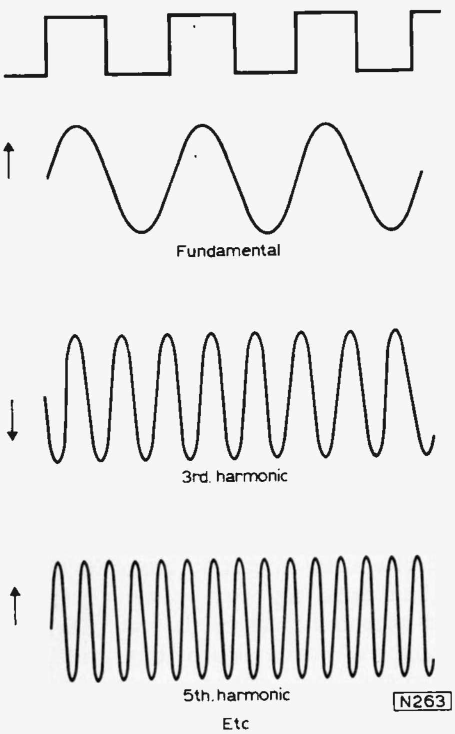


Fig. 2: Analysing a squarewave into a fundamental plus odd harmonics.

Why could an unscreened line output stage produce such violent interference on a radio tuned to much higher frequencies?

Because the line output stage produces pulses of several thousand volts amplitude. These are made up of a large number of harmonics, and so will be tunable at intervals along the band of every 15kHz or so, this being the line frequency.

Two points of vital interest in television require a knowledge of these ideas. These points are BANDWIDTH, previously mentioned, and SPECTRUM. Bandwidth is the *range* of frequencies occupied by a signal. A pure sinewave has no bandwidth; a sinewave with second harmonic added now has a bandwidth equal to its own frequency, and so on.

A squarewave or a triangular wave have, in theory, an infinite bandwidth, and the more perfectly we can make a squarewave then the greater is the bandwidth we find we need to cope with it. For most purposes, though, we can pass a reasonable looking squarewave through a network whose bandwidth is about ten times the frequency of the fundamental of the squarewave.

What bandwidth would you allow for a 1kHz squarewave? Would this have to be very different if we used 1μs pulses at a 1kHz repetition rate?

About 10kHz would do for the squarewave; we would need something nearer 10MHz for the 1μs pulses – it is the width rather than the repetition rate of a pulse which settles its bandwidth. In each case our bandwidth would have to go down to the fundamental repetition rate as well.

Bandwidth describes how much room a signal takes up in a range of frequencies. Spectrum describes exactly how this room is occupied. If we were asked to find the spectrum of a signal whose bandwidth was the whole of the medium waveband, we would tune a receiver slowly over the whole band and note the strengths of the received signals at each frequency tuned. We can use a similar technique to investigate other wavebands. Receivers which tune automatically over the bands and make a record of the frequencies in use and their amplitude are called Spectrum Analysers.

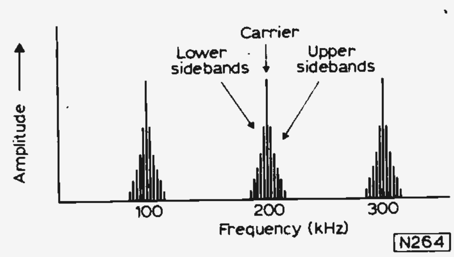


Fig. 3: Spectrum of transmissions with carriers every 100kHz, modulated by frequencies up to a few kilohertz.

We might find, for example, as a result of such an experiment, that we had strong signals every 100kHz, and the spectrum would look like Fig. 3. Since every transmission has some sidebands, these are indicated round each main carrier. Obviously, more signals can be fitted into this band in the spaces between the carriers which are not also occupied by sidebands.

What sort of plot would we obtain from a spectrum analyser if we fed in a squarewave of equal mark-to-space ratio and a frequency of 10kHz?

Fundamental at 10kHz, harmonics at 30kHz, 50kHz, 70kHz etc.

The spectrum of a black and white TV signal is of great importance, for it gives a clue as to how a colour signal may be fitted in with the minimum of interference and no increase in bandwidth. The spectrum of a TV signal is very complex, but the essential components of the spectrum can be picked out. For the UK 625-line system, the line sync pulses form one set of repetitive waveforms at the line frequency of 15·625kHz; the field sync pulses form another at 50Hz.

There is also a component at 25Hz. What causes this?

The use of interlaced scanning means that each complete picture is built up in two fields, each of which occupies a fiftieth of a second. The basic picture frequency is thus 25Hz and sidebands are present spaced out at intervals of 25Hz.

A drawing of the complete spectrum of a TV signal is shown in Fig. 4. The line pulses cause very strong components to occur at every multiple of the line frequency, and the video information forms a small spectrum of signal round these components, with stronger portions every 25Hz. These 25Hz harmonics have small amplitudes at a frequency spacing of a kilohertz or so from the main line pulse harmonics, leaving a fair amount of room for fitting in other signals. This process of fitting in other signals is called frequency interleaving.

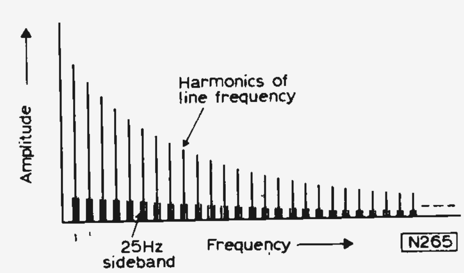


Fig. 4: Spectrum of line-frequency harmonics, each with 25Hz sidebands.

Would a single frequency between any two harmonics be enough to carry colour information?

No, it could not possibly have enough bandwidth.

We can carry another set of information in the same frequency band by adding a signal whose carrier *and harmonics* will fit exactly between the harmonics of the line frequency spectrum, see Fig. 5.

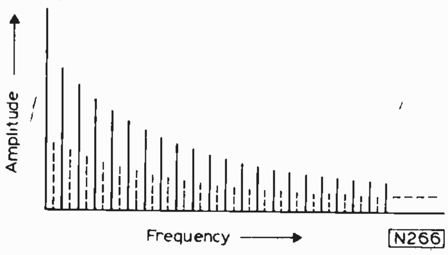


Fig. 5: Fitting another spectrum of signals in. (Frequency interleaving.)

This means that the frequency of this carrier should ideally be an odd multiple (3X, 5X, 7X etc.) of *half* the line frequency. Why can it not be an even multiple?

If it were, every even harmonic would coincide with a harmonic of the line frequency.

Fitting the new signals into the frequency gaps left by the monochrome 625-line signal is not all that is needed. Any signal transmitted as part of the video will be passed to the cathode(s) of the c.r.t. and will produce some sort of pattern on the screen. We must make sure that the new signal which we are fitting in does not cause such patterns to an annoying extent. The choice of an odd multiple of half the line frequency for the subcarrier also fits this requirement.

Consider the number of lines in one complete picture of two fields: this will be 15,625/25 = 625 as expected. Now take an odd multiple of half the line frequency. Half of the line frequency is 7,812·5Hz, and any odd multiple of this will still have half a line left over at the end. After two fields the video information of the subcarrier is half a line out of step, or 180° out of phase. If the waveform is not too asymmetrical, this will mean that the signal appears inverted after two fields (one picture).

What effect should the eye see when this signal, inverting every picture, is presented to a c.r.t.?

Ideally, nothing. The positive pattern presented on one picture should be cancelled by the negative pattern on the next.

There are snags, however. The signal content is changing and there is no guarantee that the inverted signal of the next picture will balance exactly the positive signal of the last one, although the change from one picture to the next is remarkably small.

More serious is the effect of the c.r.t. itself, which does not give a light output which is linearly proportional to the input voltage swing. Because of this, the light signal produced by a ten volt negative swing on the cathode is not balanced by a dark signal produced by a ten volt positive swing. This is specially true near cut-off, where a bright-up signal cannot possibly be balanced at all, because a signal beyond cut-off has no effect. Fortunately, the interfering signals are least visible in this condition, but the problem of tube non-linearity remains.

If we must resign ourselves to some interference from these subcarrier signals, should they be in large areas or in small ones?

Preferably as patterns in fine detail, since the eye is not so sensitive to this, and the tube is less able to resolve it.

We can achieve this minimum interference by locating the subcarrier at the high frequency end of the video spectrum (Fig. 6). Most of the energy of the additional signal is close to the subcarrier frequency, and, for the reasons detailed, will not be objectionably visible. We can improve further on this by suppressing the subcarrier and transmitting only the sidebands, by limiting the bandwidth of the sidebands, and by inserting into the video amplifier for the *Y* (luminance) signal a filter tuned to the subcarrier frequency. All of these steps are taken in the PAL system; the filter in the *Y* channel is called a NOTCH FILTER from the shape of its frequency/amplitude characteristic, Fig. 7.

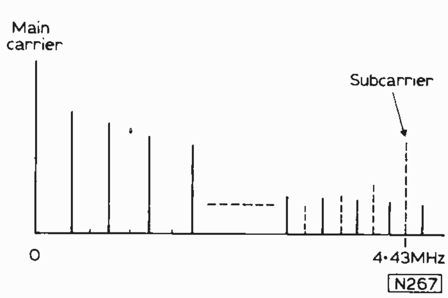


Fig. 6: Colour subcarrier and its spectrum fitted into the main carrier spectrum.

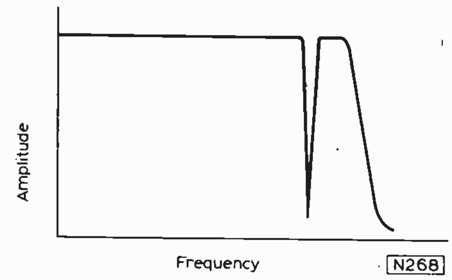


Fig. 7: Response of a receiver video amplifier with 4·43MHz notch filter.

Does the PAL system introduce any complications compared with the original NTSC system?

The phase switching of the *V* subcarrier on alternate lines introduces a half-line frequency component into the signal spectrum. As a result a half-line offset between the luminance carrier and chrominance subcarrier cannot be used. Instead, a quarter-line offset is used. The dot patterning is slightly more noticeable than with the original NTSC system, which does use a half-line offset, but is reduced by adding a 25Hz (half-field frequency) offset.

The notch filter causes a slight loss of resolution on the viewed picture, but this is hardly apparent to the eye, and is certainly not so objectionable as the patterns which would be seen if the filter were removed. It may seem odd that the filter should be tuned to reject the subcarrier frequency when the subcarrier has been suppressed anyway. However, because of the modulation method used, there is a signal component at the carrier frequency. Also, complete suppression of the modulated subcarrier is difficult to achieve, and there is a lot of energy in the sidebands very close to the subcarrier frequency.

To take an example, large areas of colour (blue sky, green grass) mean repetitive low frequency signals which will be very close to the subcarrier frequency. Such signals can cause quite severe patterning on a monochrome set with no notch filter.

What about the outer sidebands which the notch filter does not stop?

These represent fine detail, where the eye is not so responsive to patterning.

We have seen previously how the colour information is modulated on to the subcarrier. Because the subcarrier is suppressed during this process, we have to send a subcarrier reference signal along with the video signal to make sure that we can synchronise a subcarrier oscillator in the receiver. Some space has to be found for this signal. There is no problem in fitting it in to the spectrum, as we have made a gap for it, but the timing of this signal is important.

If it is sent during picture time, any resulting change of phase of the regenerated subcarrier would cause a sudden shift of colour during a line. In addition to this, transmitting a subcarrier (notch filter or not) during picture time would cause patterning. We therefore transmit this signal during a time when the video signal is at black level and no picture is seen. Such intervals occur before and after each line sync pulse, and are known as the front and back porches. We can fit 10 cycles of a subcarrier signal into the back porch, which is the longer one, and so this time is chosen for the portion of the subcarrier reference signal known as the BURST, see Fig. 8. It is not visible because half of it is below black level, and the spot is off screen anyway.

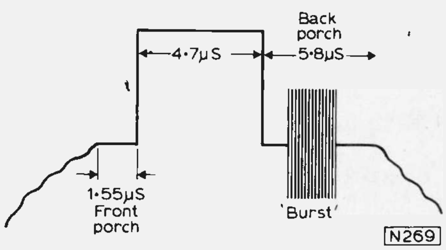


Fig. 8: Timing of the colour sync signal. The "burst" consists of 10 cycles (±1 cycle) of the colour subcarrier.

Why not transmit it at the top of the line sync pulse, so getting many more cycles?

In the 625-line system, where negative modulation is used, the top of the sync pulses corresponds to 100% amplitude of the carrier. To add another signal to this would mean having to decrease the amplitude of the rest of the signal to avoid overmodulation, or making the colour signal different in voltage standards from the monochrome signal.

An additional complication with the PAL system is the need to synchronise the *V* signal phase switching in the receiver with that at the transmitter. There is otherwise a 50:50 chance of red being displayed as green each time the set is switched on! To facilitate this synchronisation, the phase of the burst is shifted ±45° on alternate lines. This gives rise to a 7·8kHz squarewave signal at the burst detector output – the IDENT signal which is used to synchronise the switching. This signal is also used to produce the COLOUR KILLER action which inhibits the colour circuits when a monochrome signal is being received, so preventing colour interference on the screen. ■

CEEFAX/ORACLE

continued from page 308

two changeover switches. A typical circuit configuration for the CD4016 is shown in Fig. 61. Each of the switches has an ON resistance of around 300 ohms and the OFF resistance is of the order of 10 megohms. Since a CD4016 can pass frequencies up to 10MHz it is quite suitable for handling the picture video signal. A colour system would require two CD4016 devices to give a total of four changeover switches for R, G, B and Y signals respectively.

Future trends

In this series the basic techniques needed for the decoding and display of teletext have been described. No attempt has been made to cover all of the possible logic arrangements since there are so many variations which a designer might use.

At the present time a decoder unit built up from TTL devices might contain around 85 to 100 separate integrated circuits and would take a current of some 3 amperes from a stabilised 5 volt supply. The cost of the parts alone for such a system would be around £100 and to this must be added the cost of assembling the relatively complex wiring. Whilst this type of decoder might well be attractive to the home constructor it would be expensive to manufacture for the normal retail market.

One way of reducing assembly cost is to use larger and more complex integrated circuits which require less interconnecting wiring and a smaller number of packages. These circuits are known as large scale integration (LSI) devices in which one 40-lead package may contain as much logic as perhaps twenty standard TTL devices. Among the devices currently being made are microprocessor circuits which can be programmed to perform almost any logic or arithmetic function and might well be used to implement a large part of a teletext decoder system.

It is likely that special LSI logic circuits will be developed for use in teletext decoders so that a complete decoder might be reduced to perhaps half a dozen large integrated circuits. Texas Instruments are developing such a set of circuits which will be known as TIFAX and will use some six or seven integrated circuits to perform all of the functions of a basic teletext decoder. Other manufacturers are also working on the development of similar systems which might eventually reduce the cost of a decoder system to around £30 when built into a TV receiver.

In the field of memory devices much larger units are now becoming available with 4000 or even up to 16,000 bits in each memory device. At the same time the cost of memory devices is still falling so that soon it will be practicable to have a page memory capable of holding several pages of text at the same time.

Recently the Post Office have developed a system called Viewdata which is similar to teletext. In this case however the text data is transmitted to the viewer via the normal telephone line and may then be displayed on a television screen if required. It seems likely that the decoder and display system for Viewdata might well be built into future teletext decoders so that both systems can be used. ■

Servicing the THORN 8000 8000A 8500 chassis

Barry F. PAMPLIN

PART 4: FIELD TIMEBASE

THE complete field timebase circuit is shown in Fig. 1.

Field Generator

Transistors VT406 and VT407 are connected as a complementary relaxation oscillator, with the field sync pulses coupled by W407 to the base of VT407. During the scan period both transistors are off since the base voltage of VT406 is held above that of its emitter by the reverse bias on W408 caused by the charge on C430. VT407 stays off since there is no forward bias on its base.

During this scan period the field charging capacitors C433 and C436 charge via the height control R446 to produce a linear scan voltage. VT407 is isolated from the charging circuit by diode W409.

After a period of time determined by the setting of the vertical hold R439, the charge on C430 leaks away and W408 becomes forward biased. This reduces VT406's base voltage and it starts to turn on. Because of the coupling between VT406 collector and VT407 base, VT407 also turns on. Both are rapidly driven into saturation. In the absence of sync pulses the field timebase runs at a frequency determined by the time-constant of C430 and the hold control. With the sync pulses present VT407 is turned on before the "natural" changeover period.

Once VT407 turns on it discharges the field charging capacitors C433 and C436 ready for the start of the next scan. Meanwhile C430 recharges from the supply via R440, the emitter-base junction of VT406, W408, R444 and VT407 until the voltage on the base of VT406 exceeds its emitter voltage and both transistors cut off again.

Driver and Output Stages

From this description it is apparent that at the start of each scan VT408 is switched off – VT409 as well. With VT409 off its collector is at 46V and VT411 is also non-conducting. VT410 is hard on however and driving current through the scan coils to produce the first half of the scanning stroke. This current starts at a high value and decreases as C433 and C436 charge and turn on VT408 and VT409. By the time the middle of the scan is reached VT410 is almost off and VT411 starts conducting to drive a linearly decreasing current in the reverse direction through the scan coils to complete the scan. Diodes W411 and W412 prevent crossover distortion.

Good linearity is achieved by heavy negative feedback from the scan coils to the field current amplifier VT408 via C436. Field scan correction is provided by W410, R449 and C434.

At the end of the scan period, i.e. when VT406/7 turn on, VT408, VT409 and VT411 all turn off and the sudden change in scan coil current gives rise to a back e.m.f. which forward biases W414 to "tip" the surplus energy into the h.t. rail. Capacitor C438 couples this voltage pulse to the base of VT411 to keep it non-conducting: it also provides base current for VT410 which conducts in the reverse direction during the flyback.

Servicing

Apart from output transistor failure the field timebase circuit gives rise to few servicing problems. This is perhaps just as well since fault finding is not easy in this sort of circuit. In difficult cases the following summary may be helpful.

Field collapse:	VT410, VT411, VT408, VT409, R457, R458.
Field jitter:	VT406, W407, C432, C430, W408.
Low height:	VT410, VT411, R447, W410, VT408.
Top foldover:	VT409, W414.
Top cramp:	W411, VT410.
Bottom cramp:	VT410, VT411, C436, C435.
General non-linearity:	VT410, VT411, VT409, W411, W412, C436, C435, C439.
Wrong field frequency:	R438, VT407, C430, C429, W408, R439.
Poor field hold:	W407, C428, C431, C432, W101 (on signal board), W408, VT406, VT407.

When fault finding around the field output stage bear in mind that there are two different varieties of panel, with different copper patterns around the VT410/VT411 area. The variations are shown in Fig. 2 – the general effect is that on later boards the collector and base connections are reversed. This will not produce problems if exact replacement transistors are used, but in any case of doubt the compatability of the transistor type being fitted with the copper pattern should be checked. Amongst the transistor types found on these boards are BD222/BD225, 16599/16600, 2N6178/2N6180, 16199/16120, MPSU05/MPSU55. Keep to these pairings when making replacements.

Field Convergence

The signal for driving the vertical convergence circuits is obtained directly from the scan coil feed. A sawtooth voltage is developed across the sampling resistor R461 and a parabolic voltage across the coupling capacitor C439. These voltages are applied across R514 (tilt) and R513 (amplitude) respectively, the matrixed red and green convergence coils being connected between the sliders of these two controls. Differential drive to the red and green coils is provided by R518 (R/G difference) whilst R460 (R/G balance) provides tilt balance. C503 isolates the d.c. in the scan coils from the convergence coils. W502 (not fitted to later units) acts as a d.c. restorer for the voltage across R512 and R513. R519 and C504 (both not fitted to earlier units) provide improved operation of the tilt control

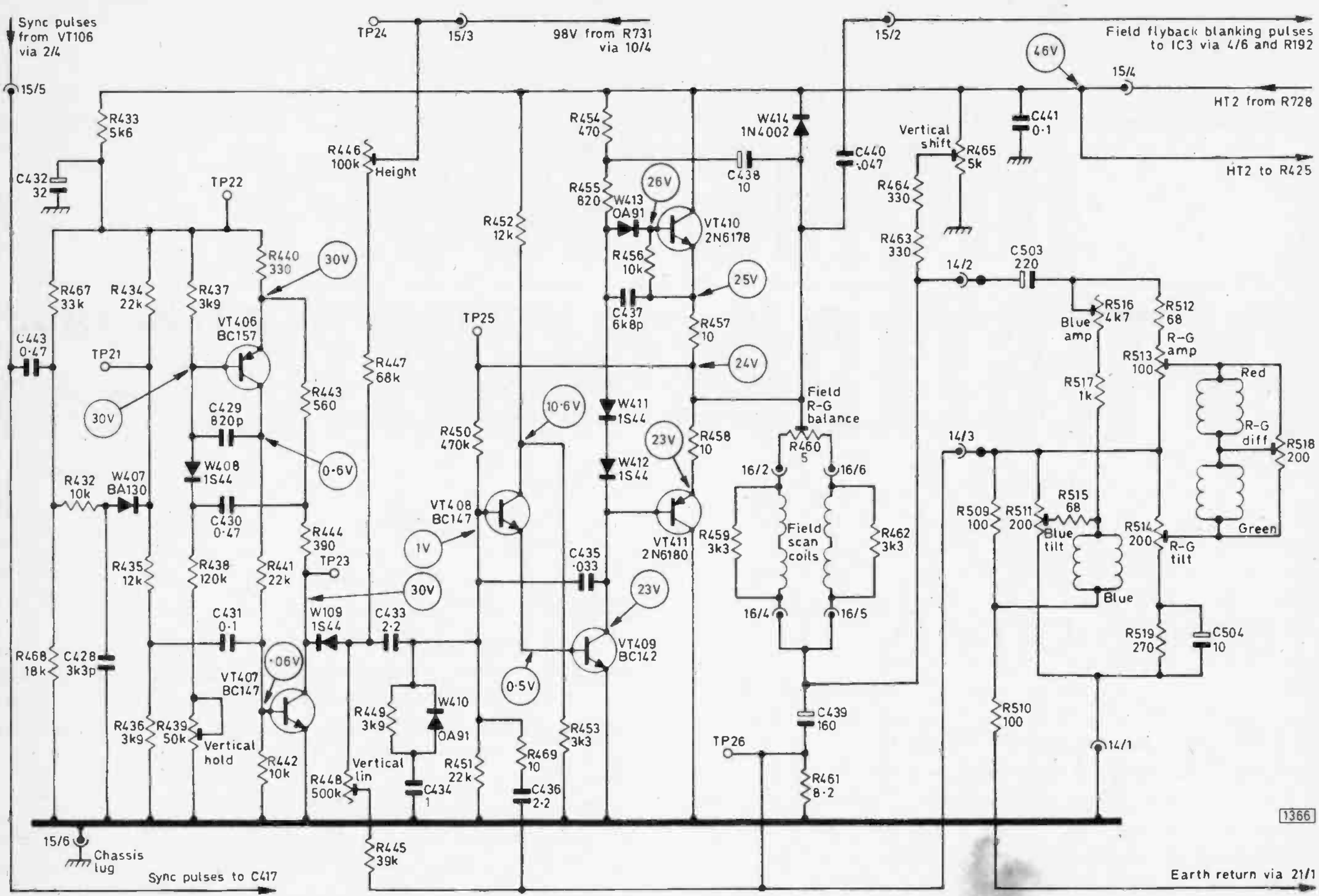


Fig. 1: Field timebase and vertical convergence circuits. C503 is 150µF on the 8000/8000A chassis. C504/R519 were added and W502 (in parallel with R512 and R513) deleted in later production to give improved convergence.

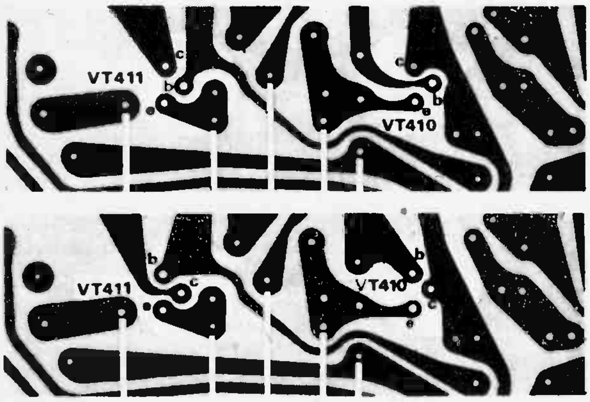


Fig. 2: Field output stage printed pattern change. Top, up to and including boards marked 643D; bottom, 643E and later boards. The board identification number is adjacent to L404.

R514, especially at the top of the screen.

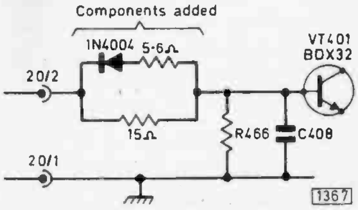
Blue correction is provided by the blue tilt control R511. This gives correction in both directions and the small parabolic current required is provided via the amplitude control R516.

Some Modifications

The field output transistor emitter resistors R457 and R458 have been reduced in value to 2Ω in recent production to prevent cramping with low-gain transistors. R469 (10Ω) was originally 39Ω – changed to improve top linearity.

The later PC650 timebase panel incorporates an f.e.t. buffer amplifier (VT412, type BF256LC) between the field oscillator and field current amplifier (VT408) stages. This

Fig. 3: Modifications in the 8000/8000A chassis when a BDX32 line output transistor is used.



panel was introduced with the 8800 series chassis and can be used in the 8000, 8500 or 8800 chassis. The earlier panel can be used in only the 8000 and 8500 chassis.

The line output transistor used in the 8000/8000A series chassis varies. Early models were fitted with the BU105/02 which was replaced by the BU206. In some later models a BDX32 is used, as in the 8500 chassis. This is not a direct replacement. Where it is used the base drive circuit is modified as shown in Fig. 3. The extra components are mounted on the transistor heatsink assembly. These components must be fitted when a BDX32 is used, and must be omitted when a BU206 is used (the BU105/02 is now obsolete).

The mains fuse F802 is 3·15A (anti-surge) on all later production chassis. The 25V supply fuse F801 is 1A (anti-surge) in later 8500 series chassis.

Line Output Stage

Finally, a cause of line output transistor failure not mentioned in Part 3 last month – a defective line output stage tuning capacitor (C406). The capacitor can go intermittently open-circuit, killing the line output transistor. This was particularly so in early 8000 series sets. If in doubt, replace both components. ■

MORE 'SCOPE

TV TEST EQUIPMENT REVIEW

PART 3

E. TRUNDLE

Telequipment D54 and D61

Telequipment is probably the most popular manufacturer of TV service oscilloscopes, and the D54 and newer D61 will be described. These two instruments are similar in most respects, being 10mV, 10MHz dual-trace portable models. The D54 is rather more expensive than the D61, but boasts a rectangular c.r.t. and better presentation. Although it is largely a matter of personal opinion, the greener trace of the rectangular c.r.t. fitted to the D54 is felt to be better than the bluish-green trace of the D61. Another minor advantage of the D54 is that the front panel input/output sockets are amenable to the ubiquitous crocodile clip, whereas the D61 requires wander-plugs for external connections.

Y amplifiers

The Y channels of both instruments are similar, being d.c.-coupled with a maximum sensitivity of 10mV and 3db bandwidth of 10MHz. The D54 has a variable Y-gain control in addition to the Y-gain step attenuator, this feature being notably absent from the D61. The usefulness of a Y-gain vernier control is a moot point, and it is true that if none is provided, false readings due to maladjustment cannot happen. On the other hand, when comparing amplitudes, the vernier is very useful for fitting the display between two convenient graticule lines.

Timebase

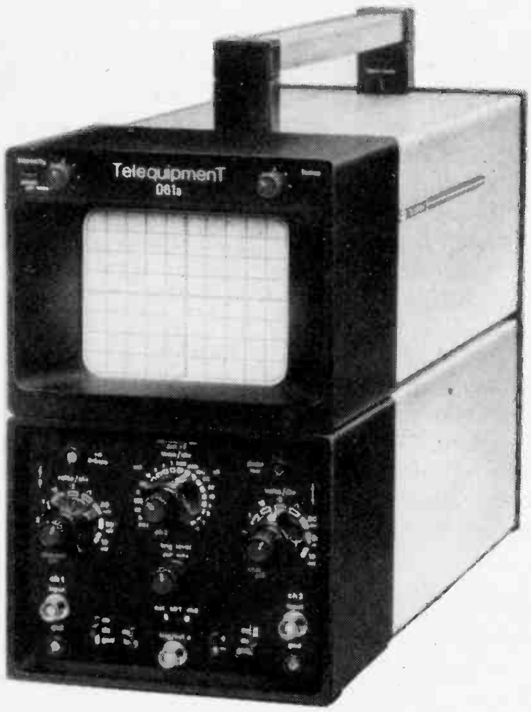
As always, Telequipment have done us proud in the sweep department, with 22 sweep speeds on the D54 and 19 on the D61. The range covered is more than adequate for all requirements, and the D54 has a variable sweep speed control for continuous coverage between ranges. The D61 has no such vernier. Fine adjustment of X gain is catered for on the D54, whereas the D61 has a simple "pull for ×5" knob. For those with wobbulators, the D54 has a sweep output available at the front panel, but not the D61.

Trigger

Both instruments have a TV-trigger facility, and composite video traces can be solidly locked at line or field rate using the internal trigger mode from either Y channel. Again, trigger facilities are more comprehensive on the D54, but both 'scopes are above reproach in this department.

Probe-test and Y amplifier calibration outputs are provided on the front panel, and Z-modulation is catered for. The high e.h.t. of these instruments is useful where a strobed display is necessary. The author has been faithfully served in bench and field servicing work for two years by a D54, and this instrument is widely held to be the definitive TV service oscilloscope. Both instruments are eminently suitable for field work on colour TV and the like, the D61, with its uncluttered panel and minimum of controls, being exceptionally simple to 'drive'. While there are few things the D54 can do that the D61 can't, the former, with its more comprehensive facilities, is, if anything, to be preferred for bench use. ●

Abridged specification
D61



Editorial Note – The D61 has just been replaced by the D61a (pictured here) in a restyled, more robust case. Technical specifications remain the same, apart from the incorporation of enhanced triggering capabilities and a multi-range power transformer. The price is £155 plus VAT.

VERTICAL DEFLECTION SYSTEM (Dual trace)
Deflection factors: 10mV/cm-5V/cm in a 1-2-5 sequence.
Accuracy: ±5%.
Bandwidth: D.C. (2Hz on a.c.)-10MHz (−3dB).
Rise time: 35ns.
Input impedance: 1MΩ/35pF.
Operating modes: Channel 1 only. Channel 2 only. Alternate between channels for 1ms/cm and faster; chopped between channels at 100kHz for 2ms/cm and slower. (Selection automatic by sweep speed switch).

HORIZONTAL DEFLECTION SYSTEM
Sweep speeds: 0·5μs/cm-500ms/cm in a 1-2-5 sequence.
Accuracy: ±5%.
X Expansion: × 5 (±2% degraded to ±5% at 100ns/cm).
External X input: 250mV/cm.
Bandwidth: 2Hz-1MHz.
Input impedance: 1MΩ/10pF.
Special features: Full X-Y mode facilities using Channel 2 for horizontal input. Bandwidth d.c.-1MHz.

TRIGGERING
Sources: Channel 1. Channel 2. External.
Sensitivity: Internal; 5mm from 40Hz-1MHz, 10mm at 10MHz. External; 100mV from 40Hz-1MHz, 1V at 10MHz.
Controls: Polarity. Level/auto on-off. Coupling – AC, TV (auto line or field).

GENERAL
E.H.T.: 3·5kV.
Graticule: Ruled 8 × 10cm.
Power supply: A.C. mains 200-240V, 48-400Hz, 25VA. 100-120V version available.
Size: 280 × 160 × 420mm (11 × 6·25 × 16·5 in).
Weight: 6·5kg (14·3 lb).
Accessories available: Probe kit.
Price: See note.
Further details are available from Tektronix U.K. Ltd., Beaverton House, P.O. Box 69, Harpenden, Herts. Telephone Harpenden (058 27) 63141.

Abridged specification
D54

VERTICAL DEFLECTION SYSTEM (Dual trace)
Deflection factors: 10mV/cm-50V/cm in a 1-2-5 sequence.
Accuracy: ±5%.
Bandwidth: D.C. (2Hz on a.c.)-10MHz (−3dB).
Rise time: 35ns.
Input impedance: 1MΩ/40pF.
Operating modes: Channel 1 only. Channel 2 only. Alternate between channels. Chopped between channels at 100kHz.
Special features: Probe test output. Voltage calibrator output. Z-mod input.

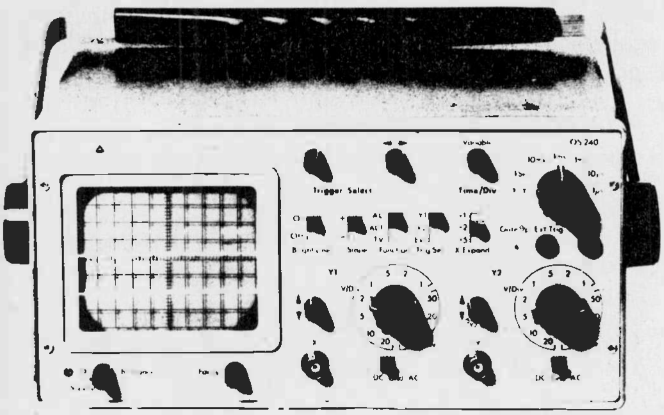
HORIZONTAL DEFLECTION SYSTEM
Sweep speeds: 200ns/cm-2s/cm in a 1-2-5 sequence plus uncalibrated 2·5:1 variable control.
Accuracy: ±5%.
X Expansion: Variable up to × 5.
External X input: 600mV/cm-3V/cm.
Bandwidth: D.C. to 1MHz (−3dB).
Input impedance: 1MΩ/30pF.
Special features: Sweep ramp output.

TRIGGERING
Sources: Channel 1. Channel 2. External.
Sensitivity: Internal; 2mm. External; 1·5Vp-p, 50Hz-1MHz.
Controls: Polarity. Level/auto bright line on-off. Coupling – AC, TV field, TV line, HF sync 1 MHz-10MHz.

GENERAL
C.R.T.: 5 in. flat faced. **E.H.T.**: 4kV.
Graticule: 6 x 10cm, variable illumination.
Power supply: A.C. mains 100-125 or 200-250V, 48-400Hz, 32VA.
Size: 245 x 210 x 447mm (9·75 x 8·25 x 17·5 in).
Weight: 9kg (20 lb).
Accessories available: Probe kit.
Price: £198 (plus VAT).

MORE 'SCOPE

Advance OS240



The OS240 is a 10MHz, dual-trace instrument. The smallish 4 in. c.r.t. has been given 10 × 8 graticule divisions by reducing the usual 1cm divisions to 0·8cm. This is just acceptable for fine measurement, provided the brightness is kept within bounds to maintain good focus. A useful X-Y facility is provided, with the Y1 amplifier feeding the X deflection system when X-Y is selected. Provision for Z-modulation is also made via a rear socket.

Y Amplifiers

These are identical d.c.-coupled channels, 3db down at 10MHz. The maximum sensitivity of 5mV is better than most, and is particularly useful in VCR servicing where peak-to-peak amplitudes of as little as 3mV are required to be measured. No variable sensitivity control is provided, the twelve-step attenuator giving sufficient range by itself. This avoids erroneous readings due to maladjustment of the vernier control. Chop and Alternate beam modes are automatically selected by the timebase switch.

Timebase

It is in the sweep generator that we must make our most severe criticism of this instrument. The six sweep speeds provided compare very unfavourably with the twenty or so pre-set speeds available in comparable instruments. A wide-range variable control is provided, but with a maximum sweep speed of 1μs/div, examination in detail of frequencies above about 3MHz necessitates expanding the X deflection by two or five times with the switch provided. This is fair enough, but the fact that up to 80% of the trace is now off the screen, combined with the 1·5kV e.h.t., means that the trace is dull and defocused. It seems a pity to provide such excellent Y amplifiers, only to hamstring the performance above 3MHz with an inadequate timebase. *See Note.*

Trigger

It seems that the pennies saved in the horizontal sweep department have been spent on the trigger circuitry, which is excellent. The OS240 has been designed with television service in mind, and a sync separator is incorporated for field triggering. Switches are provided for trigger source selection, function and polarity, with a bright line facility in the absence of trigger pulses. Good trigger peformance is invaluable for TV servicing, and full marks must be given to the OS240 on this count.

Weight and performance of the OS240 make it suitable for bench and field work and the robust case and combined handle/stand suggest that it will weather the rough and tumble of field service well. ●

Editorial Note – We understand that a modified version of this oscilloscope, to be called the OS240A, is being introduced by Advance during 1976. This should go a long way towards meeting Mr. Trundle's criticisms.

Timebase sweep speeds will range from 1μs/div to 500ms/div in a 1-2-5 sequence. Trace expansion factors become x5 and x10 and a brighter c.r.t. is being used.

Abridged specification

VERTICAL DEFLECTION SYSTEM (Dual trace)
Deflection factors: 5mV/div-20V/div in a 1-2-5 sequence.
Accuracy: ±5%.
Bandwidth: D.C.-10MHz (–3dB).
Input impedance: 1MΩ/28pF.
Operating modes: Channel Y1 only. Alternate between channels for 0·1ms/div and faster; chopped between channels at 250kHz for 1ms/div and slower. (Selection automatic by sweep speed switch).
Special features: Z-mod input.

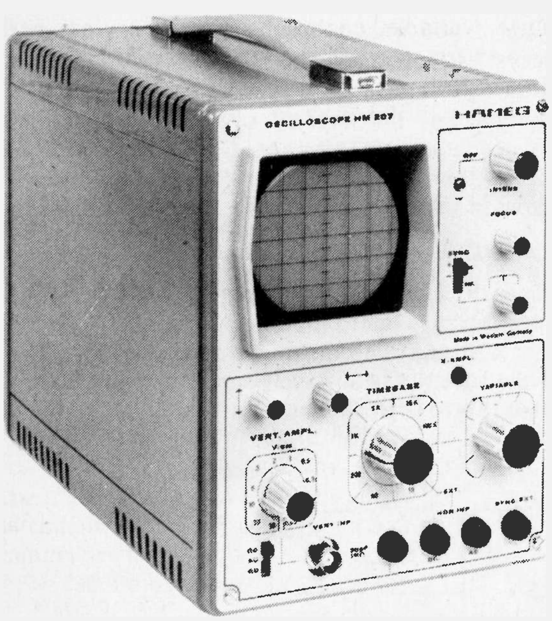
HORIZONTAL DEFLECTION SYSTEM
Sweep speeds: 1μs/div-100ms/div in decade steps, plus uncalibrated 10:1 variable control.
Accuracy: ±5%.
X Expansion: × 2 and × 5 (±5%).
External X input: Full X-Y mode facilities using Y1 for horizontal input.
Bandwidth: D.C.-500kHz.
Special features: Timebase gate-pulse output.

TRIGGERING
Sources: Channel Y1. Channel Y2. External.
Sensitivity: Internal; 0·3 div from 40Hz-2MHz, 1 div from 8Hz-10MHz. External; 1·5V from 40Hz-2MHz, 5V from 8Hz-10MHz. (Input impedance 100kΩ/10pF).
Controls: Polarity. Level. Auto bright line on-off. Coupling – AC, AC fast, TV field.

GENERAL
C.R.T. 4 in. flat faced. **E.H.T.**: 1·5kV.
Graticule: Ruled 8 × 10 divisions, each division 8mm.
Power supply: A.C. mains 115, 220 240V ±10%, 45-440Hz.
Size: 132 × 270 × 317 mm (5·25 × 10·75 × 12·5 in).
Weight: 5kg (11 lb) approximately.
Accessories available: Probe kit.
Price: £137 (plus VAT).
Further details are available from Gould Advance Limited, Instruments Division, Roebuck Road, Hainault, Essex IG6 3UE. Telephone 01-500 1000.

MORE 'SCOPE

Hameg HM207



The Hameg HM207 is the simplest and least expensive oscilloscope here reviewed, and has been chosen as representing several makes of small single-beam oscilloscope. This type of instrument is the minimum requirement for modern TV service work, and the 8MHz bandwidth enables it to hold its own when investigating decoder circuitry. The $2\frac{1}{2}$in c.r.t. gives a surprisingly bright and sharp little trace, aided by a respectable 1kV accelerating potential. This little instrument boasts many of the features of its big brothers, such as f.e.t. input, d.c.-coupled Y amplifier and push-pull deflection on both axes.

Y amplifier

Again, the instrument price is a good index of Y performance, and the Hameg is less sensitive than more expensive instruments, reaching down to only 50mV/cm. With the necessary ×10 probe, 250mV peak-to-peak is the minimum amplitude at which a trace can be locked and deciphered, which means that the early stages of a colour decoder will remain shrouded in mystery. Where the circuit impedance is sufficiently low to tolerate a ×1 probe, more gain can be realised.

Timebase

Seven sweep speeds are provided, the fastest of which permits easy examination of a colour subcarrier sinewave, and without any X-expansion. This is better than the Advance OS240, which is a more expensive instrument altogether. One of the few real objections we had to the HM207 was that the sweep range switch is calibrated in frequency rather than time. This can involve some tedious calculations when measuring pulse widths and the like, and this feature is reminiscent of World War Two practice! An uncalibrated vernier control is provided for fine sweep speed adjustment. An external X-input socket on the front panel is selected by the sweep speed control. X amplitude is controlled by a front panel-mounted pre-set.

Trigger

A sync-selection switch allows triggering from positive or negative flanks of the displayed waveform, or external sync via a front panel socket. Unless the displayed waveform has a clearly defined trigger pulse present, it is necessary to 'fiddle' with the sync control, and we found that it was more practical to trigger externally via a loose wire hung near the line output stage of the receiver under test.

Flyback blanking left a little to be desired, especially at the faster sweep speeds. The lack of a Z-modulation input could be a handicap, if anything more ambitious than X-Y displays are contemplated. It must be remembered, however, that this instrument is remarkably inexpensive. Its small size and weight (11 lb) make it ideal for first-line servicing in the field, and provided its limitations are realised, it represents very good value for money. ●

Abridged specification

VERTICAL DEFLECTION SYSTEM (Single trace)
Deflection factors: 50mV/cm-30V/cm in a 1-2-3-5 sequence.
Accuracy: ±3%.
Bandwidth: D.C. (2Hz on a.c.)-8MHz (−3dB).
Rise time: 44ns.
Input impedance: 1MΩ/40pF.

HORIZONTAL DEFLECTION SYSTEM
Sweep speeds: 333ns/cm-16·6ms/cm, but calibrated in frequency in a 1-5-25 sequence. Plus uncalibrated 5:1 variable control.
Accuracy: ±2%.
X Expansion: Variable up to ×3 by front panel preset.
External X input: 250mV/cm.
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Sensitivity: Internal; 2mm at 10kHz, 5mm at 8MHz.
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Further details are available from ITT Instrument Services, Edinburgh Way, Harlow, Essex. Telephone Harlow (0279) 29522.

NEXT MONTH

Pattern Generators

LETTERS

INTERMITTENT FIELD COLLAPSE

In the December "Your Problems Solved" the symptom of intermittent field collapse on a set fitted with the Rank A823AV 90° colour chassis was brought up. Quite logically you suggest checking for a dry-joint on the field timebase panel (scan drive panel). We have had this exact fault on a couple of occasions recently however and in each case the dry-joint turned out to be at the base of the pincushion correction phase coil 6L20 which is mounted on the scan control panel. This panel is accessible after "opening" up the scan drive panel. – **R. W. Hunter** *(Sunderland).*

PAY AND CONDITIONS

With reference to the recent letters on the vexed subject of service engineers' pay and conditions, I must sympathise with those who have become disillusioned and disappointed with the television trade. I write as a qualified service engineer of many years experience who now realises that there are only two alternatives: to work for a large firm and be overburdened with too many calls and never having the time to do a proper job, or to work for a small firm and although this gives more job satisfaction there are no perks and the money is terrible.

I earn less than £2,000 a year and although I attend field calls I am not allowed the private use of a vehicle: unfortunately the present economic climate has prevented me finding alternative employment in the trade.

If the present attitudes of the dealers and television rental companies continues, that is in regarding engineers as cheap exploitable labour and not as technicians in their own right, the net result will be a drastic fall off in the number of apprentices coming into the trade and a famine of qualified personnel. In some parts of the country this situation already exists, and could be reversed only by major restructuring of the pay and conditions. Only then will the trade attract the sort of technician capable of dealing with the increasingly advanced circuitry used in the latest television receivers. – **D. Chilvers** *(Norwich).*

SOME SUGGESTIONS

The following suggestions may help other readers.

Television Colour Receiver: Lack of Width, EHT Normal.

After using the lower e.h.t. tapping (tag 4) and adjusting the linearity the width was still inadequate. This was cured by increasing the value of the line output transformer fifth harmonic tuning capacitor C601 to 220pF (pulse disc type). Readers should not increase the value of this component beyond 270pF.

I have found as a service engineer that scan correction capacitors can be critical in achieving adequate width. Reducing the value of the S-correction capacitor C404 from 0·68μF to 0·33μF may help if there are signs of slight cramping in the middle of the scan. Reducing the value of this capacitor too much will result in cramping at the start and finish of the scan. A value which gives good linearity over the whole scan should be aimed at.

Philips 210, 300 and Pye 368 Chassis: Shorting Scan Correction Capacitors.

Both ends of the line scan coils are capacitively coupled in these chassis on 625 lines, resulting in the coils floating and capacitor breakdown after taking on a static charge. The symptoms are lack of width with cramping at the middle of the line scan. To avoid this, add a resistor of say 22kΩ across the 0·33μF capacitor (C2068 in the Philips chassis, C122 in the Pye 368 chassis). No action is necessary if 405 only is used. If one of the S-correction capacitors is found to be short-circuit and 625-line operation only is required it is more economic to fit a wire link in place of the 0·33μF capacitor and replace the 0·56μF capacitor (C2069 or C123) with an 0·22μF capacitor – this being the effective value of the two original capacitors in series.

Adding a Black-level Clamp to the Pye 368 Chassis.

Replace R70 (47kΩ) with an 82kΩ resistor and 10μF capacitor (positive plate to chassis) in parallel. Cut the print between R70 and the coupling capacitor C68 and add a silicon diode (e.g. OA202 etc.) across the gap, cathode to C68 (see Fig. 1). Following this modification the video

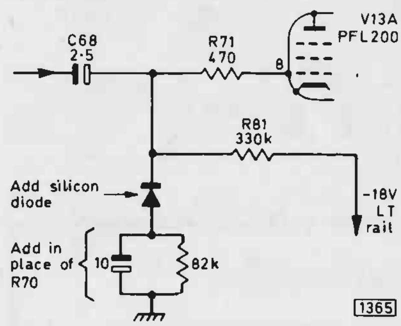


Fig. 1: D.C. restorer circuit suggested by W. R. Hill for use with the Pye group's 368 chassis. This was the final dual-standard monochrome chassis produced by the group.

output pentode's quiescent anode voltage is higher at 175V but falls to near normal (145V) under drive conditions. The clamp is simple and very effective.

Pye Hybrid Colour Receivers.

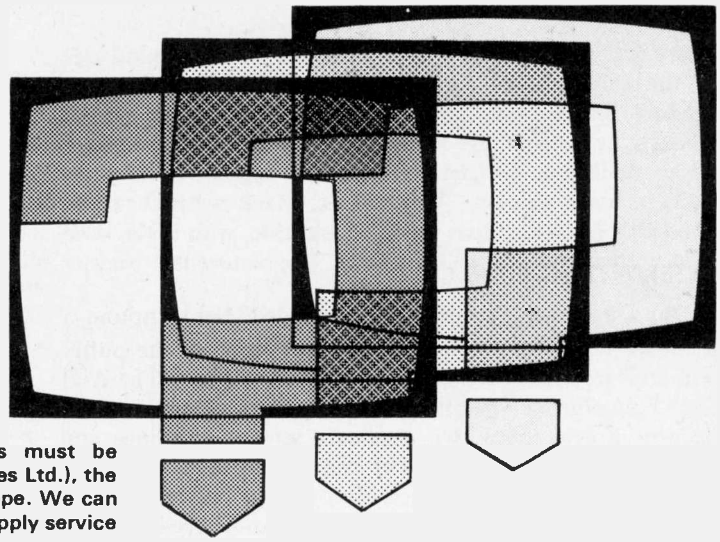
Creep up at the bottom of the raster before full height is reached can be overcome by reducing the value of R255 (33Ω) which is in series with the field charging capacitors, on the chassis side. Either replace with a 47Ω preset or temporarily connect a 250Ω potentiometer across R255 to ascertain the optimum value and add a selected fixed resistor in parallel to give this.

The field output stage midpoint voltage can be easily set as follows. Since the output transistors are readily accessible connect the meter from VT27 collector to chassis (negative lead). Then adjust RV24 for a reading of 2-3V positive. – **W. R. Hill** *(Bristol).*

"TELEVISION" COLOUR RECEIVER

A couple of points which may help other constructors of the *Television* colour receiver. Like many others apparently, I experienced considerable difficulty in getting colour lock. This was found to be due to the reference oscillator frequency being too high, giving only partial colour with C14 fully closed. Adding a 15pF capacitor in parallel with C14 enabled the latter to be easily adjusted for colour lock and a full colour picture. Secondly I found that removal of C36 in series with the reference signal feed gave improved red. The value of C36 is such that it will not normally give any appreciable phase error, but ideally it should be omitted. – **E. P. Smith** *(Petersfield).*

Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 331 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

ITT FEATHERLIGHT 15

The focusing around the edges of the picture on this monochrome portable is poor. Everything seems to be o.k. however except that the c.r.t. first anode voltage is low at 300V instead of 400V.

The first anode voltage has no effect on the focusing and can be disregarded. Everything depends on how bad the focus is at the picture extremes: it is a characteristic of small, wide-angle tubes to have marginal defocusing towards the edges, but if the effect is really severe your tube could be out of tolerance. A faulty scan yoke can give the same effect, but this is unlikely. (ITT VC301 chassis.)

ULTRA BERMUDA

When this 19in. monochrome set is first switched on the boost diode lights up brilliantly, then dies back down to normal brightness. The other valves appear to be slightly brighter than normal. One boost diode has already burnt out. The picture is good on all channels.

Many different Ultra sets have carried the name Bermuda. Our guess however is that yours is fitted with the Thorn 950 Mk. II chassis. In this the heater line thermistor fitted in the Mk. I version of the chassis was removed and a wire link substituted in its place. The link is situated on the right-hand side, where it is marked X3. Remove the link and fit a thermistor – type TH1A, VA1026 or similar.

FERGUSON 3816

The set is working perfectly though the 10Ω resistor in parallel with the series regulator transistor is getting excessively hot. On checking, the input voltage to the regulator was found to be slightly up, at 19·6V instead of 16·8V. All other voltages are o.k. however. The mains transformer and rectifier circuit seem to be in order, but the regulator driver transistor is running rather hot. I have noticed the same fault on another of these sets.

Make sure that the set h.t. voltage potentiometer R104 is set for 5V at the base of the regulator driver transistor VT22. This should result in normal current demand if the load is correct. Check the value of R103 which is in series with R104 however – it often changes value. If necessary, try inserting a 2Ω resistor in series with fuse F2 at the regulator input in order to reduce the strain on the audio output circuit which is fed directly from the mains rectifier/battery output circuit. (Thorn 1590 chassis.)

DECCA CS1900

The initial condition was no e.h.t., with the PL509 line output valve red hot. While testing, the 470Ω resistor R500 on the convergence board, in series with the line windings on the pincushion distortion correction transductor, burnt out. With this resistor open-circuit the line output stage came back to life. The resulting picture was nearly normal except for a small amount of distortion at the top of the screen. Replacing R500 brought back the original fault, the resistor running hot and soon burning out. If the screened lead to the convergence coils is unplugged the line output stage returns to life – but without line scan of course since the line scan circuit is open-circuit, the line scan and convergence circuits being in series.

The fault is almost certainly due to a defective transductor loading the line output stage. The part number is 550717. (Decca interim single-standard colour chassis.)

BUSH TV183SS

I have changed all the line timebase valves in this set but still have the problem of picture pulling from right to left.

If you look at the component side of the chassis you will find just to the right of the tube neck a small electrolytic capacitor. It's mounted on the edge of the panel and its negative connection is returned to chassis via a blob of solder on one of the tags on the vertical metal strip. The capacitor is used to decouple the h.t. supply to the line oscillator. Clean off and resolder the earth connection and if necessary check the capacitor. (Rank A774 chassis.)

GEC 2028B

A thick band of snow moves slowly down the screen, accompanied by buzz on sound. The colours are greeny yellow in the centre, violet in the bottom corners, with a red band down the outer edge of the width. The colour indicator does not operate, this latter fault having occurred more recently.

A band of snow accompanied by a mixture of colours such as you describe could be the result of arcing on the degaussing panel: this could also account for the buzz on sound. We suggest that you also check the smoothing components. We assume that you are receiving a colour picture but that the colour beacon does not operate: in this case examine the associated transistor TR26, the lamp itself, and resistors R51 and R321 in this circuit.

ULTRA 6702

There is a slight yellow-green patch on the right-hand side of the screen. This gives subjects in this area a green shadow on the right-hand side. When a white post, or lettering, is shown there is red to the left and then the green. On monochrome a slight green shadow appears to envelope white or black objects. On a white or black raster the right-hand side is darker than the left-hand side, with a ¾in. wide light vertical strip down the centre. The picture is otherwise excellent.

The colour patches are due to impurity and the fringeing to misconvergence. You will have to carry out the purity and convergence procedures given in the manual. The R/G line convergence potentiometers in this chassis often become noisy: there is a duplicate set for 405 lines and these can be used as spares. For the shading, check the c.r.t. first anode supply reservoir/decoupling capacitor C23 (0·047μF) on the line timebase panel, and for the light strip the efficiency diode W4 (1AS029). (Thorn 2000 chassis.)

GEC C2103

The problem with this set is the field hold. The picture can be locked only with the hold control towards one end of its travel, and as the PL508 field output valve ages there is no longer any adjustment available. Replacing the PL508 cures the trouble, but as this is required every couple of months it cannot be the sole answer to the problem – which has been present since the set was new. Initially a replacement timebase panel was fitted, but the situation did not improve.

The sync separator transistor TR109 (BC117), though not its collector circuit components, is on the i.f. panel. We suggest you replace the transistor and check the value of the upper resistor in its base bias network (R131 1MΩ). Then if necessary replace the field pulse integrating capacitor C514 (0·005μF) and coupling capacitor C513 (300pF) on the timebase panel. Make sure that the PL508's cathode components are in order – this should include C600 (250μF) on the convergence board.

PHILIPS G23T212

The problem with this set is no raster. The line whistle is present, but there is no e.h.t. at the DY87 e.h.t. rectifier which does not light up. All line timebase valves have been checked by substitution with known good ones. The only previous fault was when the 1kΩ resistor on the line output transformer burnt out a couple of years ago: after this burnt out a second time it was replaced with a higher wattage type and is o.k.

That 1kΩ resistor damps the line linearity coil. We suggest you check whether the coil is open-circuit and make sure that the connections to it are sound. Otherwise the scan current will be flowing through the 1kΩ resistor and this will impose a heavy load on the output stage. If this is o.k. however, check whether the PL504 line output valve is cold. If so check whether its screen grid voltage is present – 180V at pins 6 and 7. Check the 2.2kΩ feed resistor R2158 if this voltage is absent. If all is o.k. so far, remove the top cap from the PY800 efficiency diode. Presence in this condition of h.t. on the PL504 line output valve top cap indicates that either the boost capacitor C2064 (0·1μF) is short-circuit or the line output transformer has shorting turns. This assumes that there is drive to the PL504 – prove by checking for the presence of –50V or thereabouts at its control grid (pins 1 and 2). (Philips 210 chassis.)

ITT GK500.

The problem with this set is weak colours. The colours fade during the evening, necessitating constant readjustment of the colour control. Eventually this is at maximum, with little or no colour. Occasionally the colour control has to be turned up to maximum to obtain colour when the set is first switched on.

There could be several causes of the trouble. Check whether the voltages around the chrominance amplifier transistors T27, T28 and T29 are correct when the fault condition is present. Check the tantalum capacitors C153, C155, C162 and C165 in this area. And if any of the polystyrene capacitors C158, C156 or C161 are of the see-through type, replace them. Use of an aerosol freezer and hair drier might help narrow the field of search. (ITT CVC5 chassis.)

KORTING 90° COLOUR SET

The initial problem was intermittent loss of sections of the picture, and sometimes also brightness and colour content variations. Subsequently a more regular loss of the field scan occurred, a short interruption of the supply restoring this. The first problem was traced to the luminance output emitter-follower transistor T151 having an intermittent short-circuit. But it's difficult to trace the field fault because the load imposed by the test meter restores the scan.

We have known this fault to be caused by intermittent failure of the field blocking oscillator timing capacitor C312 (0·01μF) and by R322 (330kΩ) which is in series with the slider of the height control. We assume that you have replaced the PCL805 field timebase valve, and probed around the field timebase for loose connections and dry-joints. Failure of the 265V h.t. line (U5) which powers the field timebase can also occur, due to intermittent connections in the power unit.

BUSH TV181S

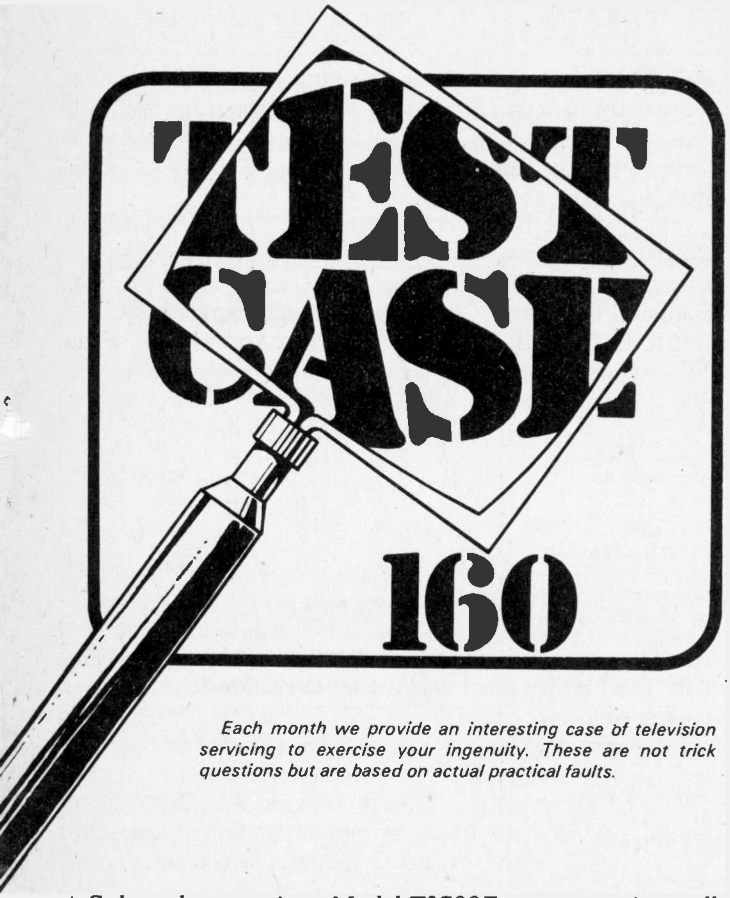
The line hold on this set is giving trouble. Sometimes it will hold from switch on, usually it will settle down after about ten minutes, but at other times there seems to be no line sync at all – the field holds perfectly however. Adjustment of the line oscillator coil makes no difference and I've changed the electrolytic 3C31 which decouples the line oscillator's h.t. supply.

It is essential that 3C31's negative connection to the tag on the metal strip on the right-hand side is good – we suggest resoldering. When this has been done check that the line oscillator coil's tuning capacitor 3C32 (0·0047μF) is a reliable type – not the silver type often fitted. Then if necessary check 3C33 (0·47μF) in the flywheel sync anti-hunt network. (Rank A774 chassis.)

TANDBERG CTV1

The sound cuts out for a second or two with a plop, then comes back again. Giving the side of the set a fairly vigorous thump with the flat of the hand when the sound cuts out restores it. The trouble occurs once or sometimes several times an evening. The set has been examined for loose wires etc. without anything being found. There is no disturbance to the picture when the sound goes.

The problem is due to a dry-joint or poor connection. Check all relevant plugs and sockets, and gently tap and probe the printed board in the area of the intercarrier sound and a.f. circuits. An aerosol freezing compound might help in locating the fault area.



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TELEVISION APR. 1976

A Saba colour receiver, Model T2700F, was operating well within the service area but failed to provide a picture of the quality expected. An on-site investigation proved that the display was certainly below the potential of this model, though the sound was perfectly acceptable. As it was in the service area, the receiver was being operated from a correct channel group u.h.f. aerial fitted in the roof space, and the signal was fed to the receiver through standard coaxial cable.

All channels were below par, and there was little doubt that the trouble was caused by lack of aerial signal at the receiver. This was subsequently proved by measuring the level of the carriers with a signal strength meter. A visit to the roof space revealed a service area type u.h.f. aerial supported by cord attached to the beams. The aerial was in approximately the correct orientation, but owing to space limitations it was not possible to move the aerial to many different positions or to increase its distance from a large metal water tank. An improvement in reception was nevertheless achieved by aerial adjustment, but still the receiver didn't give the completely noise-free and well defined display of which it is capable.

The solution appeared to be the use of an outside aerial, and since the house was detached it was agreed to mount a relatively simple array on a short pole on a rather short, isolated chimney stack, in spite of this bringing the elements fairly close to the roof tiles. The existing aerial was left in the roof space, and the new installation gave a dramatic improvement in reception of all channels – to the great joy of the viewer.

All was well for several weeks during the summer months, a call then being received that the reception on the BBC-1 channel was worse than with the original aerial, but that with the outside aerial the other two channels were "perfect" while with the roof space aerial all channels *were poor, as in the first place. Since the receiver had not failed completely the call was not given priority. A technician in the area a couple of days later reported that the set was now working very well indeed on all channels so that the symptom must have been attributable to the transmitter. All was well for another few weeks when the procedure was repeated almost exactly.*

A few more weeks went by and then the same complaint was made once again – BBC-1 very weak and noisy, the other two channels perfect! In spite of a heavy rain storm, the service mananger dispatched the outside technician immediately to check the problem while it was actually happening. True enough, BBC-1 was very poor, having all the symptoms of a weak signal, while the other two channels – although not quite to the standard as when the aerial was first erected – were giving very acceptable pictures.

What was the most likely cause of this unusual effect? See next month's TELEVISION for the answer and for a further item in the Test Case *series.*

SOLUTION TO TEST CASE 159
Page 275 (last month)

The cause of the poor BBC-2 reception was in fact the neighbour's new installation. The aerial erector had (with permission!) placed the neighbour's fringe u.h.f. aerial on the shared chimney stack, the two rather elaborate arrays then being fairly close together.

Owing to standing-wave conditions at the fringe location, the colour subcarrier was being absorbed by the array in proximity, but only on the BBC-2 channel! The trouble was cleared by merely reducing the height of the neighbour's aerial, since this moved the wavelength relationship from that corresponding to the subcarrier "suckout".

Owing to the possibility of such interaction it is undesirable to mount two u.h.f. arrays in close prix
imity on a shared chimney stack. The effect can be likened to coupling together two tuned circuits, as a result of which a significant (and sharp) dip in the overall response characteristic occurs due to signal energy absorption.

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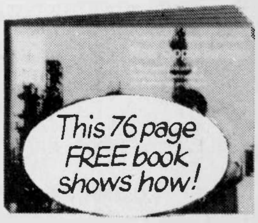

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AF178	0.50
AF180	0.55
AF181	0.40
AF239	0.36
AL100	0.80
AL102	0.90
AL112	0.60
AL113	0.60
BC107	0.12
BC108	0.12
BC109	0.12
BC113	0.10
BC114	0.10
BC115	0.10
BC116	0.12
BC117	0.12
BC119	0.20

Type	Price (£)
BC125	0.12
BC126	0.12
BC136	0.14
BC137	0.14
BC138	0.14
BC139	0.20
BC140	0.20
BC141	0.20
BC142	0.22
BC143	0.22
BC147	0.10
BC148	0.10
BC149	0.10
BC153	0.14
BC154	0.14
BC157	0.14
BC158	0.13
BC159	0.13
BC160	0.20
BC161	0.22
BC167	0.12
BC168	0.12
BC169C	0.13
BC171	0.12
BC172	0.12
BC173	0.14
BC177	0.16
BC178	0.16
BC179	0.16
BC182L	0.10
BC183L	0.10
BC184L	0.10
BC186	0.24

Type	Price (£)
BC187	0.24
BC209	0.12
BC212	0.12
BC213L	0.12
BC214L	0.12
BC249	0.30
BC251	0.16
BC262	0.18
BC263B	0.18
BC267	0.17
BC301	0.28
BC302	0.28
BC303	0.27
BC307A	0.11
BC308A	0.11
BC309	0.13
BC547	0.10
BC548	0.10
BC549	0.10
BC557	0.10
BD112	0.50
BD115	0.50
BD124	0.70
BD131	0.35
BD132	0.35
BD133	0.35
BD135	0.30
BD136	0.35
BD137	0.35
BD138	0.40
BD139	0.40
BD140	0.40

Type	Price (£)
BD222	0.45
BDX22	0.70
BDX32	1.80
BDY18	0.70
BDY60	0.70
BF115	0.20
BF121	0.24
BF154	0.12
BF158	0.18
BF159	0.18
BF160	0.17
BF163	0.30
BF164	0.18
BF167	0.20
BF173	0.20
BF177	0.24
BF178	0.30
BF179	0.28
BF180	0.30
BF181	0.28
BF182	0.34
BF183	0.30
BF184	0.22
BF185	0.22
BF186	0.30
BF194	0.11
BF195	0.11
BF196	0.12
BF197	0.12
BF199	0.16
BF200	0.28
BF216	0.12

Type	Price (£)
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF251	0.20
BF256	0.35
BF258	0.40
BF259	0.47
BF260	0.23
BF262	0.23
BF263	0.23
BF271	0.15
BF273	0.15
BFX84	0.25
BFX85	0.25
BFX88	0.24
BFY37	0.20
BFY51	0.23
BFY52	0.23
BFY53	0.25
BFY55	0.25
BHA0002	1.90
BR100	0.30
BSX20	0.22
BSX76	0.22
BSY84	0.34
BT106	1.05
BTX34	1.80
BU105/04	1.90
BU126	1.50
BU208	2.20

Type	Price (£)
OC22	1.10
OC23	1.30
OC24	1.30
OC25	0.45
OC26	0.40
OC28	0.60
OC35	0.45
OC36	0.58
OC38	0.43
OC42	0.45
OC44	0.18
OC45	0.18
OC46	0.35
OC70	0.22
OC71	0.22
OC72	0.30
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OC81D	0.14
OC82	0.20
OC82D	0.13
OC83	0.22
OC84	0.28
OC85	0.13
OC123	0.20
OC169	0.20
OC170	0.22
OC171	0.22

Type	Price (£)
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TBA341	0.90
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6AH6	0.80	6K7G	0.35	30P19	0.88	ECH83	0.52	PC97	0.42	R19	0.75
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6BJ6	0.64	7Y4	0.80	E88CC	1.20	EF92	0.60	PCF806	0.60	UCL83	0.64
6BK7A	0.85	9D7	0.70	E180F	1.17	EF98	0.95	PCH200	1.00	UF41	0.82
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6BR8	1.25	10P13	0.88		0.45	EH90	0.44	PCL84	0.50	UF89	0.47
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6BW7	0.65	12AC6	0.90	EAF801	0.80	EL41	0.60	PCL805	0.70	UL84	0.49
6BZ6	0.57	12AD6	0.90	EB91	0.23	EL81	0.70	PFL200	0.82	UM80	0.60
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6DE7	0.88	12K5	1.17	ECC40	1.20	EY83	0.70	PL509	1.65	U801	0.80
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AC176	0.25
AC178	0.27
AC187	0.25
AC187K	0.26
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
AD140	0.50
AD142	0.52
AD143	0.51
AD149	0.50
AD161	0.48
AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.32
AF124	0.25
AF125	0.25
AF126	0.25
AF127	0.25
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50
AF186	0.40
AF239	0.40
AF279	0.84
AL100	1.10
AL102	1.10
AL103	1.10
AL113	0.95
AU103	2.10
AU110	1.90
AU113	2.40
BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	0.13
BC114	0.20
BC115	0.20
BC116	0.20
BC117	0.20
BC119	0.29
BC125	0.22
BC126	0.20
BC132	0.15
BC134	0.20
BC135	0.19
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147	0.13
BC148	0.12
BC149	0.14
BC152	0.25
BC153	0.20
BC154	0.20
BC157	0.15
BC158	0.13
BC159	0.15
BC161	0.48
BC167B	0.15
BC168B	0.13
BC169C	0.13
BC170	0.15
BC171	0.15
BC172	0.14
BC173	0.20
BC174B	0.26
BC176	0.22

Type	Price (£)
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	0.11
BC183	0.11
BC183K	0.12
BC183L	0.11
BC184L	0.13
BC186	0.25
BC187	0.27
BC208	0.12
BC212L	0.12
BC213L	0.12
BC214L	0.15
BC238	0.12
BC261A	0.28
BC262A	0.18
BC263B	0.25
BC267	0.16
BC268C	0.14
BC294	0.37
BC300	0.60
BC301	0.35
BC303	0.60
BC307B	0.12
BC308A	0.10
BC309	0.15
BC323	0.68
BC377	0.22
BC441	1.10
BC461	1.58
BCY33	0.36
BCY42	0.16
BCY71	0.22
BCY88	2.42
BD115	0.65
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BD130Y	1.42
BD131	0.45
BD132	0.50
BD135	0.40
BD136	0.46
BD137	0.48
BD138	0.50
BD139	0.55
BD140	0.62
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BD145	0.75
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BD520	0.76
BD599	0.75
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BDX32	2.55
BDY18	1.78
BDY20	0.99
BF115	0.20
BF117	0.45
BF120	0.55
BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.17
BF198	0.20
BF199	0.25
BF200	0.35
BF218	0.35
BF222	1.08
BF224J	0.15
BF240	0.20

Type	Price (£)
BF241	0.22
BF244	0.18
BF254	0.45
BF255	0.45
BF256	0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	0.70
BF263	0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.60
BF459	0.63
BF596	0.70
BF597	0.15
BFR39	0.24
BFR41	0.30
BFR61	0.30
BFR79	0.24
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	0.19
BFW60	0.20
BFW90	0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.90
BPX29	1.70
BPX52	1.90
BRC4443	0.68
BRY39	0.47
BRY56	0.40
BR101	0.47
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BSY95A	0.27
BT106	1.24
BT116	1.20
BU105/02	1.95
BU108	3.25
BU126	2.99
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40NI	0.45
E1222	0.55
E5024	0.20
ME6001	0.16
ME6002	0.17
ME8001	0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.85
MJE3055	0.74
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76

Type	Price (£)
MPSU56	1.26
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.59
OC36	0.64
OC42	0.55
OC44	0.25
OC45	0.32
OC70	0.32
OC71	0.32
OC72	0.32
OC73	0.51
OC75	0.25
OC76	0.35
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.25
OC171	0.30
OC200	1.30
OCP71	0.92
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.95
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
TIS90	0.23
TIS91	0.23
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1164	3.60
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.51
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.26
2N2905A	0.28
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N2955	1.12
2N3012	0.91
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60

Type	Price (£)
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3250	1.02
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3501	6.99
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3766	0.99
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.43
2N4033	0.54
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4392	2.84
2N4871	0.24
2N4902	1.30
2N5042	1.05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2N5294	0.35
2N5296	0.57
2N5298	0.58
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	0.85
2N5496	1.05
2N6027	0.65
2N6178	0.71
2N6180	0.92
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

MATCHED PAIRS

Type	Price (£)
AC128/AC176	0.52
AC141K/AC142K	0.56
AC187/AC188	0.60
AC187K/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70
TIS90M/TIS91M	0.50

Any other transistors can be matched at a supplement of 20p per pair.

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
AAZ17	0.12
BA100	0.15
BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BAY72	0.11
BB104	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.50
BY100	0.22
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.68
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY11A	0.45
FSY41A	0.40
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.85
IN914	0.07
IN914E	0.06
IN916	0.10
IN1184	0.92
IN1185	1.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07

Diodes can be supplied balanced at a supplement of **5p** per device – e.g. four balanced OA91 would be **£0.48** per set.

Variable capacitance diodes can be supplied matched at a supplement of **3p** per device.

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3045	1.35
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN76001N	1.45
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
SN76227N	1.46
SN76530P	1.05
SN76533N	1.20
SN76666N	0.90
TAA300	1.76
TAA320	0.94
TAA350A	2.02
TAA435	0.85
TAA450	2.70
TAA550	0.55
TAA570	2.02
TAA611A	1.70
TAA611B	1.85
TAA630Q	4.18
TAA630S	4.18
TAA661B	1.32
TAA700	4.18
TAA840	2.02
TAA861A	0.49
TAD100	2.66
TBA120S	0.99
TBA240A	2.97
TBA281	2.28
TBA480Q	1.90
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	3.34
TBA530	2.71
TBA530Q	2.71
TBA540	3.21
TBA540Q	3.21
TBA550Q	4.10
TBA560C	4.09
TBA560CQ	4.10
TBA570	1.17
TBA641	2.30
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA810AS	1.75
TBA920Q	4.23
TBA990	4.10
TBA990Q	4.10
TCA270Q	4.18
ZN414	1.25

Please enquire for linear op. amps, 709, 710, etc.

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7425	0.37
7430	0.20
7440	0.20
7441	0.85
7445	1.95
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7489	4.32
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

MOUNTING KITS

Type	Price (£)
TO-3	0.06
TO-66	0.06

VALVES

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

ZENER DIODES

400mW 3.0-33V **12p each**
1.3W 3.3-100V **18p each**

VDR'S, PTC & NTC RESISTORS

Type	Price (£)	Type	Price (£)
E295ZZ/01	14	E299DD/P116-P354	all 8
E295ZZ/02	14	VA1015	50
E298CD/A258	7	VA1026	41
E298ED/A258	6	VA1033	8
/A260	6	VA1034	8
/A262	6	VA1040	8
/A265	6	VA1053	8
/P268	6	VA1055S	10
E298ZZ/05	7	VA1077	12
/06	6	VA1104	35
		VA8650	110

RESISTORS

Carbon Film (5%) ea
¼W 5.6 Ω-330k Ω (E12) **1.5p**
⅛W 10 Ω-10M Ω (E24) **1.5p**
1W 10 Ω-19M Ω (E12) **3p**
2W 10 Ω-10M Ω (E6) **5p**

WIREWOUND (5%)
2½W 0.22 Ω-270 Ω **15p ea**
5W 10 Ω-8.2k Ω **13p ea**
10W 10 Ω-25k Ω **18p ea**

CAPACITORS

Full range of C280, C296, tubular ceramic, pin-up ceramic, miniature electrolytics, mica, mixed dielectric and TV electrolytics stocked. – Please see catalogue.

MASTHEAD AMPLIFIERS

Labgear uhf group amplifier complete with mains power unit CM6001/PU. Groups A, B, or C/D please specify **£12.65**

Labgear CM6030 WB vhf/uhf ultra wideband amplifier (channels 1-68). Complete with mains power unit CM6001/PU **£18.95**

Labgear CM6019 WB uhf wideband amplifier (channels 21-68). Complete with mains power unit CM6020/PU **£9.85**

PATTERN GENERATORS

Labgear CM6004/PG giving crosshatch, dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays) **£58.80**

Labgear CM6038 DB Pocket size vhf/uhf generator. Outputs as CM6004 PG above but can be used either on mains or battery **£46.60**

COLOUR/BAR GENERATORS

Labgear CM6037/DB: Dual standard band generator gives standard 8 band colour bars • greyscale step wedge • red raster • centre cross • centre dot • crosshatch • dot pattern • blank raster. Sync output also provided **£125.15**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems. Type 6022/RA **£15.90**

OUR NEW CATALOGUE IS AVAILABLE AT 30p (refundable).

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