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JUNE 1976

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CORRESPONDENCE
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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".

this month

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Television

TV ORIGINS

Television is now becoming old enough for us to be able to talk about it having a history. Its antecedents certainly go back a fair enough time. The photoelectric effect was discovered in 1873, while Paul Nipkow patented the scanning disc in 1884. Already then there was a means of converting light values into an electrical signal, and of breaking down a picture into a sequential series of items of information which could be reassembled to reconstruct the picture. The very earliest forms of valve were in fact c.r.t.s, since the discovery of the "cathode ray" started off the whole process of valve development. By the turn of the century many c.r.t.s had been constructed and used in well documented experiments. The idea of basing a TV system on the use of a c.r.t. for reception and a similar device to scan the scene was put forward by A. A. Campbell Swinton in a letter to *Nature* in 1908. He did not patent the idea however, nor did he conduct any practical experiments. The first practical electronic picture scanner, the Image Dissector, was invented by Philip Farnsworth in the USA in 1924. And next we come to Baird. 1976 marks the fiftieth anniversary, as mentioned in the April *Teletopics,* of Baird's first public demonstration of a working television system – at this stage a closed-circuit arrangement. To mark the occasion the Institution of Electronic and Radio Engineers has published in its series of History of Technology monographs *John Logie Baird: 50 Years of Television* by Maurice Exwood, FIERE (available at £1·25, postage included, from the IERE at 8-9 Bedford Square, London WC1B 3RG). The 32 page book is certainly a fascinating read for those interested in the activities surrounding the advent of television.

The TV system created by Baird and demonstrated by him in 1926 was a low-definition system relying on mechanical scanning at the transmitting and receiving ends – in other words, he adopted the Nipkow disc. He had to, since an electronic system of originating the pictures was not at the time feasible. The Farnsworth Image Dissector worked well with stills and highly-lit shots, but was far from being sufficiently sensitive to act as an all-round camera tube (though it was in use for special purposes till quite recently). For electronic picture origination to become a practical proposition we had to wait for Zworykin, working in the RCA laboratories in the USA. His Iconoscope tube was first demonstrated in 1929, though it seems that a lot of work still had to be done before production of reliable tubes could start. By 1929 however Baird had got as far as starting experimental TV transmissions using BBC medium-wave transmitters (the low definition – 30 vertical lines – meant that the bandwidth was about 120kHz). So he was ahead in the race to get TV broadcasting started, though several similar systems were being tried out at about that time in the USA. Baird's low-definition TV transmissions continued until late 1935.

What was really crucial to the future of television however was the successful development of a practical electronic camera tube. By 1932 Zworykin's Iconoscope seems to have become a practical proposition whilst at the same time EMI had produced the Emiscope. These tubes were much the same, though their development seems to have been largely independent. EMI and RCA had agreements for the exchange of information, but in the nature of things seem to have been somewhat wary of each other. Be that as it may, the fact is that these tubes made high-definition television possible. The TV system which EMI then went on to develop had 405 horizontal lines, and as we all know is still in use. It involved other major developments: more sophisticated electronic circuitry, and transmission at v.h.f. The BBC's high-definition TV service, using the EMI system, started on a regular basis in 1936, while in the USA 525-line TV broadcasting started in 1941.

Baird and his associates certainly hustled things along, and he himself was remarkably innovative. It was he who brought together the ideas of picture transmission and electronic amplification. Between 1923 and 1945 he took out over 150 patents. He produced videodiscs which were being sold by Selfridges in 1928 – a vision signal on a wax gramophone record rotating at 78 r.p.m.! He demonstrated colour television in August 1928 and stereoscopic television in September 1928. He subsequently produced a 240 line system. But the low definition of his mechanical systems meant that the results did not have real entertainment value. Whether the development of television would have gone ahead as rapidly as it did without his demonstrations and the considerable public interest they achieved is a matter of guesswork. But great though his achievements were, technically the Baird system was largely a side-show. It was the work done by the team at EMI that resulted in a practical, high-definition television system.

teletopics

BUDGET AFTERMATH

The budget with its halving to 12½% of the rate of VAT applicable to radio and TV sets was good news for the trade – and not before time. May we hope that the treasury has now learnt the lesson? Last year's increase from 8% to 25% occurred when the industry was already in recession. Its effect was disastrous, with the UK TV industry operating recently at only 50% capacity and much of the output going into store. Such a situation obviously couldn't be left long without major plant closures becoming inevitable. Though there appeared to be some slight uplift in set disposals last December, following the easing of credit restrictions, this improvement did not follow through and the figures for the first two months of the year were dismal indeed.

One ray of light is the colour TV industry's steadily improving export performance. Between 1974 and 1975 exports more than doubled, from 97,000 sets to 201,900. So in 1975 we exported not far short of as many colour TV sets as we imported, the main export markets being other EEC countries and Australia. Although imports of Japanese colour sets have declined, concern is still being expressed about Japanese competition. There does seem to be something rather odd here: despite the devaluation of the pound the prices of Japanese colour sets in the UK have remained steady – whilst in the Japanese home market they have shown marked increases.

The reduced rate of VAT has given the industry what it wanted – the opportunity to return to conditions of steady growth. This should avoid recurrence of the excesses experienced during the 1973 boom, when shortages of sets and shortages of components led to massive imports. It will also help the BBC whose finances have been badly strained by failure of colour licences to increase at the expected rate. There has been quite a tendency for those renting sets to change from colour to monochrome, with the result that not only are setmakers stockpiling new sets but also that rental concerns are finding themselves holding increasing stocks of almost new sets.

UK TV SET RELIABILITY

The reliability of UK produced colour sets has shown a marked improvement during the last three-four years – from a rate of up to five service calls per set during the first year to a rate of less than one. It nevertheless still causes concern, with the various consumer bodies returning to the subject again and again. The subject was brought up recently within the industry when Sir Robert Melville, director of the Electronic Component Board, spoke at the annual dinner of the British Radio Cabinet Manufacturers' Association. He placed the main blame for unreliability on the supply to UK TV setmakers by UK component suppliers of "third-rate components". This naturally produced a reaction from the component manufacturers, and the Radio Industry Council's component committee has called for the establishment of a joint programme by setmakers and component manufacturers "to achieve an even greater level of reliability". Mullard's quality manager L. B. Johnson commented that "further improvement can be achieved only after identifying the root causes of sets failing in the field and by designing sets with the correct stress margins to meet defined failure rate targets". He called for even closer co-operation between component manufacturers and TV setmakers, claiming that such co-operation "would equate to a considerable extent with the vertical integration of the Japanese TV industry".

All of which leaves us decidedly puzzled. Surely the UK TV industry, both setmakers and component manufacturers, have been at it long enough to have learnt what the problems are? Admittedly there have been new types of almost every component introduced during the last ten years, but then again one would have thought that adequate liaison between setmakers and component manufacturers would have been established long since. We know that silly things have been done – components placed where they are subject to excessive heat or where corona has led to breakdowns and so on, but the latest "cool" solid-state chassis seem largely free of such problems. Perhaps the subject is becoming something of a national obsession, with the press and the broadcasting authorities keeping the whole thing permanently on the boil. It must be conceded that Japanese sets are more reliable. But the margin is now slight indeed. Japanese sets are also more expensive and difficult to service, so that from the consumers' point of view we would think there's now little in it either way.

FIBRE-OPTICAL CABLE TV

Rediffusion have started a field trial designed to assess the suitability of TV signal transmission over fibre-optical lines instead of conventional cables, and to obtain familiarity with the many new techniques involved. The trial is being carried out at Rediffusion's Hastings installation, with fibre-optical transmission lines provided by BICC. It is understood to be the first time anywhere in the world that a fibre-optical link has been installed in a working system used by the paying public. A two-core fibre-optic cable has been inserted over a 1,427 metre section of the network's trunk route and is carrying the same signal as distributed through the rest of the system – an 8·9MHz amplitude modulated carrier with lower sideband (as in other Rediffusion h.f. systems the audio signals are distributed on separate lines). The input voltage signal is converted to output optical power by a Plessey HR954 gallium-arsenide light-emitting diode: at the other end of the line the light signal is converted back to an electronic signal by means of a photodiode. The l.e.d. gives an output of 35W at 900 nanometers wavelength (infra-red radiation) per steradian per square centimetre at 300mA input, and this is coupled to the cable by index matching fluid. The cable itself consists of Corning silica step index fibres. The same coupling technique is used at the cable's output, where a low-capacitance pin photodiode is used for conversion, feeding a low-noise preamplifier. Rediffusion point out that all connections are demountable so that further experiments can be carried out. In particular, it seems that new gallium-indium-arsenide diodes operating at a wavelength of 1,050nm are likely to become available shortly. This frequency is at an even more transparent part of the transmission characteristic of the fibre-optical cable, so that a significant improvement in the performance could be achieved. At a later stage Rediffusion envisage the use of time/frequency multiplexing and time multiplexed digital signals. As Rediffusion say, "who knows where it may lead?".

The technology of fibre jointing is advancing rapidly, with proprietary items already on the market. Making a T junction suitable for connection to individual subscribers is a more difficult problem however. For this reason the use of fibre-optical cables is at present likely to be limited to the trunk sections of the network, or at a later date to dial-a-programme installations where each subscriber is linked to the central exchange via an individual cable.

This is certainly a major development in the field of cable TV distribution.

We reported briefly last month on Rediffusion's provision of Teletext to their subscribers in Brighton and Hove, via a single decoder at the main aerial site. Further details of this have now been released. Twenty three of the Teletext pages – giving news, weather and sports information – are transmitted in sequence (in colour) on the BBC-2 channel during the periods when BBC-2 is off air. Each page is shown for thirty seconds, and the key to the service is a page turner which Rediffusion have built into the decoder. This is programmed to pick out the selected pages on a repeat system. Rediffusion have now introduced similar facilities for their 51,000 subscribers in Hull. The Teletext programme in this case consists of about thirty pages "covering general and specific news and a variety of other items which can be chopped and changed as demand indicates".

CRT REGUNNING EQUIPMENT

We receive a steady trickle of enquiries, mainly from readers abroad, about equipment for regunning c.r.t.s. Equipment, materials and training for the production of regunned colour and monochrome tubes are now being offered by V. N. Barrett Sales Ltd. (1, Mayo Road, Croydon, Surrey CR0 2QP) who specialise in vacuum equipment. Each outfit is made to order, and to keep costs down reconditioned vacuum pumps are used. The equipment comprises a single-position electric oven unit, single-position vacuum pumping set, combined drop sealer/necking machine, r.f heater, activation unit, vacuum guages plus sundry items and spares, the total cost being around £2,650 plus VAT where applicable. Training costs £350 per working week. It takes four hours for an operator to produce a regunned tube with the equipment listed: with extra oven and pumping sets an operator can produce 40 tubes a week. The space required for the equipment can be as little as ten by eight feet.

LEISURE CENTRE TV SET

A small colour TV setmaker, Derek Tyne Ltd., has produced a set specifically designed to act as a home information/leisure centre, i.e. for use with the Teletext service and TV games. These can be fed into an ordinary TV set of course, but a standard domestic receiver cannot be expected to give optimum results. Particularly critical is the performance of the signal circuits. The Derek Tyne receiver tackles this problem by using Plessey surface-wave filters. The improved phase response obtained in this way gives sharp Teletext and games displays and also improves normal television reception. The company is located at the Houghton Regis Industrial Estate, Dunstable, Bedfordshire.

THE ATS-6 TV SATELLITE

DX enthusiasts have been making great efforts to receive the ATS-6 satellite TV transmissions to India since Steve Birkhill's success in doing so last December. Amongst those who have reported success are Ian Beckett, Hugh Cocks and Reg Roper. The reason for the increased efforts now being made is that the experiment is shortly to be ended. The US administration – NASA own the satellite – have made it clear that they are not prepared to extend the contract beyond August – the satellite is equipped to carry out a number of experiments. All India Radio have announced that a terrestial TV network has been set up for the areas previously served by the satellite transmissions.

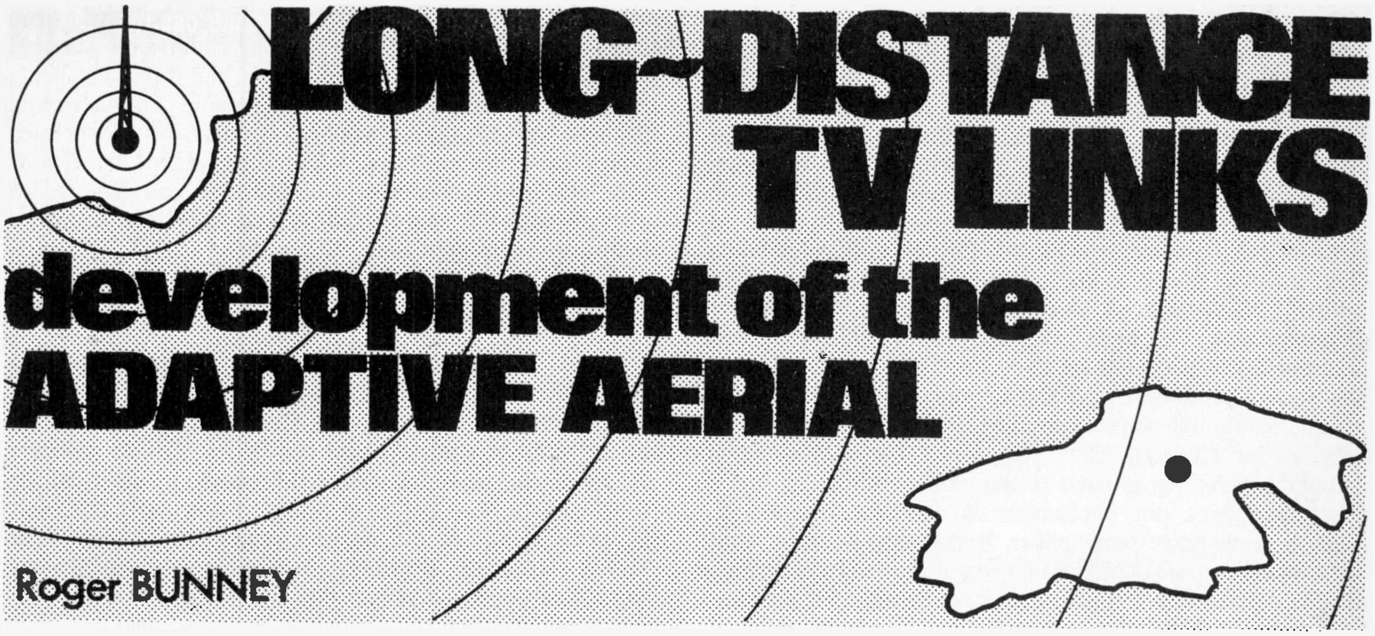
NEW PYE MONO CHASSIS

The Pye Model T184 announced in last January's *Teletopics* is the first model from the group to be fitted with their new solid-state 176 chassis. It is understood that this is to be the basic Philips European monochrome chassis. The h.t. rail is stabilised by a series regulator, most of the lower voltage supplies being derived from the emitter circuit of the BU205 line output transistor. The video circuits are d.c. coupled from the detector to the c.r.t. cathode. There are four i.c.s, a TBA750 intercarrier sound channel, TBA720 line generator, TBA890 jungle circuit (sync/a.g.c./blanking/video preamplification) and a ZKT33B to stabilise the tuning voltage supply for the varicap tuner.

WIDEBAND ANTIFERENCE UHF AERIALS

Antiference have introduced wideband versions of their XG (extra gain) range of u.h.f. aerials. This range features full-wave reflector and dipole elements and multi-element director assemblies. In addition to the group A, B and C/D versions there are now versions suffixed K covering channels 21-48 and versions suffixed W covering channels 21-68. Model XG21W with twenty one director assemblies has a gain of 13·2-19dB over the bandwidth. These wideband versions of Antiference's high-gain range of aerials should certainly be of interest to those seeking extra channels on a regular basis.

LONG-DISTANCE TV LINKS
development of the ADAPTIVE AERIAL



Roger BUNNEY

Bringing satisfactory TV reception to isolated sections of the community is a problem faced by broadcasting engineers in many parts of the world. Sometimes the isolation is by rugged terrain, sometimes due to an intervening stretch of water. Typical of the latter are the Channel Islands, where newly-developed techniques should soon be providing regular reception of UK programmes in colour.

BOTH the BBC and ITV network programmes are transmitted in the Channel Islands, but at present only a 405-line service is available – that of the BBC on channel B4 from Les Platons while Channel Television radiates from Fremont Point on channel B9. Both programmes are re-radiated, having been received off-air from the mainland with inherent problems of fading, and co-channel and adjacent channel interference from both UK and Continental transmitters. It is possible however, particularly in Alderney, for individual viewers using high gain aerial systems to receive viewable u.h.f. signals for much of the time from either Rowridge or Stockland Hill – both group A outlets.

V.H.F. RELAYS

The BBC channel B2 signal from North Hessary Tor on Dartmoor is received at a station at Torteval on Guernsey, while the ITV 405-line service is received at a site on Alderney. Here, three off-air signals from the mainland are taken. These are Chillerton Down, channel B11; Caradon Hill, channel B12; and Stockland Hill, channel B9. The latter is the main feed, the other two being back-up in case the channel B9 signal fails or deteriorates. The three signals are then fed via s.h.f. link to Jersey, actual selection of the best source being made at the Fremont Point transmitter.

At Alderney, Stockland Hill is received on two 9m (30 ft) dishes erected at 52m (170 ft) and 64m (210 ft) above sea level in a north-facing depression. This arrangement combines the advantages of height diversity with increased shielding from possible interference sources in other directions. The Chillerton Down off-air array is a bank of stacked yagis mounted on the lattice mast at the Alderney receiving station with improved screening to the rear of the arrays to reduce possible interference from various Band III TDF transmitters. Caradon Hill channel B12 is received on a wire array having an inverted V formation.

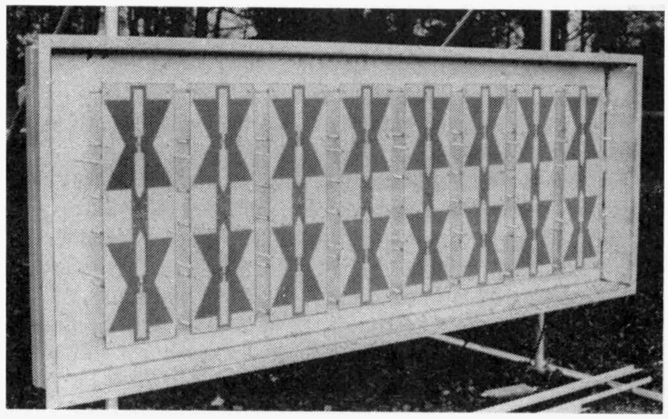


Fig. 1: A prototype single-bay adaptive aerial, shown with protective cover removed.

U.H.F. RELAYS

The problems in receiving the u.h.f. services from the UK are considerably greater than those at v.h.f. Propagation losses are much higher, necessitating higher gain arrays. The bandwidth of an eventual four-channel u.h.f. group is such that selective fading over the spectrum could well provide unequal signal strengths both between each channel (group fading) and indeed within each single channel (selective fading). Since an eventual four channels will be received, the possibilities of co-channel and adjacent channel interference from present and future sources (both known and unknown) are very high. Faced with these difficulties, the IBA are devoting considerable thought and ingenuity to overcoming them.

The dish arrays already in service on channel B9 were to be modified for u.h.f. operation and again operated in a height diversity system. The dish, however, has a fixed polar diagram with known lobes and nulls. With changing tropospheric conditions, signals not visible under normal

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Contents 4, 4.5, 5, 5.5, 6, 7, 8, 9, 10. £4.34
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Contents 0, 2, 4, 6, 8. £2.86
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4506	6BA	66p
4508	8BA	66p
4540	4mm	66p
4545	4.5mm	66p
4550	5mm	66p
4555	5.5mm	66p
4560	6mm	74p
4570	7mm	74p
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4510	10mm	74p

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3224 (368E)	8"–200mm	50p
3225 (3610E)	10"–250mm	50p

ENGINEERS

Model	Blade size	Price
3332 (464)	4" x ¼" –100 x 6mm	47p
3333 (466)	6" x ¼" –150 x 6mm	50p
3343 (566)	6" x 5/16"–150 x 8mm	68p
3344 (568)	8" x 5/16"–200 x 8mm	70p
3354 (668)	8" x ⅜"–200 x 9.5mm	84p
3355 (6610)	10" x ⅜"–250 x 9.5mm	86p

POZIDRIV

Model	Blade size	Price
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3532 (Poz 2)	4"–100mm x No 2 Point	70p
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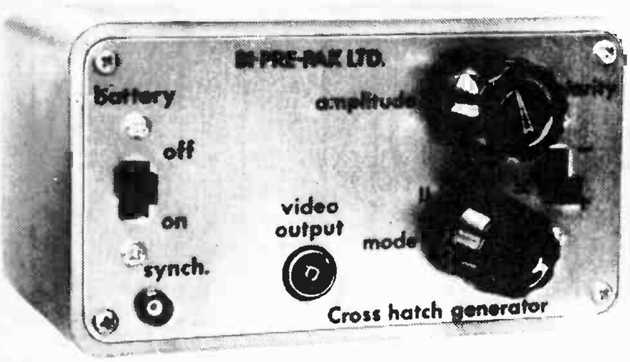

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.... TV6 circumstances (normal in this context being conditions with no enhancement of tropospheric propagation) can appear, often at considerable field strengths, and such interfering activity may well be resolved on the dish system to an extent that would render the required signal unusable. What was needed, therefore, was an aerial system capable of presenting a polar diagram that was adjustable to suit varying conditions. With such an array, in the event of an unwanted signal being received, a null on the polar diagram could be "steered" onto the interfering source so minimising the nuisance. Thus SABRE (Steerable Adaptive Broadcasting Receiving Equipment) was conceived.

SABRE

The aerial system being evolved for the cross-Channel link consists of a four-bay Batwing assembly, with 16 planar dipole units within each bay. The dipoles are etched from a copper-filmed glass fibre laminated board, and stacked together to form a high-gain linear broadside wideband u.h.f. bay (Fig. 1).

The signal output from each dipole passes through a broadband, voltage-controlled weighting network before being combined in the power adder unit with the weighted dipole feeds from the other bays (see Fig. 2). The output from the adder passes via a four-channel masthead amplifier and thence through coaxial cable to the receivers housed at ground level. The receivers are IBA-designed units, modified to give improved interference protection and to allow measurements of the main signal and unwanted interference signals. A gain control voltage for each receiver is produced by sampling its video output during the sync pulse period.

The signal output from the receiver is a combination of: (a) the wanted signal and (b) the unwanted interference after filtering and detection. The ratio of (b) to (a) is called the System d.c. error, and is used as a measure of the system performance. The system operates to minimise this error by feeding back d.c. control voltages to the weighting networks. These vary the amplitude and phase of the signal from each aerial so changing the overall polar diagram of the array. The control voltage values are held in a memory bank, being updated from a digital store every 16 lines.

To summarise, the system forms a closed loop in which correction feedback voltages are applied to the weighting networks to alter the beam pattern of the array to reduce the effects of the interfering sources. It is an iterative process in which the control voltages are changed in a systematic way to minimise the system d.c. error. Fig. 3 shows how the polar diagram of the receiving array is modified when presented with known (programmed) sources of interference. In addition to the wanted group A signals from Stockland Hill, unwanted signal information may at times be present from the Crystal Palace, Bilsdale and the future Kippure transmitters. The latter presents the most difficult problem in that its bearing from Alderney differs by only 7° from that of Stockland Hill whose signal should ideally be 45dB above it. High rejection figures are also necessary for the other signal sources shown in Fig. 4, and for any new transmitters which may come into service.

As will be seen, the polar diagram alters considerably when the correction voltages are applied to the aerial system, placing deep nulls in the directions of interference sources. In some instances, the main forward lobe may be shifted slightly off beam in the interests of retaining the best wanted/unwanted signal ratio, particularly against Kippure.

Fig: 2: Basic block diagram of the IBA's Adaptive Aerial System, SABRE.

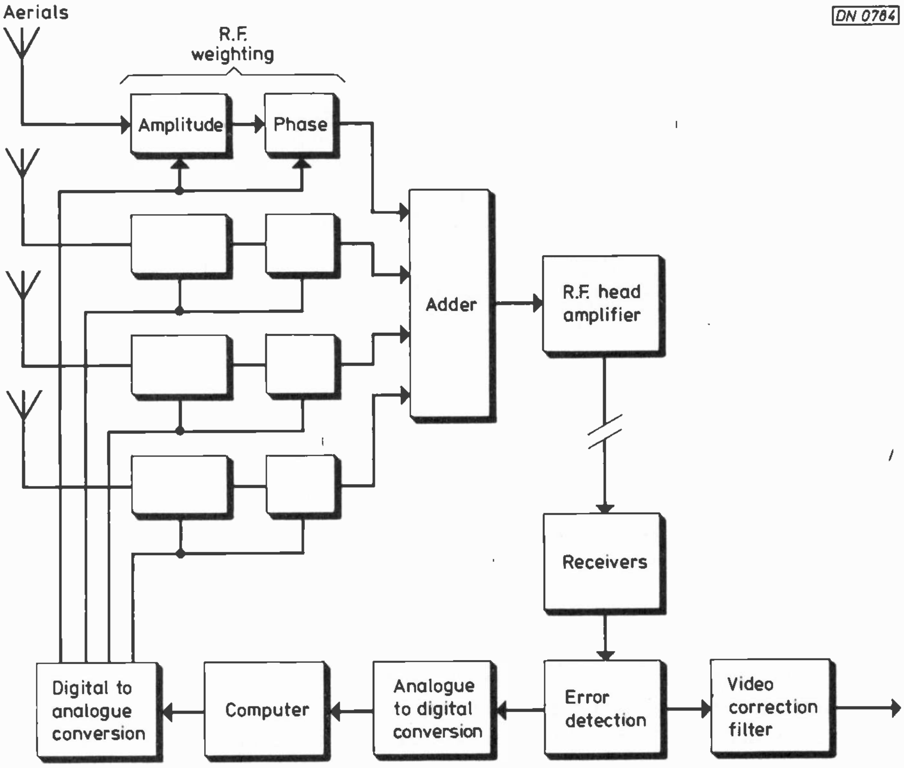
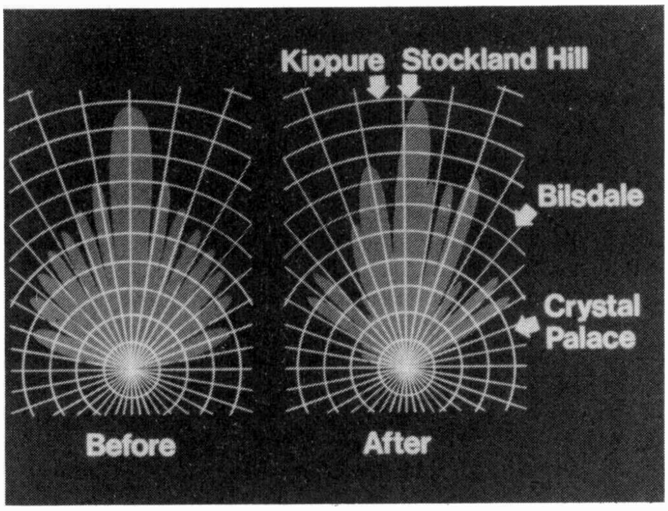


Fig. 3: How the polar diagram changes to minimise interference from other transmitters.



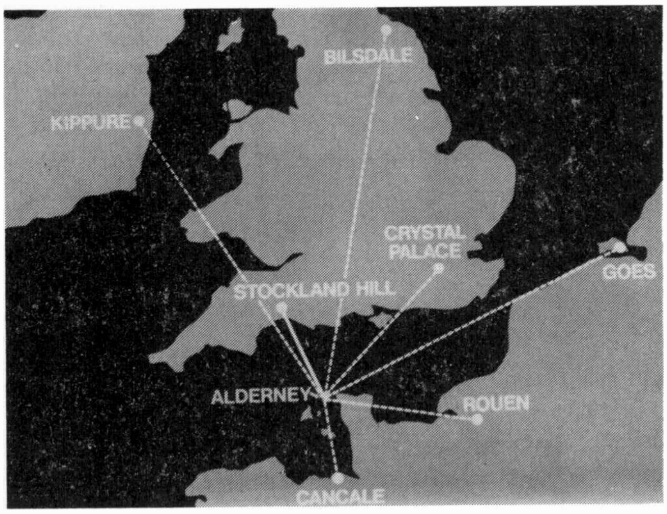


Fig. 4: This map shows likely sources of interference with the link receiving station at Alderney.

The present system as devised for the Channel Islands is capable of providing 15 nulls, each null being independent and "steerable" through the forward acceptance front. Should a new unwanted signal appear within the aerial's acceptance field, a 10dB reduction in its level can be achieved in about 10 seconds. Sampling of all signals takes place on the sync pulse tips.

FUTURE PLANS

The eventual Alderney off-air receiving station will employ two aerial systems, the dish assemblies (modified for u.h.f. working) and the SABRE system, the latter being mounted on the lattice mast. It was feared at one stage that aircraft flutter would be experienced from the island's busy airfield, but in practice the vertical acceptance angle and the time constants of the system are sufficient to reduce this hazard to a negligible figure. Selective fading within a single channel spectrum can be compensated with both luminance and chrominance correction by means of an equalising filter system originally designed by the BBC.

The prototype SABRE system went into experimental operation during January 1976. A standards converter has already been installed at Fremont Point to down-convert the 625-line signals for the 405-line v.h.f. transmitter which will continue in operation for some years to come. This converter has already permitted occasional use of the new system to provide signals for the 405-line service. Comments received from local engineers indicate that the best pictures seen in the Channel Islands are now being radiated from Fremont Point!

It is anticipated that the IBA's u.h.f. service will commence during the summer of 1976. Fremont Point will be on channel 41 (group B) with an e.r.p. of 20kW, while Les Touillets in Guernsey will use channel 54 (group C/D). Both transmitters will be horizontally polarised.

Our thanks are due to the IBA, and especially to Terry Long, Head of the R.F. Section and Paul Gardiner of the Engineering Information Service, for help in writing this article and for providing the excellent illustrations. ■

SERVICING THE DECCA 'BRADFORD' CHASSIS SERIES 10 & 30

PART 1. by R.W. THOMSON

THE Decca Bradford colour chassis first appeared as the single-standard successor to the well-known CTV25. It was a complete departure from the previous design, using a vertical modular layout with easily removable panels. The most laudable change was in the e.h.t. department, where a tripler replaced the e.h.t. rectifier and triode stabiliser which caused so many headaches, not to mention snaps, crackles and very expensive pops, in the earlier set. When it first appeared the Bradford chassis had a fully transistorised decoder panel and was fitted with a mechanical tuner. This is known as the Series 10 chassis. Sets fitted with it can be recognised by the fact that the penultimate figure in the model number is "1", e.g. CS1910, CS2211, CS2213 and CS2610. There were 19, 22 and 26in. versions as these model numbers suggest. The later version of the chassis, the Series 30 chassis, has been released with a wide range of tube sizes from 17 to 26in. It's fitted with either a mechanical or a varicap tuner. The most notable modification is in the decoder section, where a Motorola MC1327P integrated circuit (alternative Texas SN76227) has taken over the functions of quite a few of the transistors and has lead to the RGB circuits being greatly simplified. The penultimate figure in the model numbers is 3, e.g. CS1730, CS1830, CS2230, CS2631 etc.

Spares for these chassis are readily available and they do not suffer from having a profusion of transistors with unknown names and even more obscure sources of supply. All the semiconductors, with the exception of two i.c.s, are Mullard types or equivalents, and as valves are used where drive power is required servicing in those sections most likely to give trouble, i.e. the timebases, is relatively simple. Though all-transistor designs have much in their favour, it is a fact of life that valves are easier to replace than output transistors – not only because less technical knowhow is required but also because of the astronomical cost of large, high-voltage transistors. To get back to the Decca Bradford chassis however let's start at the logical place, the tuner.

Mechanical Tuner

The Telefunken mechanical tuner is probably one of the finest of its type and is very reliable. It has few of the wear and internal breakage problems that seem to beset so many of its competitors.

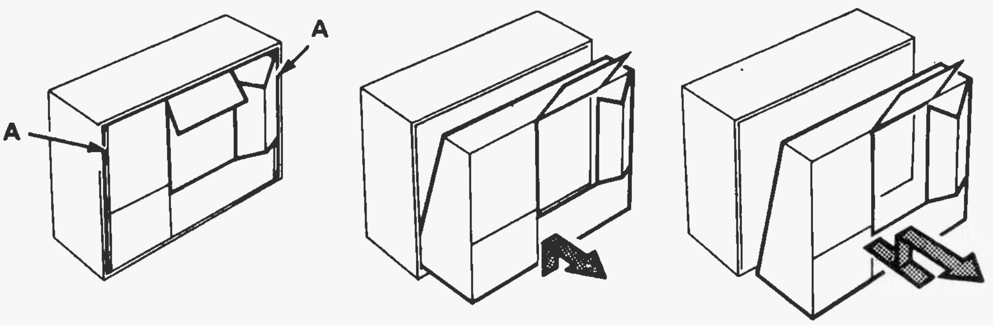
In my experience drift or low gain complaints have been few and have always responded to cleaning and lubricating with Servisol or, depending on the nature of the fault, r.f. amplifier transistor replacement. Drift is a common fault with most mechanical tuners, and in some designs little can be done to effect a cure – the trouble is inherent and unavoidable. Such is not the case with the Telefunken tuner.

Three main causes of "failure to reset to tuned positions" or "drift after station selection" have been found, only one of which can be blamed on the tuner itself. The main cause of this annoying fault is dust and grit on the sliding or rotating surfaces. A good clean up and lubrication seldom fails to restore normal working, provided the tuner is repositioned carefully so that all the buttons are clear of the holes provided for them on the cabinet front. Friction here brings on the same symptoms! The other point to watch is the tightness of the screws on the rotor clamps in the tuner. If these slacken off, failure to reset to the selected positions will occur.

Whilst on the subject of cleaning, a word of warning on the type of cleaner used. Not all the "handy aerosols" available are really suitable for the job, i.e. they don't all clean *and* lubricate, while some are positively destructive! There are few things more frustrating than a beautifully clean and shiny tuner that sticks because of lack of lubrication and has to be retuned every time a station change is made. Some of today's cleaners are really meant for the motor trade, and can damage components in a u.h.f. tuner.

Low Gain

When low gain is encountered, check the earth bond between the tuner body and the small printed circuit board carrying the external components. If this is o.k., the r.f. gain preset may be dirty or faulty through misuse – the latter condition occurs when a keen but heavy hand turns the control too far, bending the pip on the preset away from proper contact with the track. A new preset is the only real cure here. The setting of the control is simple but most important. With the control set approximately half-way, select a station and tune it in. Then turn the control anti-



A: Fixing screws — **Chassis in servicing position** — **Removal of chassis**

Fig. 1 (left): Method of lowering and removing the chassis. The bottom of the chassis is supported on nylon rollers: make sure that they are in their runners before withdrawing the chassis too far – otherwise you could end up with a cracked c.r.t. neck.

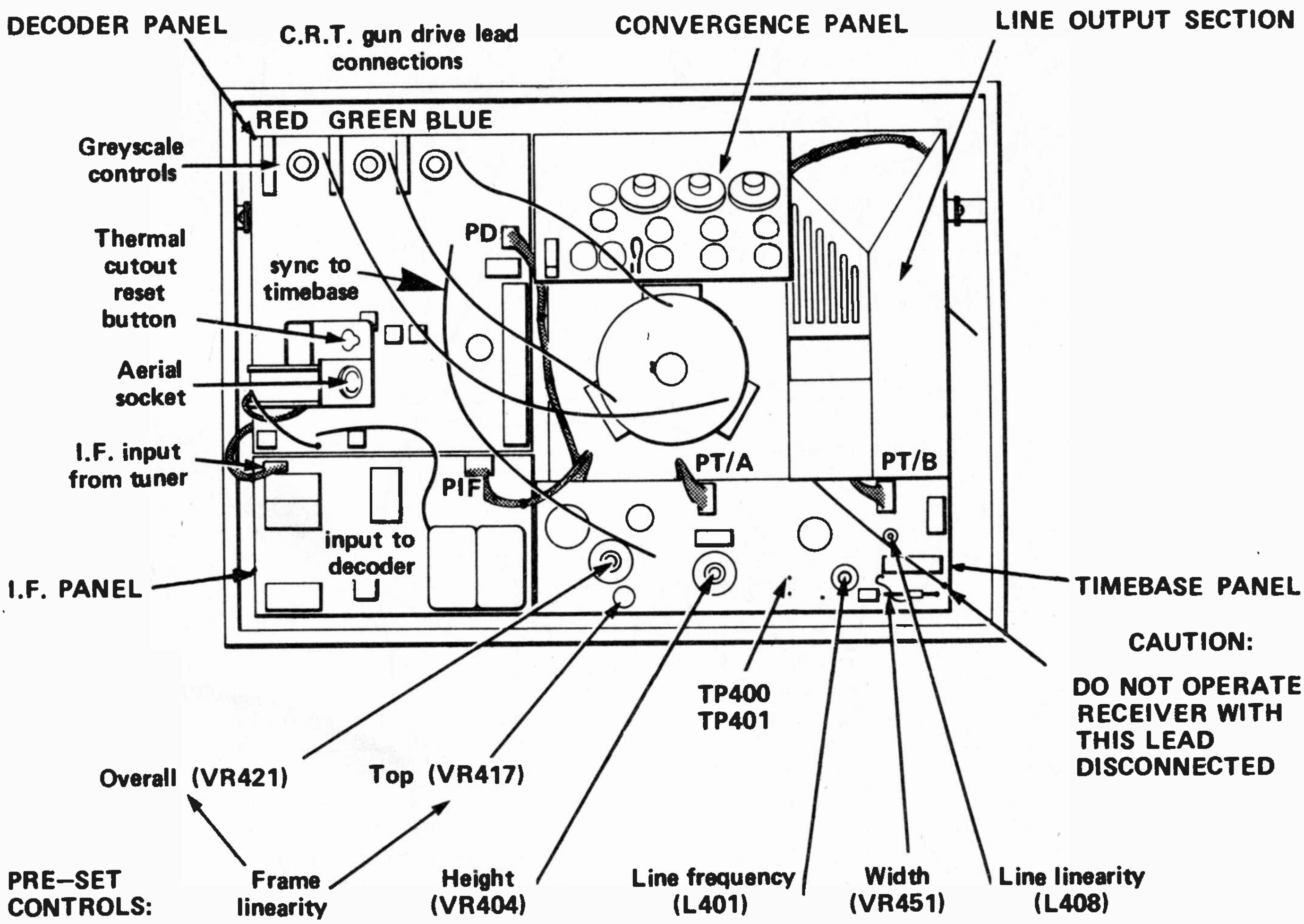


Fig. 2: Rear view of the series 10 chassis, showing panel and control layout. The series 30 chassis is basically similar.

clockwise until noise appears on the screen. Finally, gently rotate the control in the opposite direction until a clean picture *just* appears.

In the case of very low gain not attributable to the foregoing or to an obvious aerial or aerial socket fault, check the voltage appearing on R37 on the i.f. panel. If this exceeds 2·5V or so the fault lies elsewhere – we'll return to this later. If the voltage is approximately correct however the tuner's r.f. amplifier transistor is not operating normally, the transistor itself being the most likely culprit and fairly easy to check.

Transistor Replacement

Though manufacturers throw up their hands in horror at the mere idea of removing a tuner cover, or even worse an actual tuner repair being carried out by a non-boffin, nevertheless transistor replacement is not beyond the capabilities of a careful operator, given a steady hand, good eyesight and slim fingers. Provided the transistor leads are cut to the same lengths as those of the original, and that the transistor is positioned as nearly as possible in the same place as the original, any misalignment will be unnoticeable – particularly as few tuners are called upon to track all the way from the bottom of Band IV to the top of Band V.

The same remarks apply to the mixer/oscillator transistor, failure of this being very uncommon though not unknown. The symptoms are a blank raster and no sound, with some sound hiss because the i.f. stages are operating at full gain. With this symptom however the writer would again first advise a check of the voltage on R37, as the unusual beam limiting/a.g.c. system can cause similar symptoms – but more of that later.

Apart from the two transistors there is just one other semiconductor device in the Telefunken tuner, the varicap diode which provides a degree of a.f.c. This seldom fails but is hardly noticeable even when it does, because of the tuner's inherent stability.

Electronic Tuner

With the electronic tuner fitted to most 30 Series models there are no mechanical troubles because there are no mechanical parts – apart from the button latching device itself, which is small and not usually repairable if damaged. Fortunately the unit is quite cheap to replace in the unlikely event of it being broken. If trouble is experienced with it a clean with Servisol or a similar product is all that is necessary.

The remarks previously made about transistor replacement also apply to this tuner. The smaller physical size of the tuner and the presence of the varicap diodes and their associated presets make the job even more tricky however. Under no circumstances should the adjustment of the control-voltage presets be disturbed – unless very serious misalignment is evident. Even then, never disturb those not controlling the transistor you've just changed. Otherwise spurious bursts of uncontrolled oscillation can be triggered off, bringing you back to the no signal condition your careful work was intended to cure.

IF Strip

Trouble in the next section of the receiver, the i.f. panel, is most unusual. Being a low-level, low-voltage area this part of the set can be relied upon to give long and completely

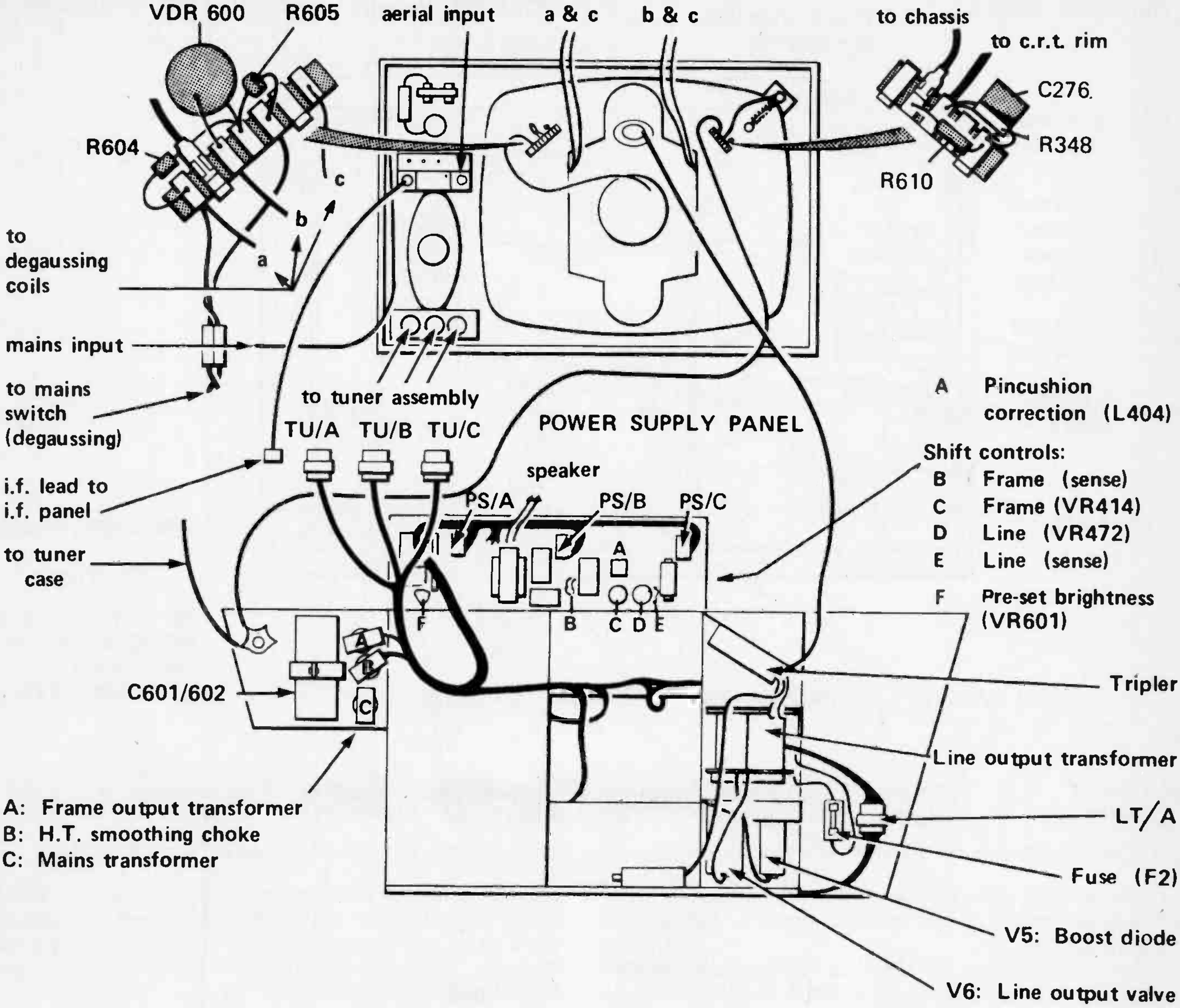


Fig. 3: Internal view, with the chassis folded flat.

drift-free service. Like the decoder and timebase panels, it is mounted vertically and held in place by spring clips, all external connections being via plugs and sockets and plugged flying leads.

Dismantly

The chassis itself is very easy to remove, being attached to the cabinet by only two screws in the top corners. The bottom of the chassis is supported on nylon rollers, permitting the chassis to slide out to a hinged down position that just allows valve and fuse replacement. All connections to the tuner, speaker, front controls and deflection coils are via plugs and are reasonably accessible. Above all, the plugs are foolproof: it just isn't possible, with the exception of the audio wiring from the volume control, to connect the wrong plugs to the various sockets.

A little care is called for when removing and replacing the chassis, if only to avoid a few choice words being uttered. No attempt has been made by the manufacturer to round off the edges of the pressed steel supports and chassis members, so that nicked fingers and scratched hands are something of a hazard. Care should be taken to see that the nylon rollers are actually in their runners. It's quite on the cards that they won't be, or that one of them has come adrift from the chassis itself. If this happens and the chassis is moved too far out, a broken c.r.t. neck and the possibility of a lethal dose of flying glass can be expected when the chassis clears its supports. You've been warned then of this dangerous and expensive possibility!

When lifting the chassis fractionally to clear the top supports, be sure to take the weight of the left-hand corner by the chassis itself, keeping the fingers clear of the decoder components. Otherwise a cracked panel may be added to your problems. The same can be said of panel removal and replacement. It's essential to move the fixing clips away from the panels and not to bend the panels clear of the clips. The latter is easy to do but flexing a printed circuit board often results in minute cracks and hairline fractures that are difficult to find. A careful approach to this is well worthwhile therefore.

Above all, never slide the chassis in or out when the power is on, or switch the set on after sliding the chassis out to its hinged position, without looking at the plugs connecting the control panel to the receiver proper. On some models it is quite possible for the large black plug and socket to hook itself on to the field output transformer or the h.t. choke, with the result of blown fuses, fault currents, open- or short-circuit transistors and damage to the plug/socket itself. Having spent hours tracing faults in

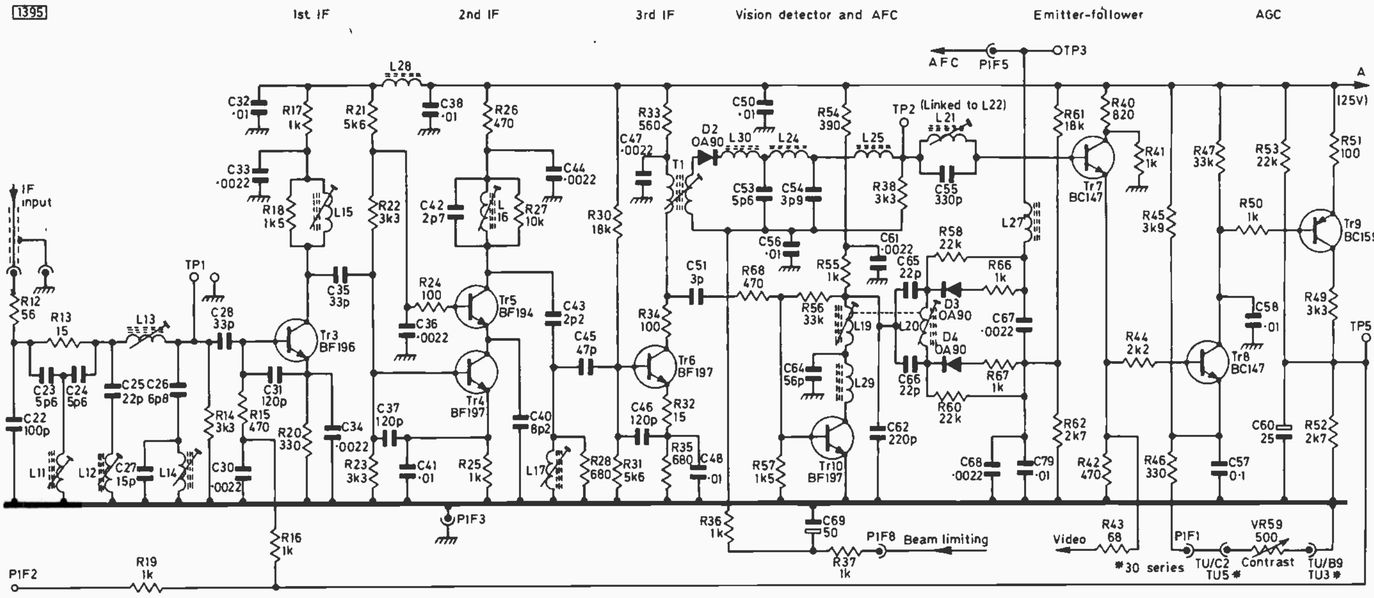


Fig. 4: Circuit of the i.f. strip. In the 30 series chassis R68 and C79 are omitted and a 41·5MHz trap is added in the detector circuit. With varicap tuners R58 and R60 are 100kΩ, R61, R62 and C68 are omitted and the junction of R60-C67 is connected to chassis.

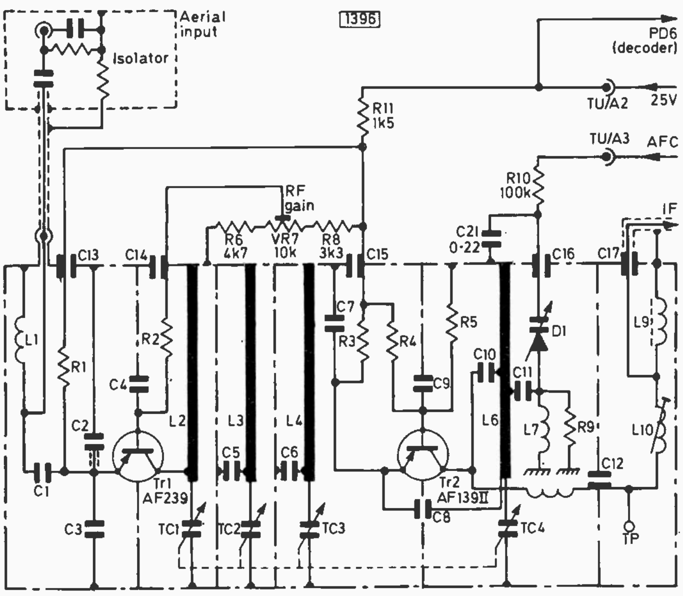


Fig. 5: Circuit of the Telefunken mechanical tuner.

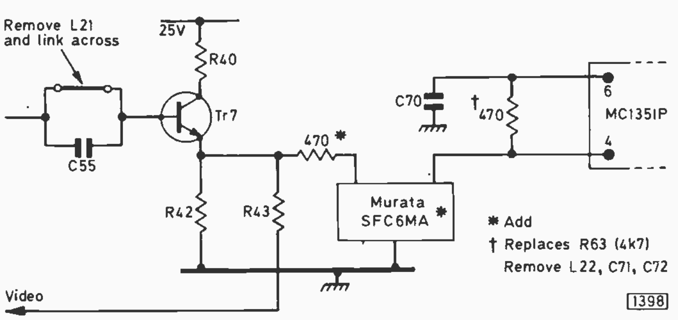


Fig. 6: Modification to remove caption buzz under difficult reception conditions. This should be tried only where normal adjustments fail to produce any improvement, and will not remove buzz due to signal overloading.

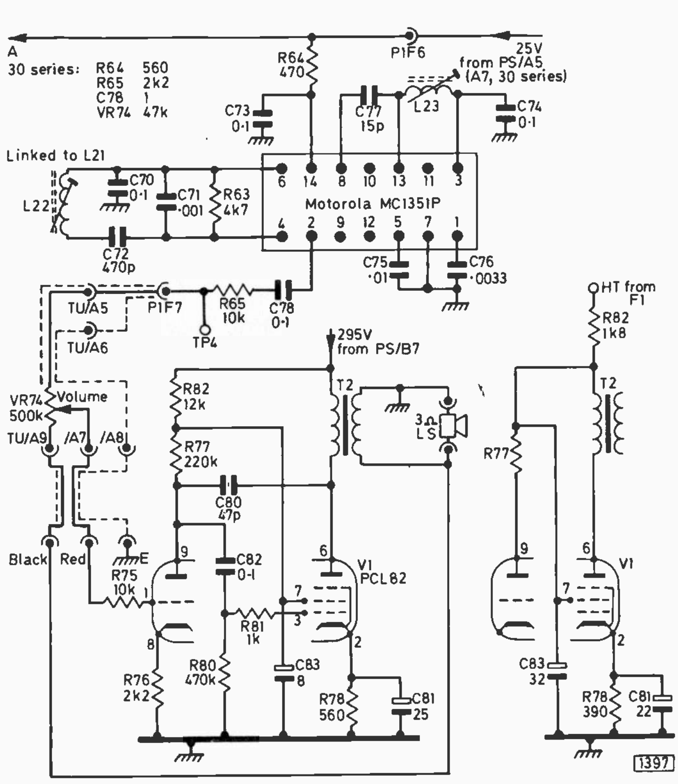


Fig. 7: The sound circuits. Modifications to the audio output stage in the 30 series chassis are shown on the right.

almost every section of the receiver after committing this error I can assure you that I am now very wary indeed of this built-in trap.

IF Circuits

Returning to the i.f. strip itself however we have to report that there are few bugs here. The three vision i.f. stages – with a cascode pair in the middle – follow the well-known Mullard circuit. The first stage is the only one to which a.g.c. is applied, the gain of the tuner being set by the r.f. gain preset previously mentioned. The a.g.c. is of the forward type, biasing Tr3 on further as the signal strength rises but producing a decrease in stage gain. This technique is not only more predictable and precise than reverse bias, but has less detuning effect on the circuit as a whole. The final transistor Tr6 drives the single luminance/chroma/sound detector D2 and also the a.f.c. circuit. Faults are rare in this area. Transistors have been known to fail, but voltage checks will soon reveal anything amiss in this respect.

Video Signal

The detected video signals are passed to the base of the video emitter-follower Tr7. The transformer L21/22 is tuned to 6MHz and performs the dual functions of removing the intercarrier sound signal from the vision channel to avoid patterning, and at the same time feeds this signal to the MC1351P intercarrier sound i.c. More on that later. The video signals are developed across R42 and pass via R43 to the luminance amplifier Tr201 and the controlled chroma amplifier Tr210 (Tr205 on the later 30 chassis) on the decoder board.

Beam Limiting/AGC System

The d.c. level at the base of the emitter-follower is tied to the voltage at the cathode of the PL509 line output valve – i.e. the voltage across R467. This provides a very simple and efficient beam limiting arrangement – and also a trap for the unwary fault finder. It's for this reason that I have emphasised the importance of checking the voltage at R37 when tracing low gain faults. A glance at the a.g.c. circuit – transistors Tr8 and Tr9 – will show how effective this trap can be! The composite video signal is d.c. coupled to the base of Tr8, hence Tr8's base is always at the same voltage as the emitter of Tr7. The voltage difference between the base and emitter of Tr8, and therefore its state of conduction, is governed by the setting of the contrast control VR59 which forms part of a potential divider across the l.t. line. Tr8 is biased to conduct on the tips of the sync pulses only, and an increase in the positive drive applied to it reduces its collector voltage. This means increased drive to Tr9 – a pnp transistor – whose collector voltage then rises. The a.g.c. potential is taken from the junction of its two collector resistors R49 and R52 and controls the gain of Tr3 as previously described.

The beam limiting action arises since any greatly increased demand on the power delivered by the line output valve will increase its cathode voltage. Since this is linked via R37, R36 and the detector diode to the base of Tr7, increased beam current will have the same effect as an increase in the video signal at this point in the circuit, i.e. it will result in the a.g.c. circuit shutting down Tr3, thus in effect reducing the video drive and in turn the current through V6. This is the trap, since confusing symptoms can lead to a lot of time being wasted in chasing imaginary i.f. or tuner faults when in fact the fault lies in the line timebase!

Beam Limiter Faults

It's for this reason that I recommend a check on the voltage at R37 before deciding for example that a grey, watery picture is due to a gain fault. Under normal test card conditions, with the contrast and brightness controls adjusted for a good, clean picture, the voltage at R37 should read 2·2V on the 10V scale of an Avo Model 8 or similar 20kΩ/V meter. Any notable increase in this voltage should lead to an investigation of the line timebase, a "notable increase" meaning one outside the normal 10% tolerance allowed on this type of equipment. Under no signal conditions a reading of 2·4V should be obtained at the positive end of C60, rising to approximately 5·5V when a good signal is being received, thus biasing Tr3 into a lower gain condition. It is vital then to check that the low-gain condition is not caused by a.g.c. action through excess line output stage current. The PL509's cathode voltage is the key, and the most convenient point to measure it is at R37 on the i.f. strip.

One cause of beam limiter action resulting in confusing symptoms is changed value resistors in the line output stage – R453 for example. We shall have more to say about this when we come to the line timebase. The symptom when R453 goes high resistance is lack of contrast and brightness. The suspicious will have noticed that there are two electrolytic capacitors that could cause trouble. When C69 which decouples R37 dries up the brightness changes from one side of the screen to the other. When C434 which decouples the PL509's cathode dries up the symptoms are uncontrollable contrast, or picture instability when the brightness and contrast controls are set higher than normally. Finally, consider what happens should the PL509's cathode bias resistor go open-circuit. Its cathode current will then pass via R36 and R37, which will burn out. This condition can even occur if the tripler shorts and none of the fuses blow.

Sound Channel

We left the sound signal blocked from the base of Tr7 by L21. The secondary winding L22 couples it via C72 to the MC1351P intercarrier sound i.c. which provides a low-level audio signal sufficient to drive the triode section of the PCL82 audio valve. The i.c. operates at very low signal levels so few problems should be expected – in fact I've not yet encountered a dud i.c. of this type in the many chassis that I've serviced using it. One or two cases of it being responsible for an intermittent buzz, like intercarrier buzz, which disappears for anything up to several days, have been reported but I've not experienced this. In some areas where the reception conditions are unusual caption buzz can be difficult to deal with. A considerable improvement can be obtained by replacing L21/L22 with a ceramic filter (Murata type SFC6MA). The circuit changes required are shown in Fig. 6. This modification should be made only where other adjustments leave the problem unsolved, and will have no effect where signal overloading is the cause of the difficulty.

Most sound faults occur around the PCL82, which is mounted on the power panel at the bottom of the chassis. Common troubles are shorted or open-circuit turns on the output transformer T2, and the screen grid feed resistor R82 going high resistance (distorted sound) or open-circuit (no sound). R82 is on the power panel. Both these faults were fairly common on the earlier Series 10 version of the chassis, and result in the PCL82 having a short life. Other common faults are dry-joints around the PCL82 valvebase and on the audio pin connectors and speaker pins, and distortion plus low volume due to the pentode section's cathode bias resistor R78 changing value.

The PCL82 has a reputation for ruining bias resistors, screen grid feed resistors etc. due to internal faults which cause sudden increases in the operating currents. This was taken into account in the later 30 Series chassis by introducing several modifications. These, in order of importance, are as follows: the use of a stand-off type valve-holder, provision of ventilation holes in the printed circuit board around the PCL82, use of a modified output transformer, and the uprating of some of the more vulnerable resistors in the circuit.

Intermittent sound on either panel can usually be traced to cracks in the print around the heavy and totally unsupported output transformer, particularly if the panel has been removed and replaced a few times. In cases of distortion try a new PCL82, check its pentode cathode components R78 and the decoupler C81 and also its screen grid feed resistor R82, and if necessary check the anode and cathode resistors R77 and R76 in the triode circuit – these also tend to change value.

CONTINUED NEXT MONTH

Service Notebook

G.R. WILDING

Blown Mains Fuse

A Bush Model CTV182S colour receiver (A823 chassis) had been working normally for over an hour but had then suddenly gone off with "a considerable bang". As expected, we found that the noise had been caused by the 5A mains fuse shattering, the other fuses in the set being intact. The cause was clearly connected with the few components associated with the mains input circuit – see Fig. 1. We first checked the thyristor h.t. rectifier 8THY1, since an anode-to-cathode short-circuit in this would effectively connect its reservoir capacitor 8C9 across the mains supply, the 600mA h.t. fuse being in circuit after this point. The thyristor proved to be in order so attention was turned to the next most likely suspect, the mains filter capacitor 8C5. Due to the primary winding of the mains transformer 8T1 there is always a low resistance across the input lead. So to check 8C5 we unsoldered one end. This component also proved to be in order, so we came to the conclusion that the degaussing circuit could be faulty. To clear the coils and their shunt capacitors 4C4 and 4C2 we removed plug 8Z3, fitted a new fuse and switched on. Within seconds smoke started to rise from the large carbon resistor 8R5. On switching off and checking this component it was found to have a resistance of less than 250Ω instead of 680Ω, and the value would undoubtedly have been much less when it was running hot.

This resistor forms part of the degaussing circuitry. At switch on the resistance of the positive-temperature coefficient thermistor 8TH1 is very low and the high voltage applied across the voltage-dependent resistor 8VDR1 and the coils results in 8VDR1 being in its low-resistance condition. With 8TH1 and 8VDR1 both in their low-resistance states, maximum current flows through the degaussing coils. As the temperature and thus the resistance of 8TH1 increases, so the voltage across 8VDR1 falls and its resistance increases as well. The result is that the current in the degaussing coils rapidly falls to a very low figure. 8R5 is there to ensure that current continues to flow through 8TH1 so that it remains hot and in its high-resistance state.

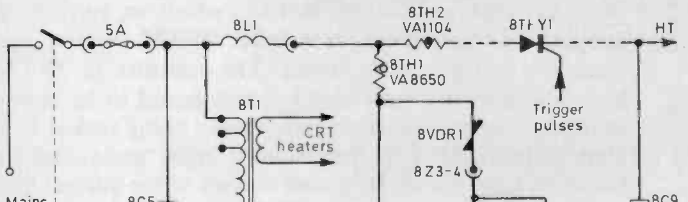


Fig. 1: Mains input circuit, Rank A823 colour chassis. Failure of the 5A mains fuse was found to be the result of a fault in the degaussing circuit.

In the faulty set the reduced value of 8R5 had resulted in excessive current in this circuit despite the presence of 8TH1. This current taken in conjunction with the receiver's normal current had resulted in the mains fuse blowing. It's the first time we've come across this unusual fault.

There is no doubt that nearly all receiver manufacturers consistently underestimate the wattage rating and/or thermal considerations of composition resistors – particularly high-value ones. I wonder how many service calls and man hours per day throughout the country are spent on replacing high-value resistors which have caused reduced width, lack of height or low gain. Increasing the wattage rating of a few critical resistors in the average receiver would cost the setmaker a few pence at the most, but would eliminate thousands of service calls during a model's working life.

No EHT

Sound but no picture was the complaint with a Bush Model TV181S (A774 chassis), and was found to be due to absence of e.h.t. Only a smallish arc could be drawn at the anode of the PL504 line output valve, while the arc obtainable at the top cap of the DY802 e.h.t. rectifier was little larger. The fact that the two arcs were of comparable size suggested a faulty line output transformer, with the e.h.t. overwinding failing to develop any real increase in voltage. New valves had to be tried however, just in case. The replacements failed to produce any significant increase in arc size, so we next disconnected the scan coils in case shorted turns were loading the stage. Shorted turns on either of the line scan coils usually result in a wedge shaped raster, but on occasion a severe short can result in insufficient e.h.t. being developed by the line output stage to illuminate the screen. This action again failed to significantly improve the lengths of the arcs, so the boost capacitor and the high-value resistors in the v.d.r. width stabilising circuit were next checked. All proved to be o.k., and as the voltages in the EF184 line oscillator circuit were normal and the coupling capacitor 3C39 to the line output valve was perfect there seemed little doubt that the trouble was due to the line output transformer.

A new transformer was ordered and arrived after a wait of about two weeks. On fitting it and switching on a perfect picture was obtained. On then changing to the channel transmitting the test card however the picture and raster gradually faded away, the brilliance control having no effect. There was still more than ample e.h.t., and on switching off to make resistance checks which led nowhere and then switching on again we found that the picture had returned, only to fade away once more to a near black background. The c.r.t. voltages were all about normal and,

Service Notebook 2

surprisingly, on shorting together the tube base grid and cathode pins to remove the c.r.t. bias there was not the expected peak white raster. It seemed at this point that the c.r.t. was faulty, but on removing the base connector we discovered that the tube's cathode pin (7) was bent and was failing to enter the appropriate base socket. Straightening the pin so that it made normal contact resulted in a constant and perfect picture.

The most surprising aspect of the latter fault was the appearance of a good picture for about half a minute when there was no cathode d.c. return path to chassis. The conclusion we came to was that the initial beam current was taken from the "space charge" inside the c.r.t., surrounding its cathode. The pin had undoubtedly been bent while the set was standing in the workshop awaiting the replacement transformer.

Blown Mains Fuse

A 26in. Pye colour receiver fitted with the 691 chassis had a blown 2·5A mains input fuse. The fuse and the 0·02μF mains filter capacitor are on the mains side of the on/off switch in this chassis. The resistance reading across the mains side of the switch with the set switched off was infinity, so the filter capacitor wasn't shorted (in recent weeks we've had a succession of these capacitors going short-circuit in a variety of makes of set). There was no sign of a short from the h.t. rail to chassis, so attention was turned to the line output stage where a reading of only about 100Ω was obtained between the anode of the PL509 line output valve and chassis (see Fig. 2). Our first suspicion was that there was a heater/cathode short in the PY500 efficiency diode, but both this and the PL509 turned out to be o.k. Our next suspect was the 0·47μF boost capacitor C218 which is connected between the line output transformer primary winding and an earthed secondary winding. On disconnecting one end and checking however this was found to be o.k., and the same was true of the output transformer harmonic tuning capacitor C219. It began to seem that the primary winding of the transformer was shorting to the core, since the other capacitors present are fed via high-resistance feeds. Nevertheless we checked C224 which smooths the boost feed to the c.r.t. first anode preset controls – and this turned out to be completely short-circuit. It's feed resistor R227 was found to have fallen in value from 100kΩ to only 100Ω! It didn't look too bad, but when removed from the chassis broke easily. A new C224, R227 and PY500 – since it had been under severe strain – resulted in a very good picture. Once again this case proved how important it is to eliminate every other possible cause before condemning the line output transformer.

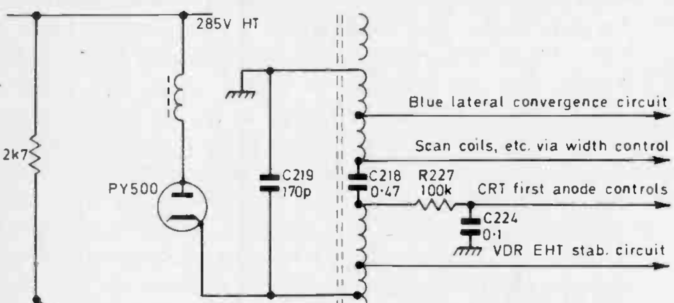


Fig. 2: Main elements of the line output stage in the Pye 691 chassis. The c.r.t. first anode voltage smoothing capacitor C224 going short-circuit blew the mains fuse. Up-rating this component from 1kV to 1·5kV gives improved reliability.

Lack of Width

An old KB Model WV70 dual-standard receiver gave a very good picture but with the width reduced by about ¾in. on either side. A new PL36 line output valve and PY801 efficiency diode failed to improve matters, but on changing the ECC81 line oscillator full width was restored. Generally speaking, line generators either oscillate or they don't, though on occasions as in this case the output waveform developed is inadequate to drive the line output valve fully, a point which should always be borne in mind when dealing with inadequate width. There was no v.d.r. width stabilising circuit on this old set.

Predominantly Red Picture

A predominantly red picture on a Bush Model CTV182S (A823 chassis) was not due to misadjustment of the preset controls. Voltage checks revealed that the collector of the red output transistor 3VT15 was at under 80V instead of 100V (with the brightness control at maximum). This low collector voltage, d.c. coupled to the c.r.t. cathode, was caused by the higher than normal voltages discovered at the base and emitter of 3VT15, which in turn is d.c. coupled to the driver transistor 3VT12 where again incorrect voltages were found. The resistors in 3VT12's base bias network were checked and found to be close to normal in value, the trouble eventually being traced to the clamp diode 3D19 in this channel being leaky and thus failing to keep the driver's base voltage at the correct figure of 2-2·5V (depending on the brightness control setting). On replacing this BA145 diode and readjusting the red drive control 3RV8 and the c.r.t. first anode preset controls a well balanced picture was obtained.

Weak, Unlockable Picture

Normal sound but only a very weak, unlockable picture on a fairly bright raster was the fault on a 12in. valve portable set fitted with the Thorn 980 chassis. Our first suspicion was that the detector diode was high-resistance, a possibility that could easily

Service Notebook 3

be checked since (see Fig. 3) the diode's output (cathode) is returned to chassis via three chokes, a 470Ω resistor and its 6·8kΩ load resistor R24 while its anode is returned to chassis via the secondary of the final i.f. transformer and a filter coil. Thus connecting an ohmmeter between the control grid of the EF80 video output pentode and chassis should measure the load resistor value one way (when the detector is reverse biased) but only the 470Ω resistor and the forward conductance of the diode the other way (diode forward biased). These tests showed that the diode and the associated resistors were in order, so next we checked the voltages in the video output stage.

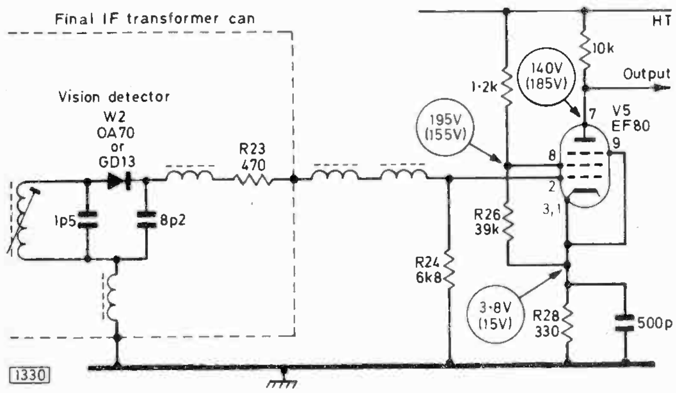


Fig. 3: Method of biasing the video output valve (V5) in the Thorn 980 chassis. Incorrect voltages, shown in brackets, were due to the bias stabilising resistor R26 having fallen in value to less than 3kΩ.

At 185V the anode was well above the correct figure of 140V, and at 155V the screen grid was markedly below the correct figure of 195V. The cathode voltage was found to be in excess of 15V instead of 3·8V. The valve was clearly heavily overbiased, and thus unable to respond to the output from the detector diode. Since capacitive coupling is used between the output pentode and the c.r.t. cathode the pentode's excessive anode voltage would not affect the normal brightness control range. The only possible cause of the three voltage changes was a major reduction in the value of the 39kΩ bias stabilising resistor R26 which is connected between the pentode's screen grid and cathode. This was found to be the case even without the need to make any further tests since it was observed to be badly discoloured and running extremely hot. It's a vertically mounted composition type, near the EF80. On test, its value was found to be under 3kΩ instead of 39kΩ. As expected, the value of the 330Ω cathode bias resistor R28 was also found to have changed substantially, due to the excessive current flowing through it. After changing both resistors a first class picture was obtained.

No Results

A single-standard Pye hybrid colour receiver we attended to had a blown mains fuse. From past experience with such sets we directed attention to the line output/e.h.t. department, where a dead short-circuit was found from the top caps of the PL509 line output valve and PY500 efficiency diode to chassis. On removing the PY500 we found that it had an internal short from its top cap (cathode) to its anode (pins 2, 7 and 8). Now this of itself would not have caused the mains fuse to blow, but did indicate that the valve had been grossly over-run. A further check revealed that with the valve removed there was still a short-circuit to chassis.

There was no burning smell from or signs of damage to the line output transformer, so our immediate suspect was the 0·47μF boost capacitor which is returned to chassis via windings on the transformer. It's connected between terminals 5 and 6 of the transformer and is rated at 1kV working. Snipping one end off proved that it was short-circuit and after fitting a replacement normal results returned.

A capacitor of this rating may well not be in your replacement stock. It is permissible to make up the value with two or three smaller types in parallel, but it is not permissible to use two 600V or 750V types in series. Apart from decreasing the net capacitance, the insulation value of capacitors varies from sample to sample. Thus the total applied voltage will be divided in accordance with the insulation resistance of each capacitor. One will take a greater proportion of the applied voltage therefore, and this could well exceed its nominal working voltage rating. In consequence it could break down with the result that the voltage would then be developed across the remaining capacitor causing this to break down as well.

Intermittent Screen Black Out

A valve v.h.f. portable set fitted with the Thorn 980 chassis would work perfectly for hours. The screen would then suddenly black out, leaving the sound unaffected. The c.r.t. grid is returned to chassis via a 10kΩ resistor (R93, see Fig. 4) which provides an injection point for the negative-going field and line flyback blanking pulses. Its cathode is a.c. coupled to the EF80 video amplifier by C26, the brilliance control R91 varying the d.c. bias applied to the cathode via R92. When the picture blacked out, the c.r.t. cathode rose to about 140V and was completely unaffected by the setting of the brilliance control. Since the grid was at virtually chassis potential, the c.r.t. was biased back to −140V under these circumstances, cutting off the beam current. Momentarily shorting the grid and cathode (pins 6 and 7) resulted in a full brilliance unmodulated raster, the action having removed the tube's bias.

The cause of the trouble was an intermittent short in C26. Varying the setting of the brilliance control under the fault condition made no difference because of the inclusion of R92 (150kΩ). The fault was unusual since this is about the only time I have come across a voltage carrying capacitor that intermittently short-circuited itself and then healed up. Normally a capacitor which has gone short-circuit breaks down on application of its working voltage, even if it reads o.k. on an ohmmeter test.

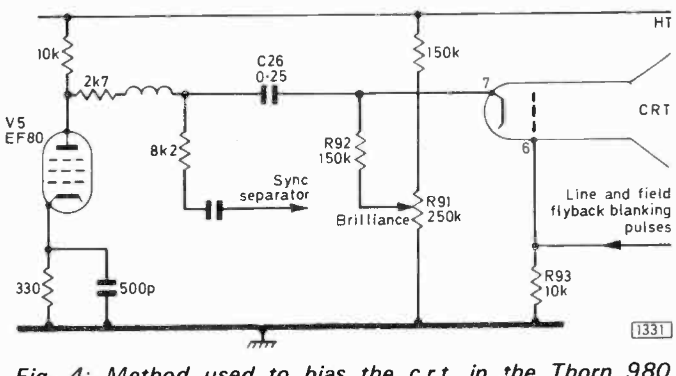
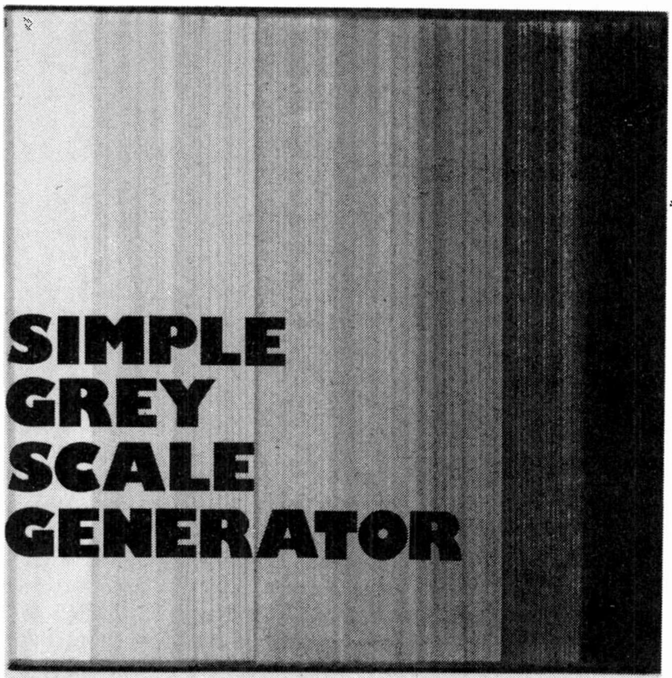


Fig. 4: Method used to bias the c.r.t. in the Thorn 980 chassis. The grid is at chassis potential while the d.c. level at the cathode is set by the brilliance control, the a.c. coupled video signal being superimposed on this bias.



SIMPLE GREY SCALE GENERATOR

D. SYMONS B.Sc.

THE design to be described generates a signal suitable for injection into the video or luminance amplifier. Line sync pulses are picked up by means of a wire placed near the line output stage of the receiver, which must be receiving an off-air transmission.

The grey-scale video signal

One line of a 625-line video signal is shown in Fig. 1. The video information is a descending staircase waveform and is the luminance (Y) signal of the 8-step colour bars, each bar being about 6·5μs in duration.

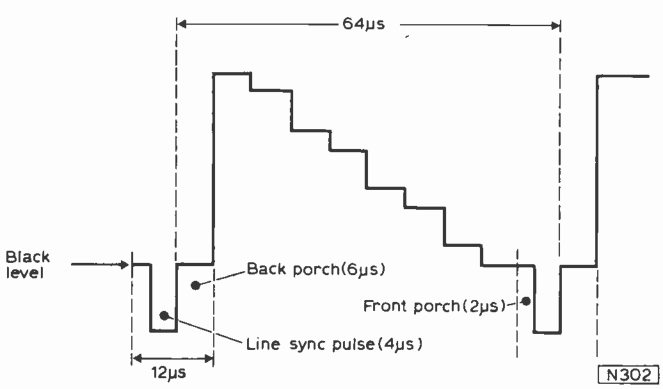


Fig. 1: The grey scale video signal. Each step lasts approximately 6·5μs.

A number of different sets of colour bars are in use, each with slightly differing characteristics. The BBC transmit a 100% amplitude, 95% saturated signal, the IBA and EBU use a 75% amplitude, 100% saturated signal, while most commercial pattern generators produce a 100% amplitude, 100% saturated signal. The amplitude levels for the eight bars in each of the three signals are shown in Table 1.

The basic design given in this article produces a 100% amplitude. 100% saturated signal, but simple modifications to produce either of the other signals are also given at the end. For further details of the various signals see the Supplement to *Television,* April 1976; *PAL Receiver Servicing* by D. J. Seal, or *Colour Television Theory* by G. H. Hutson.

Staircase generator

The staircase sequence can be produced by using a binary coded decade counter and letting each of its outputs represent an amplitude level. Table 2 shows the count sequence and the total output if A = 11, B = 30 and C = 59.

The circuit of the complete generator is given in Fig. 2. IC2 is a 7490 decade counter with outputs Q_A, Q_B and Q_C connected to three of the inputs of a 7405 open-collector inverter package, IC3. When each counter output goes to logic *1* the corresponding 7405 output goes to logic *0*, effectively earthing the bottom end of the associated resistor R_A, R_B or R_C.

Table 1 – Amplitude levels for three common colour-bar signals

Specification	White	Yellow	Cyan	Green	Magenta	Red	Blue	Black
100%A 95%S (BBC)	100	92	78	69	56	49	33	0
75%A 100%S (IBA, EBU)	100	66	53	44	31	23	8	0
100%A 100%S	100	89	70	59	41	30	11	0

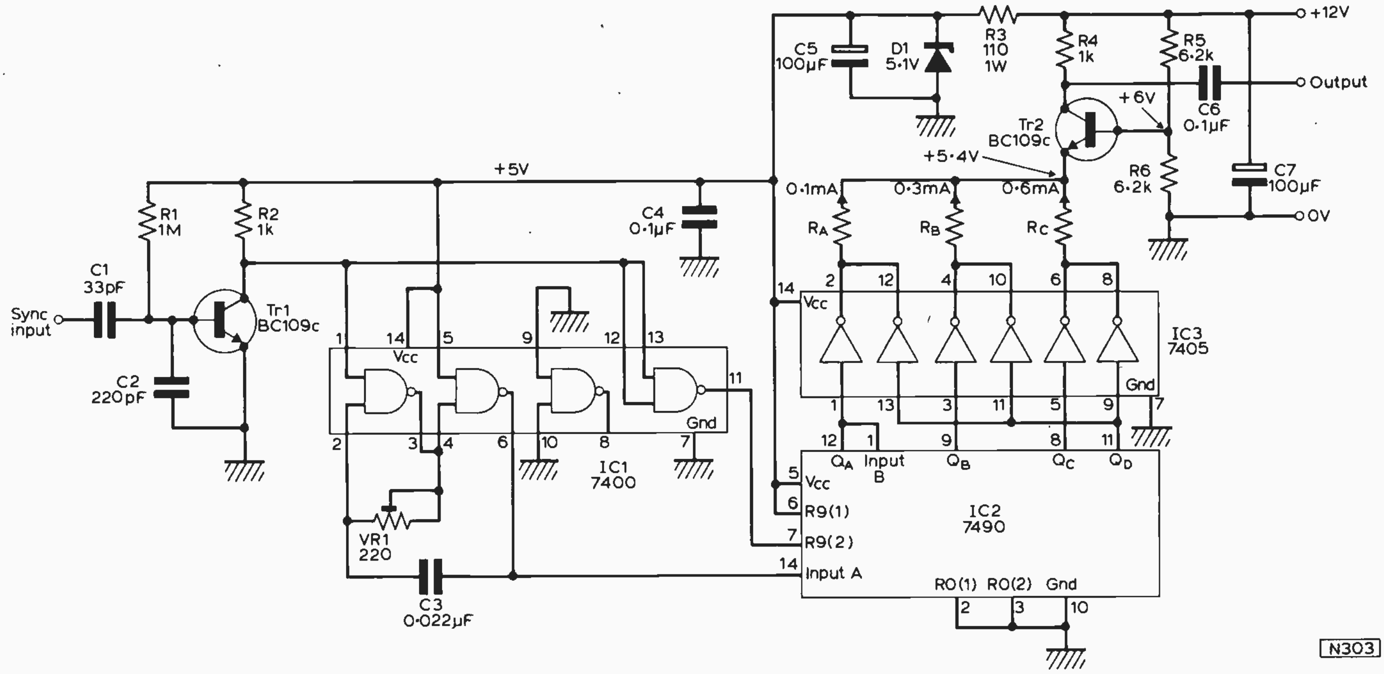


Fig. 2: Complete circuit of the simple grey-scale generator. The currents shown for RA, RB, and RC, are those required to produce an output signal of 1V peak amplitude. See section "Modifications".

The base of Tr2 is connected to a +6V supply from the potential divider R5/R6. Its emitter, to which the top ends of RA, RB and RC are returned, will therefore sit at about +5·4V. By choosing the appropriate values for the three resistors we can arrange to pass 0·11mA, 0·3mA or 0·59mA, or their various sums, through Tr2 and its 1kΩ collector load, R4. The collector voltage is thus a staircase waveform of the correct steps and 1V peak amplitude, the output being taken via a 0·1μF capacitor.

Flyback blanking

To maintain the black level output through the line flyback period, the QD output of the counter is fed to the remaining three inverters of the 7405. The outputs of these inverters are connected in the wired-OR mode with the inverters carrying the QA, QB and QC signals, to force the output of Tr2 to black level for the counts of 8 and 9, when QD is at logical *1*. (See Table 2 and Fig. 3.)

Table 2 – Count sequence and output amplitude for a 100%A 100%S signal, where A=11, B=30 and C=59

Colour	Count	A	B	C	Output
White	0	0	0	0	0
Yellow	1	1	0	0	11
Cyan	2	0	1	0	30
Green	3	1	1	0	41
Magenta	4	0	0	1	59
Red	5	1	0	1	70
Blue	6	0	1	1	89
Black	7	1	1	1	100
	8	Forced to			100
	9	1	1	1	100

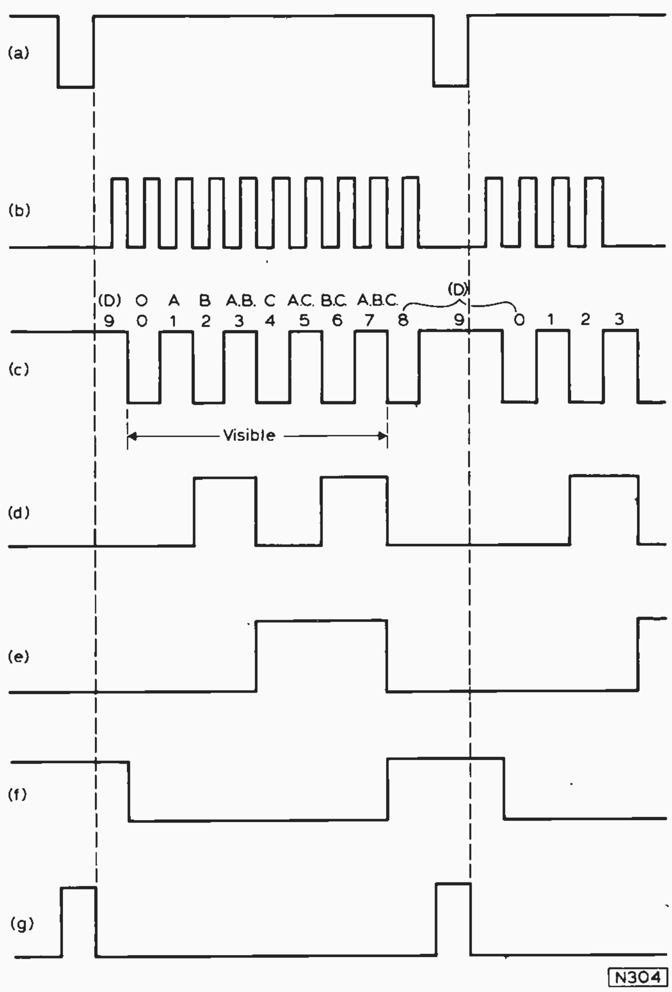


Fig. 3: Idealised waveforms. (a) Tr1 collector pulse. (b) IC2 input, pin 14. (c) IC2 output A, pin 12. (d) IC2 output B, pin 9. (e) IC2 output C, pin 8. (f) IC2 output D, pin 11. (g) Reset pulse, IC2 pin 7.

★ Components list

Resistors:

R1	1MΩ	½W	R3	110Ω	1W
R2, R4	1kΩ	½W	R5, R6	6·2kΩ	½W

Resistor ¼W, ±2%	Amplitude/Saturation % 100/100	100/95	75/100
RA	47	56	56
RB	15	18	20
RC	7·5	10	10
RX	—	18	—
RY	—	—	18

The values for RA–RY are all in kΩ and are for a 1V peak amplitude output (see text).

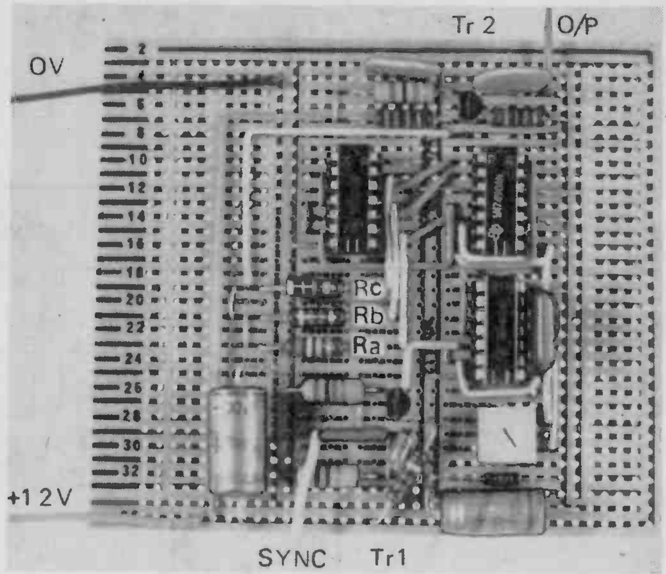
VR1 220Ω miniature preset

Capacitors:

C1 33pF silver mica
C2 220pF polystyrene
C3 0·022μF polyester
C4, C6 0·1μF disc ceramic
C5, C7 100μF 25V electrolytic

Semiconductors:

Tr1, Tr2 BC109c
D1 BZY88C5V1 zener (5·1V 400mW)
IC1 7400 IC2 7490 IC3 7405



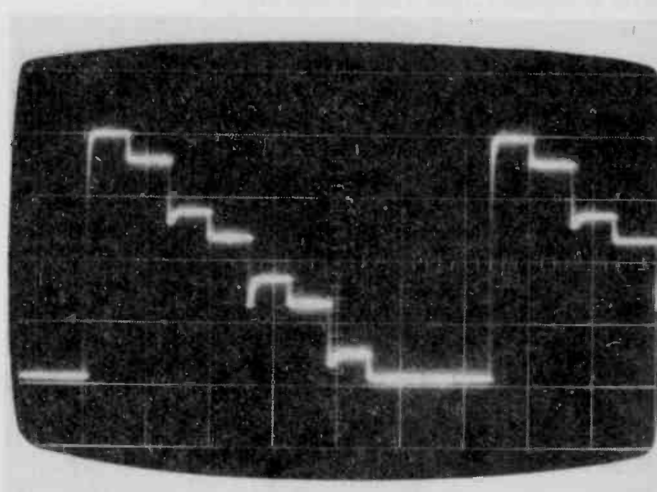
The completed generator, constructed on a West Hyde Prototype board.

Clock oscillator

Two gates in IC1 form an oscillator which runs at about 10 times line frequency, synchronised to the line flyback pulses which are picked up from the receiver and amplified by Tr1. The oscillator frequency is adjusted by means of VR1 so that eight bars just fill the screen. The flyback pulse is also inverted by one of the gates in IC1 and used as a reset pulse for the counter. On receipt of this pulse, the 7490 is forced into the 9-count state if it is not already there (as might happen for instance during initial adjustment of the clock frequency), and remains there until the first clock pulse of the following line. Idealised waveforms for various points in the circuit are shown in Fig. 3. The fourth gate in IC1 is unused.

Construction and use

The prototype generator was constructed on West Hyde Prototype board as shown in the photograph. Any other form of stripboard or a printed board could equally well be used.



The generator output waveform. (Scale – Vertical: 0·5V/cm, Horizontal: 10μs/cm.)

The sync pickup lead will generally need only to be brought within a few inches of the line output stage for the generator to work. On no account must any direct connection be made, nor should the wire end be stripped. The best point to connect the video output lead depends on the receiver. If possible the set's own video should be temporarily disconnected at the point where the staircase is injected, to avoid interference from the received video. It is necessary to choose a point after sync extraction so that the line output stage is still synchronised. When in doubt, the best course is to make the connection at the output end of the luminance delay line.

Modifications

A 100% amplitude, 95% saturated signal can be produced by adding one triple-input NAND gate and three open-collector inverter gates (Fig. 4(a)), and making A = 8, B = 24 and C = 44. When all three counter outputs go to logic *1* at the count of 7 (BCD *111*) resistor RX, which is calculated to pass 0·25mA, is switched into Tr2 emitter circuit. Counter output QD is also connected to RX in the wired-OR mode via one of the inverters.

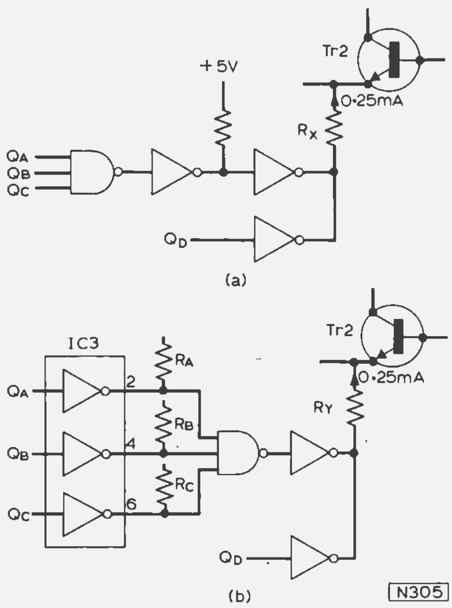


Fig. 4: (a) Extra logic for a 100%A, 95%S output signal. (b) Extra logic for a 75%A, 100%S signal. Current shown is for 1V peak output.

A 75% amplitude, 100% saturated signal is produced by adding one triple-input NAND gate and two open-collector inverter gates (Fig. 4(b)). In this case RA, RB and RC are chosen such that A = 8, B = 23 and C = 44. When all three counter outputs are at *0*, resistor RY is unconnected. At all other counts it is switched into Tr2 emitter circuit and passes an extra 0·25mA. The inverted QD output is again connected in wired-OR mode to RY.

The values given for RA, RB, RC, RX and RY in the components list will give a 1V peak amplitude output. If a different amplitude is required, the values should be changed while keeping the same relative proportions. For instance, for a 2V output the values should be halved and the nearest preferred value used. If the required value of any resistor works out to be about half way between two preferred values, choose that one which keeps the relative proportions more nearly correct. For an accurate output signal, the proportions are more important than the actual values. ■

VIDEOTAPE COPYING TECHNIQUES

Vivian CAPEL

IF pre-recorded video tapes and cassettes are to become a feature of the domestic entertainment scene, as the audio cassette has done, one of the problems facing the software producers is that of economical copying. Unlike the video-disc which can be stamped out at high speed and at low cost per unit, each tape must be individually copied from a master.

While the same problem exists in the case of the audio cassette, it is eased by the practice of fast copying. This has been done for years by amateur tape-recordists with multi-speed machines, when desiring to make a quick copy of a tape recorded at a low speed. Thus copying a 9·5 cm/s ($3\frac{3}{4}$ i/s) tape at 19 cm/s ($7\frac{1}{2}$ i/s) halves the time taken to do the job, while recordings taken at 4·75 cm/s ($1\frac{7}{8}$ i/s) can be copied in a quarter of the time. As cassettes normally run at this slower speed, commercial copying can be done at high speed in a fraction of the running time. This, combined with the practice of making a number of copies simultaneously on slave recorders from a single playing of the master, enables tapes to be produced economically.

As the playback speed is doubled, so the highest recorded frequency is doubled, and so both playback and recording machines involved in the copying process must be capable of handling these high frequencies if the quality is to be maintained. With the relatively low upper frequency limit of audio cassette recordings this is no great problem.

In the case of video recordings matters are different; not only do higher speeds pose problems of recording the higher frequencies thus generated, but the mechanical movement of the helical-scan head, already fast, becomes well-nigh impossible to accurately control. So, although some attempts have been made at high-speed videotape copying, they have not been very successful and the copying speed has to be kept well down.

This means that copying has to take the same amount of time as the actual running time of the tape. For educational or commercial organisations making a few copies for internal use, this is no great drawback, but if videocassettes are to capture a mass market similar to the audio cassettes, as it is hoped, then such copying methods are obviously impracticable.

Hitherto, the only way to satisfactorily copy a tape was to run a number of slave recorders similar to the audio copying machines, but at the normal running speed. There is for example the Sony D100 copier which is designed to copy the U-Matic videocassette. This consists of a master play unit and a minimum of eight slave copiers for economical operation although fewer can be used. Elaborate servo alarms are included to give immediate indication of any fault in the system. Other copiers are available for the other cassette types such as the Philips VCR, and the Japanese EIAJ/1, but they work on the same general principle. Here though, quantities are still limited, and even the largest bank of slave copiers would take a considerable time to make 1,000 copies of an hour-long cassette.

Contact prints

An alternative to the re-recording process is to copy by means of making contact prints. Audio tape recorder enthusiasts will be familiar with the phenomenon known as "print-through", whereby parts of a recording appear on adjacent layers of the tape when it has been spooled up for a long period, giving echo or pre-echo effects. The print-through is faint because the material of the tape lies between the two layers of magnetic coatings and conditions are rarely favourable (fortunately) for maximum transfer.

It can be appreciated that copying by this method offers certain theoretical advantages. As the copy is not being re-recorded, there is no frequency-response limitation of the copying machine to worry about. Nor is there any need to accurately track the helical scans, because everything on the first tape will be transferred as it stands on to the second. So, providing the conditions are optimised for near instantaneous magnetization of the receiving tape, the tapes can be run through the machine very rapidly, at many times the normal running speed.

There is one snag though, obviously we cannot make a satisfactory transfer through the base material of the tape as happens with print-through. The tapes must meet face-to-face with actual contact between the magnetic coatings. A moment's thought will make it obvious that what we then produce on the second tape is a mirror image of the first; just as with printing on paper, the type-face is in reverse in order to produce print the right way round. So the copy is useless as it is. What now has to be done is to make another copy from the first one, and this one will then be the right way round. Thus, the contact method of copying requires the making of a mirror-image tape which is then used to produce the actual copies.

The making of the image tape is usually done in actual running time by re-recording on a special recorder, as it has to be as perfect as possible in order to make other copies. Hence for an hour-long cassette, the first hour is spent making the image copy during which time a conventional 8-slave copier would have made 8 copies. The second hour would see the production of 10 copies if the machine is run at 10 times the normal speed, whereas a conventional re-recording copier would by then have made 16. The third hour would result in 20 copies compared with 24 for the slave units. It is only in the fifth hour that they break even, then subsequently the contact copier shows an advantage.

Of course, a re-recording copier with more slaves, say up to 16, would hold its own longer, but contact copiers are now available that can operate at up to 20 times normal running speed. A 16-slave copier takes up a lot of space however, needs skilled attention, and is no cheap item, so on this score the contact method has much to commend it.

As mentioned before, transfer from one tape to the other by means of contact takes place under certain favourable conditions. Apart from intimate contact, transfer can be stimulated by placing the tapes in an alternating magnetic field; this is known as the anhysteretic process. Care must of course be taken that the master tape is not erased in the process! There are two basic systems using this principle, the National Panasonic type of copier, where the two tapes are reeled up together with coatings in contact, placed in the a.c. field and then separated onto their individual reels, and the Ampex method where the two tapes are run separately from their respective spools to their take-up spools, and brought in contact at one point only where the field is applied.

Transfer can also be obtained in the case of chrome dioxide copy tapes by the application of heat. This material has a low Curie point (the temperature where it ceases to possess magnetic properties), but when subject to this temperature, it then becomes very susceptible to fresh magnetization. The master tape cannot be of the chrome variety as it would be erased by heating to its Curie point, but chrome copies can be made from a ferrous master. The thermal method thus has limitations and is not commonly used by itself. Most of the high-speed contact copying is done by the magnetic-field process.

STAM

Recently, a new process was introduced by the 3M Company which overcomes several of the problems of high-speed contact copying at one go. First, contact copies are made without the need for a mirror-image tape, the original can be used directly. Second, the master tape is not placed in an a.c. field and so is not in jeopardy of losing any information through erasure.

tape contacts it in the presence of an alternating field just after it leaves it.

What happens is that the belt having just left the hot drum has been heated to its Curie point and is therefore sensitive to receive magnetic impressions. Here it is contacted by the master tape and therefore magnetized, but almost immediately it is cooled by passing around the cold drum, so the magnetization is "fixed". The impression will be a mirror-image and so suitable for making a direct copy, which it does on leaving the cold drum. At this point it enters the a.c. field at the area of contact with the copy tape and so the magnetic impressions are transferred to it. If the field produces any deterioration of the signal on the belt this does not matter because it has done its job and now the belt passes to the heated drum where it is again brought up to its Curie point thereby erasing it and sensitising it ready for its next contact with the master. The whole process is continuous, and high speeds are possible.

The original STAM copier, the HRP-1 runs at 190 cm/s (75 i/s) which is 20 times the speed (linear) of the U-Matic cassette. With no mirror-image tape to make, a large output can be achieved in a short time. A single machine for example can equal the capability of a 16-slave copier. Other versions are available such as the smaller and slower (half-speed, or x10 times running speed) unit designed for the U-Matic cassette, but a x15 version is shortly to be produced.

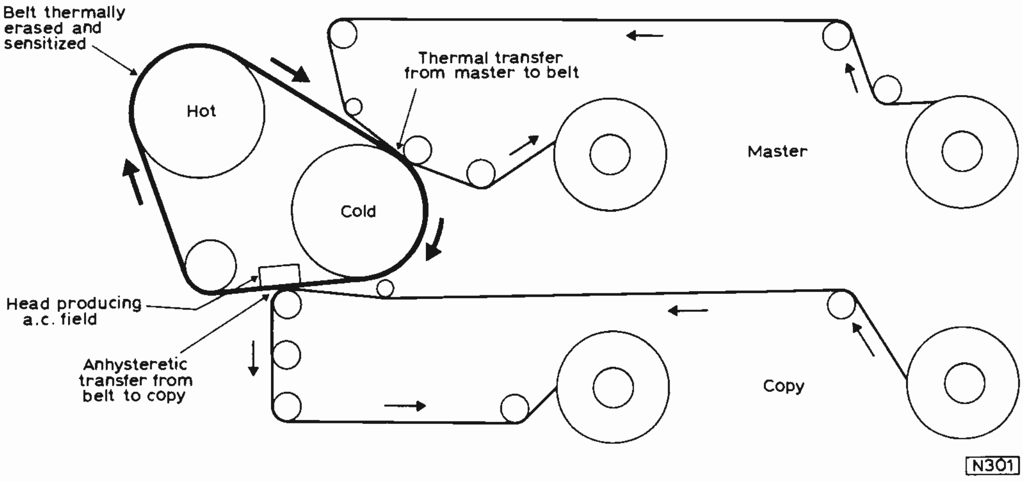


Fig. 1: Basic principle of the STAM high-speed contact copying process.

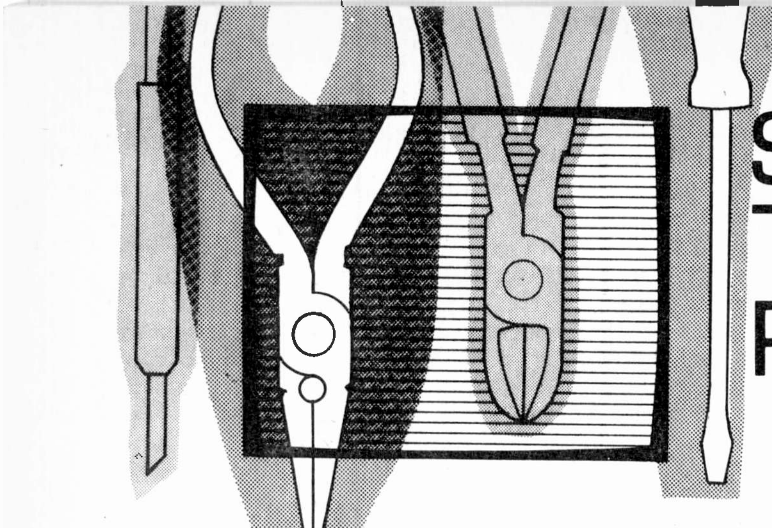
A feature facility, although this is not an inherent feature of the process, is that tapes of all the standard sizes from 12·5mm to 50mm ($\frac{1}{2}$ inch to 2 inch for those like me who have not yet absorbed metric sizes) and all types of format can be accommodated. This latter feature will be of little interest to the big video recording companies who will be churning out material in quantity for the domestic market in the not-too-far-distant future. Rather like the various manufacturers of quad records in the audio field, they will be committed to a particular format and size. The smaller professional copying concerns though should find it a boon.

The system uses a combination of anhysteretic and thermal transfers in sequence and so is known as Sequential Thermal Anhysteretic Magnetization or STAM for short. (Strange how the initials of complicated designations usually spell out a short pronouncable word or name.)

The principle of operation is both comparatively simple and ingenious. The heart of the system is an endless belt made of a metallic substance having a low Curie point, which passes over two drums, one heated and the other cold. The master tape is brought into contact with the belt as it is about to pass around the cold drum, and the copy

The copies can be either on ferrous tape or chrome, and the latter is normally used for videocassettes. The master must be ferrous because a chrome tape would be erased by the hot belt. However, if the Curie point of the belt could be lowered further thus reducing the temperature required, chrome master tapes could be used. The makers envisage that future development may be along this line. At present they have produced a special high output tape which gives best results in copying when used as a master, but it is not essential to use it. The copying process adds approximately 2dB to the noise level.

This process could well prove to be a big step forward toward mass domestic VCR utilisation. There are other hurdles to overcome though, such as the complexity and cost of the playing units. There are cheaper systems such as the videodisc, while cine film for either pre-recorded material or home-made programmes is cheaper still. It seems that one of the main attractions of VCRs is the recording of TV programmes for future viewing, but this at the moment is bedevilled by copyright restrictions. So there are many imponderables and what the final outcome will be time alone will tell. ■



SERVICING TELEVISION RECEIVERS

PYE 173 AND 573 CHASSIS

L. LAWRY-JOHNS

SOME two years ago we discussed the Pye 169 chassis. Since then many modifications have been made and the subsequent 173 chassis can be regarded only as similar. In addition, several further "stock faults" have come to light. All in all then another article on these sets is due.

The Invicta models have an attractive front control panel with four press buttons (as opposed to push buttons, i.e. no push is required) each with its own tuning scale. Above this are the two front controls, volume on/off and brightness. Some near relatives from the Pye-Ekco ranges use a similar tuning assembly, but with slider controls and a separate on/of switch – this is referred to as the 573 chassis. The press button assembly incorporates the switches and resistors for controlling the tuning of the varicap tuner, which is mounted on the main panel.

Access

The rear cover is secured by four turn screws. With this off, the chassis and model numbers will be found on the top frame, on the right side. The main panel is pegged to the cabinet brackets and usually only the top pegs need be removed for servicing. The nylon retaining string should be hooked on the upper right side to prevent the panel swinging down too far unexpectedly when the pegs are removed (you have been warned!).

IC Complement

There are three i.c.s on the main panel. Two are obvious, the other isn't. The two that are obvious are the TBA480Q intercarrier sound i.c. (IC1) and the TBA550Q video processing, a.g.c., sync separator etc. i.c. (IC2). The third i.c. is less obvious and lives just to the left of IC2: it's the TAA550 voltage regulator for the varicap tuner (IC3). Since the tuning is by selected voltages, the supply line must be held constant to avoid the need for constant adjustment. And thereby hangs a tale.

Tuning Faults

If your vocation brings you into contact with these receivers, or if you have one yourself, at some time or other you will be faced with the complaint that although the screen lights up and there is evidence of life in both the vision and sound channels, no signals can be received. Do not rush to the tuner and accuse it of all manner of vile things. If you cannot resist this temptation, just check the voltages at points C and D. D should record 11V whilst C should record the selected tuning voltage. The chances are that these will be absent.

Whilst there are several possible reasons for this, such as a short in C123, C124 or IC3, the usual cause is to be found at the top of the panel just under the left side of the mains dropper. R122 will on most panels be found to be a carbon 2W resistor with a stated value of 20kΩ. It tends to go high in value and present a discoloured appearance. Replacement will restore normal working (unless the tuning of the press buttons has received the attentions of the family) and the tuner will have been cleared of all the charges hurled at it. Later models may be fitted with a wirewound resistor in the R122 position: this rarely gives trouble. So there is the first common fault.

Having said this we must admit that the TAA550 voltage regulator i.c. has on occasions played up, and has had to be replaced before the tuning could be stabilised. Also the tuner has been found to be responsible for several weak or no reception faults, sometimes intermittent. Tackling this sort of problem depends mainly on one's patience and resources. If a replacement tuner is to hand and time is precious it is better to put it in and see if this clears up the trouble. If one is more economy minded and time is not pressing it is often rewarding to trace the fault and clear it, even though there is no one around to pat you on the back for your zeal and efficiency. Intermittent reception may be caused by the close proximity of the tuner print and the screening, shorting under some conditions of heat and or vibration. But we don't propose to go into the ins and outs of tuner faults and their remedies: if you are clever enough to tackle any repair on these items you don't need any help from us and if you're not the tuner should not be tampered with at all.

The IF Strip

The output of the tuner is taken via various filters to the base of VT1, which is a BF196. This has a minimum forward bias determined by R4-R7, and a.g.c. forward bias via R9 from IC2. If the emitter voltage reads about 2·5V the stage can be assumed to be in working order, unless other tests indicate otherwise and all other stages are working. The usual trouble is an open-circuit base-emitter junction. In this case although the voltage at the base is reasonably correct (say 3V) there is no voltage drop from emitter to chassis.

If this stage is in order but the signals are not what they should be move up the panel to VT2 and VT3. These are connected as a cascode pair. We've had almost no trouble

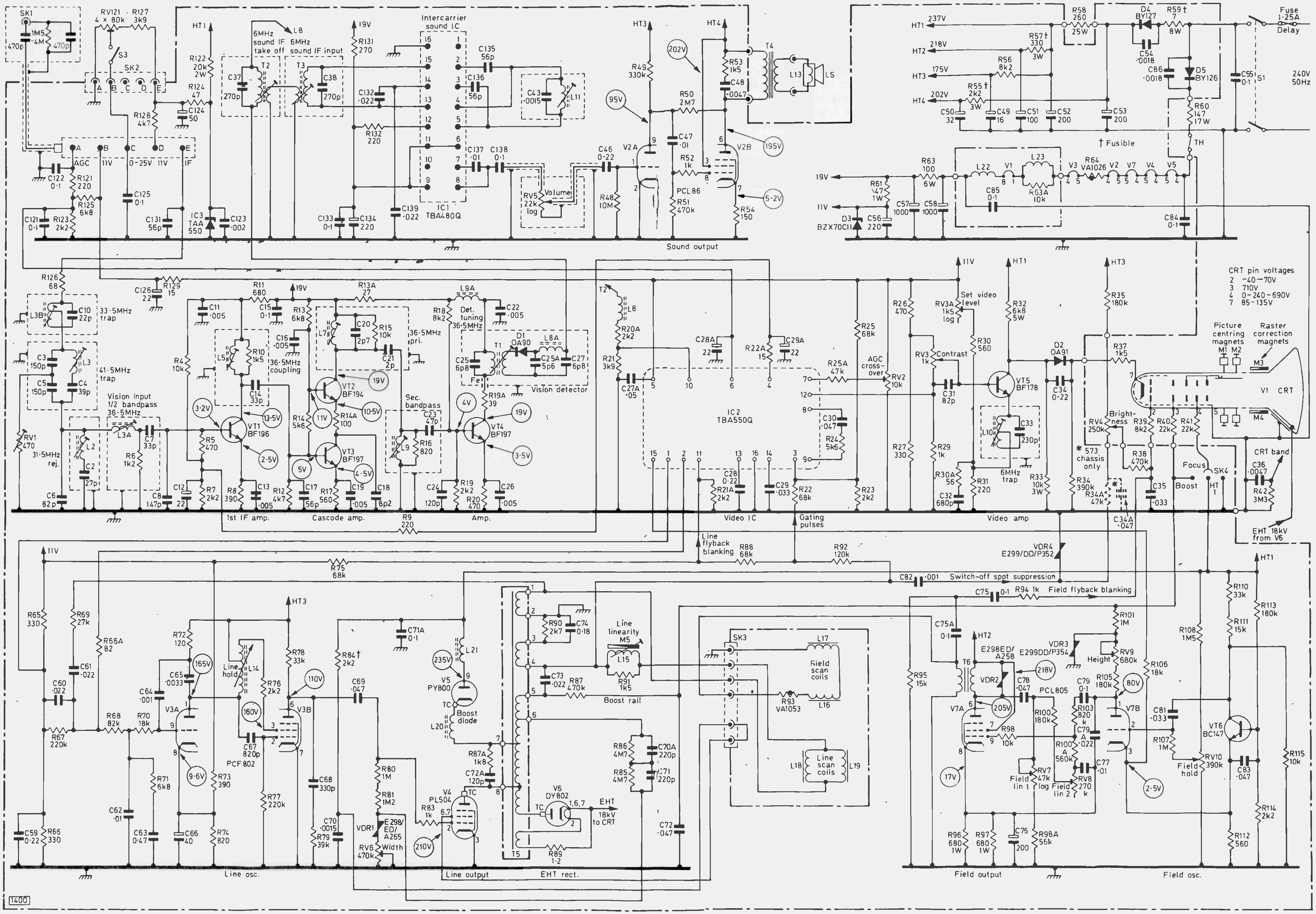


Fig. 2: Circuit diagram, Pye 173 and 573 chassis. C12, C28A, C29A and C126 may be 20μF, C56 250μF, and R22A may be omitted.

transistor when this has been fitted to the panel. There are several roughly equivalent transistors which can be used in place of the BF178 (the BF337 for example). Check the voltage rating however before fitting a different type.

Brightness Circuit Check

A bright raster need not indicate a video circuit fault, and a quick check on the VDR which returns the brightness control to chassis can often be rewarding. The quickest test consists of simply shorting it across, i.e. returning the brightness control direct to chassis.

Sound Stages

The sound stages do not present much of a problem if there is a picture on the screen. Nine times out of ten the PCL86 is responsible for faults, particularly when the sound goes off with a sharp crack and returns (sometimes) in the same way. A tap on the valve will often prove this, but there are times when the valve is quite innocent and a few checks must then be made to ascertain the cause.

If there is no voltage at pin 3 of the base, the feed resistor R55 will often be found open. If it has sprung open, suspicion must return to the PCL86 which can short internally and heat up the resistor. If it has not sprung but is open-circuit the valve is not usually responsible.

Should voltages be present at pins 3 and 6 a hum test at pin 1 should produce a nice response. If this is very low (with the volume up) check R49 which can go high in value. If there is a nice response from pin 1 or the volume control the plot thickens, since we are now getting back to IC1. The first step should be to check the supply voltage at the junction of R131-R132: C134 could be shorted. If the supply is present you are faced with the prospect of suspecting IC1 and checking associated components.

Distorted sound can be due to the quadrature coil L11 being off tune. In all cases where the PCL86 is for any reason suspect its cathode resistor R54 should be checked.

The Timebases

Despite what has so far been said the majority of faults occur in the power supplies and in the timebases. Assuming that the supplies are in order – we will discuss later what is likely to be wrong if they are not – the timebase faults fall into fairly well defined and oft repeated cases.

Field Faults

Complete field collapse, i.e. only a nice white line across the screen, can be due to a number of causes. If the line is not straight but has a distinct curve in it one should immediately check the continuity of the field scan coils on the tube neck. R93 (the thermistor) is easily checked by shorting it out. To check the coils, remove the scanning plug and check across the outer pair of the four tags grouped together.

If the line is straight and the coils are in order the next check should be on the PCL805, to see whether h.t. is present at pins 6 and 7. If there is no voltage at pin 7 check back to the HT2 supply where R57 may be open-circuit. If the voltages are present check at pin 8 (cathode). The voltage here gives an indication of how much current is being drawn by the valve. The voltage should be about 17V.

The fact that this voltage is present does not clear the PCL805 of suspicion however. The fault could be in its triode section. Quite obviously the quickest and most essential check is to replace the valve and then if necessary consider what to do if the new one fails to open up the scan. The next check is to see what voltage is present at pin 1. If this is low (should be about 80V) it does not mean that there is necessarily something wrong with the supply, only that there possibly is. Have another look at that white line. Was it necessary to advance the brightness fully to resolve it at all? If the line is brilliant the brightness should be turned down fully to avoid burning the tube face, but if it is not brilliant check the voltage at pin 3 (first anode) of the tube base. If this is absent or very low, check the decoupler C72 which may be short-circuit. If it is R87 may be a bit burnt up. C72 must have a minimum rating of 1kV.

It may be thought that failure of the boost supply to the c.r.t. first anode would result in a complete black out, but since the height control is fed from this same point the concentration of whatever beam current there is can still result in a quite discernible line across the screen.

Generally however the line will be very bright, denoting full boost supply at the junction C72-R87. If there is little voltage at pin 1 of the PCL805, one can assume one of two things: either something is wrong in the height circuit consisting of R101 (primary suspect), the height control itself and R105 (less likely); or the field oscillator is just not oscillating.

When the stage is oscillating there should be a negative voltage at pin 2 of the PCL805 (triode grid). If a slight positive voltage is found here, the anode voltage will be very low indeed and no research into the height chain resistors will be rewarding.

If this condition (non-oscillation) is causing the trouble it should be appreciated that the oscillator consists of the triode section of the PCL805 and transistor VT6 (BC147). If the PCL805 is not at fault the BC147 probably is, but there are plenty of other possibilities. A simple ohms test on the BC147 can be made and may prove the transistor defective: more often than not however it may read right. This is not conclusive, and a new transistor should be fitted if a quick test on the associated components suggests that these are in order. If the transistor is not at fault, a more thorough check must be made around R113, R110, R111, C83 etc. The whole condition could be due to a dry soldered joint. Speaking of which, a case of intermittent field collapse with no voltage at pin 6 in the fault condition turned out to be due to a dry-joint where the connection from the output transformer passes through the board – just below VDR2.

Rolling Picture

Hold problems can usually be sorted out fairly easily, but there are exceptions. If the picture rolls when the set is first switched on but steadies after a period (this can vary from a few seconds to several minutes) a new PCL805 will put things right. If the hold is at the end of its travel, again check the valve but keep an eye on the possibility that R108 could have gone high-resistance. C81 is rarely the cause but of course could be.

Poor Linearity

Poor linearity with severe bottom compression is usually due to C76 having a poor lead out contact rather than the capacitor having dried up. RV7 can also be responsible, with either poor wiper contact or poor contact to the track rivets. Remember that this preset control forms part of the PCL805's control grid chassis return.

CONTINUED NEXT MONTH

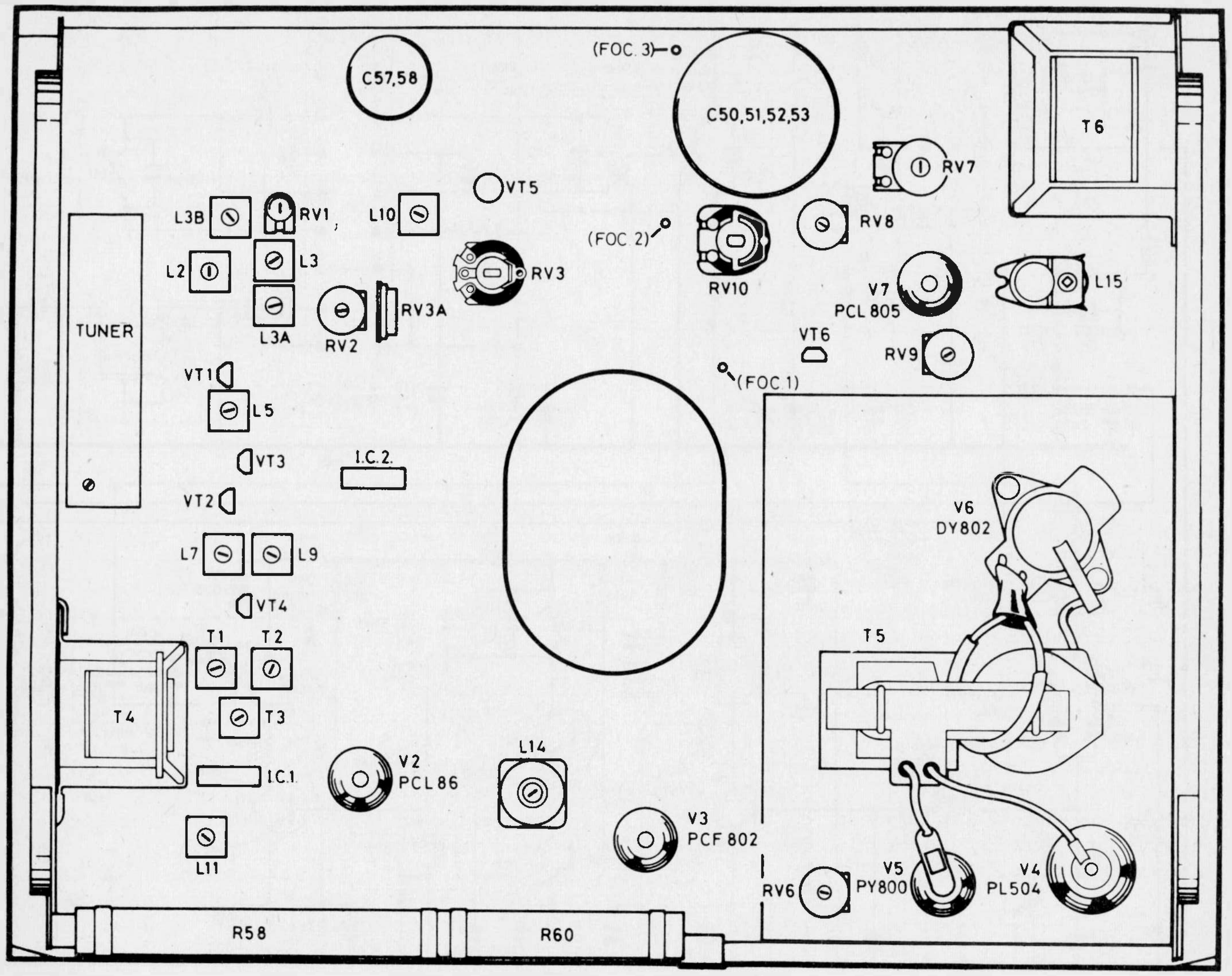


Fig. 1: Plan view of the chassis.

with this stage, so our main comment is that the usual emitter check at VT3 (4·5V) should show whether both transistors are functioning or not. In one or two cases dry-joints at the pins of the tuning coil L7 have produced the symptom low sound with no vision.

The final i.f. stage is a different proposition altogether and we have often traced loss of signals to this stage. If VT4's emitter voltage is about 3·5V it is likely that all is well. If it's absent or very low check the base voltage which should be about 4V. If this is right and the collector voltage is up to standard (say 19V) the transistor is faulty. If the emitter voltage is high (higher than the base voltage) the transistor is again faulty. The base voltage should be steady at about 4V if resistors R18-R19 are in order. If there is doubt, cold test the transistor with an ohmmeter or better still put in another BF197.

The signal detector diode D1 (OA91) gives little trouble but can easily be checked by measuring the back-to-front resistance from the junction L8A-C27 to chassis: the reading should be low one way and about 5kΩ the other way.

After this the sound and vision signals separate, the sound going into IC1 for i.f. amplification and detection while the vision goes into IC2 for processing.

Video Chip

The video chip (IC2) is a fairly expensive item and should not be condemned lightly. A faulty chip will generally pass some video signal and the sync may not be affected, the net effect tending to throw suspicion on the video output stage (which may well be at fault). It is often the case however that the video output stage is behaving perfectly and a test signal injected at the contrast control will show a nice black and white pattern with lovely grey-scale tracking (the cagey old goat will have his little jest), proving that both the video output stage and the tube are in order, but a similar injection at the junction L8-R20A may show what can only be described as a "plastic" picture or display with little detail. Check the supply to the chip and associated components, but be prepared to replace it.

Video Output Stage

Should the video output stage come under suspicion the resistors should be checked as routine, particularly the load resistor R32 6K8 (6·8kΩ as I prefer it). This resistor can go open-circuit, thus leaving a bright raster. Also check the setting of the video level control RV3A. This should be set to give 85V at VT5's collector when a test card is being transmitted. If this and the contrast control are in order but 85V cannot be obtained it is reasonable to suspect the transistor: a cold test will almost certainly show it to be defective.

It's not surprising that this transistor is so often at fault: it has to do quite a hard job for such a small device. Don't forget to remove the heatsink clip and put it on the new

WHAT ELSE?

TV TEST EQUIPMENT REVIEW

PART 5

E. TRUNDLE

IN this concluding part of our survey, we look at four instruments which have been found very useful in the television workshop. They have been grouped together because unlike the classes of instrument previously reviewed, most are unique to one manufacturer, or, as in the case of the e.h.t. meter, too simple to merit a complete review by themselves. While not all are absolutely essential for TV service work, none are in the luxury class, and in the present economic climate, first-class service work is the best possible recommendation for dealers. If the present sales slump continues, it might even prove to be their salvation! Professional technician and enthusiast alike are finding it necessary to prolong the life of receivers as High-street prices soar ever higher, and with the right attitude and the right equipment, it is surprising how much can be done with the more elderly receiver. At the risk of raising the Editorial eyebrows, the author is inclined to put the first (dual-standard) colour receivers firmly in the elderly category.

At the other end of the time-scale, the ever-increasing complexity of modern receivers demands greater sophistication in the test equipment used to diagnose faults and set up or align circuitry. Even the most dyed-in-the-wool engineer must by now have abandoned his neon screwdriver and valve tester! Television receiver performance is improving all the time, but when the set has aged a bit, and the factory alignment and adjustment has drifted a little, peak performance is only potential unless the right gear is available.

We are fortunate in the UK to have, in the PAL system, what is acknowledged as one of the finest systems of colour transmission. The broadcasting authorities, BBC and IBA alike, are the envy of many parts of the world for the quality of the engineering standards they maintain – a trip across the Atlantic will very quickly prove this point. When one takes this into account, and bearing in mind the design effort put into a colour receiver and the care taken at the factory to achieve optimum performance, it is sad that a £400 set all too often gives less than its best in the home. Sometimes this is unavoidable where signal reception is poor, or mains supply difficulties are present. More often, however, all that is required is careful setting up, and this is where the correct test gear scores. A chain is only as strong as its weakest link, and in our business, that link is often the last one!

Most television work is basically a question of diagnosis in the broadest sense, whether it be an experimental clamp that won't clamp or a super-duper brand X slimline colour TV with a pink patch on the raster. It is not unknown for an attempt to be made to repair or adjust a receiver without the operator really knowing what is wrong with it. This ludicrous situation is avoided by having the correct test gear to start with, and having a thorough knowledge of both the set and the test equipment. Knowing precisely what is wrong is a very short step from putting it right, whether this involves adjusting a drive potentiometer or replacing a delay line.

Having delivered ourselves of that little oration, we hastily move on to more practical matters. Some test gear can be little used once the novelty has worn off, and tends to be banished to gather dust on a shelf in a corner of the workshop. We have studiously avoided anything which could come into this category, and each item described here has been in useful and productive service for some time.

Avo TT169 Transistor tester

The TT169 from Avo is a useful instrument designed to perform basic tests on transistors in-situ. Its usefulness depends rather on the individual user, as many transistor defects can be diagnosed in circuit by analysis of electrode voltages with a multimeter. It is not unknown for a transistor to be replaced in a piece of equipment, and when

Abridged specification

Devices tested: Signal and switching transistors.
Power transistors of low/medium ratings.
Signal and rectifier diodes.
Thryristors.

Power supply: Internal 4·5V battery (3 x HP7).

Size: 191 x 89 x 44mm (7·5 x 3·5 x 1·75in) in carrying case.

Weight: 0·45kg (1lb) in case.

Price: £23.52 (plus VAT) UK Trade.

Further details are available from Avo Limited, Archcliffe Road, Dover, Kent CT17 9EN. Telephone Dover (0304) 202620.

WHAT ELSE?

the question is raised as to what was wrong with it, the operator doesn't know, which suggests that he didn't know the equipment was repaired until he heard the music! There are many situations however, where a quick rough check of a transistor's condition is useful, especially in field service work where there are neither the time nor the facilities for the niceties of Ohm's law and beta.

Principle of Operation

Basically, the instrument consists of a relaxation oscillator of the astable type, of which an internal transistor forms one half, with the transistor under test as the other half. A light-emitting diode forms part of one collector load, the flashing of this providing the 'readout'.

Power transistors require a higher collector current during testing, and often have markedly low gain, so the arrangements for testing them are different in that the astable action is provided internally, a squarewave output being applied to the base of the device under test. The load for the latter then consists of a tungsten lamp, the test collector current being a respectable 250mA.

How Well Does it Work?

Inevitably, there is a certain degree of suspicion on the part of the cynic towards this type of instrument. The first things to spring to mind are circuits such as Darlington-pair complementary output stages, and television line scan circuits, in which a low impedance or another semiconductor junction are present across the device being tested. We are possibly more cynical than most, and much time was spent exploring the capabilities of the instrument. To dismiss parallel resistance first, as a very general rule of thumb, we found that where the resistance involved is up to a few hundred ohms, disconnection is necessary. Above this, no problem arises during in-situ testing.

In an involved complementary audio output stage of a hi-fi system, we found that the TT169 checked the npn half of the stage, but gave misleading results on the pnp half. In all conscience, it should be pointed out that this was one of those 'death or glory' circuits, in which semiconductors far outnumber passive components, and the odd resistor interposed between direct-coupled junctions serves only to catch alight when a fault occurs ... but we digress. The more straightforward complementary sound output stage of the TCE 3000 series television for instance, was amenable to complete testing with the instrument. All signal transistors checked out happily, so that probably 90% of transistors in domestic equipment may be tested. Experiments were next carried out in circuits where large values of capacitance were present across the transistor being checked, and we were surprised to find that apart from a slight slowing of the LED 'wink rate', capacitances as large as 2500μF could be tolerated across the c-e junction of the device under test. This is very good, and suggests that no problem would be encountered in practice on this score.

We found that individual diodes in full-wave bridge rectifier configurations could be checked, although where a short-circuit junction exists, the instrument indicates two faulty junctions where the bridge is fed from a transformer secondary winding. Otherwise, it was found possible to check most diodes, signal and power, in circuit.

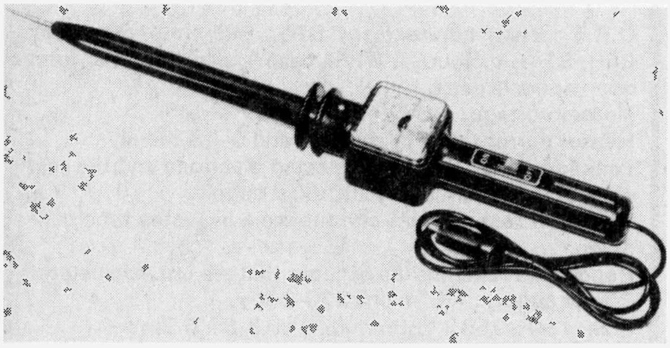
Turning now to thyristor and power transistor testing, we were unable to find any thyristor in television equipment which could not be tested in-situ with the TT169. Some thyristors are fed by a pulse transformer in certain equipment, the secondary of the transformer being connected between the gate and cathode of the device. In such cases, it is necessary to disconnect the thyristor gate before testing. Ordinary power transistors in most circuit configurations were easily tested, and gave a clear indication of their condition. Again, where a transformer winding is present across a junction, disconnection is necessary, but such a circumstance is uncommon except in the case of the driver transformer feeding a line output transistor. Even after disconnection of the base, we found that most modern high-performance line deflection transistors such as the BU208 were not happy under test in that they gave rather uncertain indication, and required critical adjustment of the control knob. This applied whether the transistor was in or out of circuit.

Conclusion

The TT169 is a useful instrument, especially for the field technician. Once experience is gained, the limitations described above become known, and we found that once having got the feel of the instrument, it was in constant demand. Obviously, there are many characteristics of transistors which the TT169 does not check, and in such cases substitution is necessary. The instrument is intended purely as a quick 'go no-go' checker, and this it does, without circuit disconnection being necessary in the vast majority of cases. ●

WHAT ELSE?

Heathkit IM-5210 EHT meter



Abridged specification

Measurement range: 0–40kV d.c.
Accuracy: ±3% of f.s.d.
Impedance: 800MΩ (50μA f.s.d.).
Size: 381 x 48 x 38mm (15 x 1·9 x 1·5in).
Weight: 0·22kg (0·5lb) approximately.
Price: £13.70 (plus VAT).
Further details are available from Heath (Gloucester) Ltd., Bristol Road, Gloucester GL2 6EE, telephone Gloucester (0452) 29451, or from the London Heathkit Centre, 233 Tottenham Court Road, London W1P 9AE, telephone 01-636 7349.

Surprisingly devious means of measuring e.h.t. are used by many engineers. Strings of 22MΩ 10% carbon resistors in long and lethal paxolin tubes, doubtful pitch-filled probes gently hissing and precariously hooked up to ordinary multimeters. . . . . The author once saw a gadget called a calibrated spark gap. Its operation was explained by its owner, a grizzled technician of the old school. it seems that the stern was earthed and the probe was applied to the c.r.t. final anode, after which, with a trembling hand, a knob at the rear was twisted to wind a brass sphere along the axis of the glass tube which formed the body of the machine. Inevitably, flashover occurred between the spheres at some point, whereupon the direction of travel was smartly reversed until the spark stopped (assuming that the e.h.t. rectifier had withstood this onslaught!). Give or take a few per cent for the humidity of the air at the time, it was possible to read from the calibrated scale what the e.h.t. voltage was before the e.h.t. transformer gave out.

Seriously, an accurate means of reading e.h.t. voltages is essential on the bench or in the home, and there are currently available several designs of inexpensive and reasonably accurate meters. There used to be much fuss about the loading effect of the meter on the e.h.t. supply but, provided the beam is extinguished during testing, even on a monochrome set results are satisfactory where a 50μA meter is used – if the voltage differs appreciably between zero e.h.t. current and 50μA, there is definitely something wrong with the regulation!

The Heath IM5210 came to us in kit form, and was assembled in about half an hour. Like all Heathkit equipment, it is of American origin, although the meter movement is Japanese. No calibration is necessary, as the movement is pre-calibrated and the resistor is of close tolerance. We made doubly sure of the joints in ours, as bad soldering and e.h.t. voltages are poor bedfellows.

Accuracy was well within specifications, and the meter was found satisfactory in use. One objection to the 'probe' type meter, as opposed to the free-standing type, is the necessity to hold it in position. If continual monitoring of e.h.t. voltage is required for any reason, this is not convenient, but it was found possible to wedge the lightweight IM5210 in position, as shown on the front cover of our November 1975 issue.

The on-off switch might seem a little pointless until it is remembered that a moving-coil meter is dynamically damped when it is shorted out, and the switch is provided to prevent physical damage to the movement during transit. The whole thing is quite robust and should stand up to field service conditions well. No damage was sustained during an accidental fall from the bench to a concrete floor.

In a compact meter of this sort, the dial is necessarily small, so that accuracy probably depends on the angle of observation more than the inherent accuracy of the instrument. Unfortunately, the situation is aggravated in the IM5210 by the fact that f.s.d. is an unapproachable 40kV, so that most readings are made at little more than half-scale. It is felt that accuracy would have been enhanced, and the usefulness diminished not at all, if the meter had been designed to indicate 30kV maximum. This apart, we were happy with this instrument, and can recommend it. ●

Video Circuits V31A CRT tester

The V31A is a comprehensive instrument for checking the condition of cathode-ray tubes. Virtually all types of colour and monochrome tubes are catered for, and a reactivation facility is provided. A V31A has been in use here for some years, and has proved invaluable.

For monochrome c.r.t. testing, B7G and B8H bases are provided, covering modern c.r.t.s, while the older (B12A) base is available as a kit with fitting instructions. Three heater voltages are preset by a switch, while heater current is set by a front-panel mounted potentiometer, and monitored on the panel meter. This has the advantage that present or future c.r.t.s with odd heater voltages can be accommodated. These potentiometers tend to go 'junky' and noisy in use in some older designs of c.r.t. tester, but no such trouble has been experienced in all the time we have had the V31A.

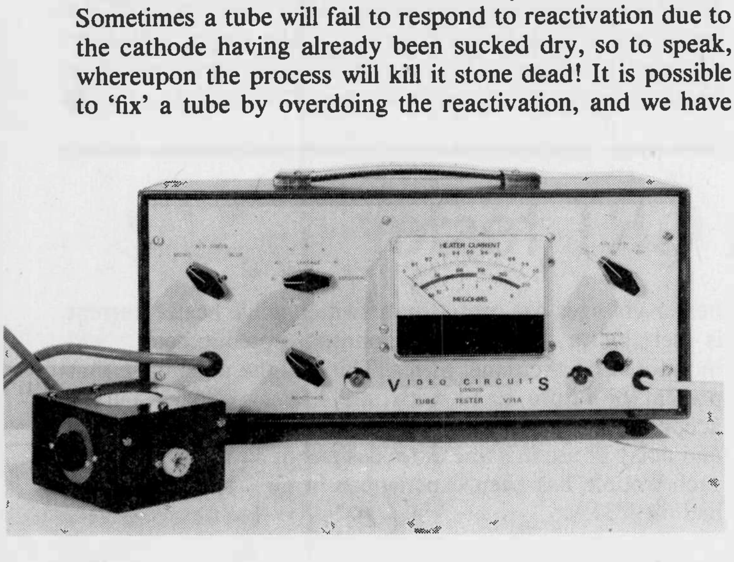
WHAT ELSE?

All gun faults that can develop can be detected with this instrument. Interelectrode leakage is read out in megohms with a suitable d.c. voltage present. We have found that intermittent electrode leakage faults can be provoked by slightly increasing the heater current and/or tapping the c.r.t. neck while the test is in progress. Open-circuit electrodes are revealed during the emission test. Cathode emission is indicated in microamps on the meter, which has green and red segments labelled 'low' and 'normal'. We have found that a good c.r.t. almost invariably produces a beam current of 230μA under the bias conditions provided by our tester, and this alone indicates the accuracy with which a c.r.t.'s condition may be estimated. For emission checks, the beam current is collected at the first anode, avoiding the necessity to make connection to the final anode cavity connector, which can be very inaccessible on some TV models.

A word of warning, here – the instrument renders the c.r.t. conductive during testing, which means that any potential on the final anode appears on the guns, now no longer earthed to the receiver chassis. The net result is that the potential between the receiver chassis and the tester becomes very high, and a nasty shock can result. The instructions supplied with the instrument regarding discharge of the c.r.t. capacitance should be strictly adhered to. When discharging a c.r.t. for this or any other purpose, the final anode must be discharged to the outer aquadag coating of the c.r.t. or the earthy side of the spark-gaps on the tube base. Discharging the anode direct to the receiver's metal chassis can result in the destruction of semiconductors.

Reactivation

The reactivation process has been described before in these pages, and put in a nutshell, consists of 'blasting' a forward current through the diode formed by the cathode and grid. This drags poisoned material off the cathode, thus revealing a new emitting surface. If this sounds rather crude and drastic, it is, but the process works surprisingly well in cases where there is sufficient emitting material remaining on the cathode. Reactivation should only be attempted where the emission test shows markedly low beam current. Sometimes a tube will fail to respond to reactivation due to the cathode having already been sucked dry, so to speak, whereupon the process will kill it stone dead! It is possible to 'fix' a tube by overdoing the reactivation, and we have found that three flashes of the indicator are sufficient to rejuvenate the tube without overcooking it.



Abridged specification

C.R.T. Base connectors: B7G, B8H (monochrome), B8H, B14G (colour). A B12A base is available in kit form as an optional extra.
Heater voltage: 4·0V, 6·3V, 12·6V.
Heater current: Set by rheostat and 0–1A meter.
Leakage tests: Between selected electrode and the rest strapped together, using 300V d.c. supply.
Emission tests: Beam current scale indicates tube condition.
Reactivate: Extends life of tubes that are not exhausted.
Power supply: A.C. mains 220-240V.
Size: 150 x 350 x 150mm (5·9 x 13·8 x 5·9in).
Weight: 4·9kg (10·8lb).
Price: £60.50 (plus VAT) including post and packing. B12A base kit £1.25 (plus VAT).
Further details are available from Video Circuits Ltd., 104 Salisbury Road, Barnet, Herts. Telephone 01-449 3087.

Colour CRT Testing

A standard B14G base is provided for conventional colour tubes, together with a B8H base for Trinitron and similar tubes. Each gun is tested separately by means of a selector switch, and the previously described leakage and emission checks can be carried out on each individual gun. A common cause of inability to achieve good grey-scale tracking is impaired emission of one of the three guns, and comparisons may be made between the performances and warm-up times of the guns. Reactivation of colour tubes may be carried out in the same way as for monochrome c.r.t.s, and therein lies the greatest value of the V31A.

Construction

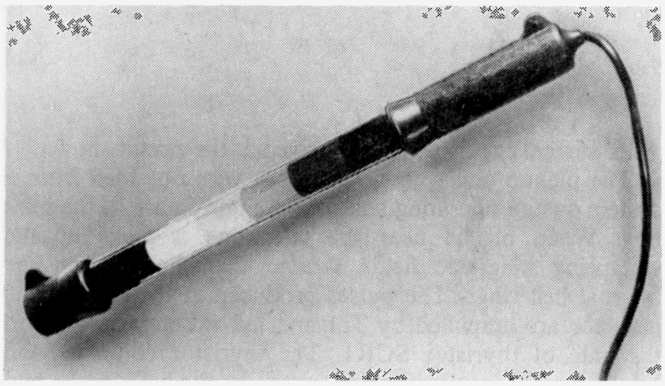
The instrument is readily portable, being housed in a stout steel case. Four multi-position switches select ranges and function, and a pilot light and reactivate indicator are provided. The large moving-coil meter gives clear legible readings. The c.r.t. sockets are mounted on the faces of a steel box which connects via a multicore cable to the instrument proper. Internal construction consists mainly of wiring and switches, the principal component being the mains transformer. With so little to go wrong, a long trouble-free life may be expected, the only vulnerable components being the c.r.t. socket pins themselves. The bases can be easily replaced however.

Conclusion

This instrument is one of the most practical and useful pieces of equipment we have come across. The reactivation process can, under good conditions, prolong the life of a c.r.t. for two years or more in our experience, and with colour c.r.t.s especially this represents a great financial advantage. Certainly ours has paid for itself many times over. ●

WHAT ELSE?

Fisher Color-trak



Probably the most common of all defects in colour receiver pictures in the home is incorrect grey-scale reproduction. Accurate tracking of the three colour guns is fundamental to good colour reproduction. The composite colour picture is built upon the basic monochrome picture, and in isolation the subjective effect of poor tracking is to degrade the colour picture in a rather subtle way, so that while the reproduction does not look right it is difficult sometimes to say precisely why. The situation might be likened to that of a house built on a sloping foundation!

The colour of the ambient light in the viewing area has a great bearing on the apparent colour rendering, and while the engineer has no control over this, he can ensure that the white tone of the reproduced picture is correct. It is significant that the broadcast authorities regularly check their monitors with a similar, if more elaborate, instrument to that described here.

Grey-scale adjustment is surprisingly difficult if perfection is aimed at, even more so if the c.r.t. concerned has impaired emission on one or more guns, slight though this may be. When the cathode surface becomes tired in a c.r.t. gun, the characteristic curve of the triode formed by the first three electrodes (cathode, grid, first anode) becomes markedly non-linear. To put it another way, the shape of the curve alters as well as its slope, so that the conventional drive and background controls are unable to fully compensate for this effective change in the gamma law. The classic symptom of this is the situation where, at the best possible setting of the tracking controls, one colour is predominant in highlights and near cut-off, but weak in the middle of the scale. This state of affairs is often noticeable in varying degrees in a tube nearing the end of its life. Where there is doubt about the emitting qualities of a colour tube, a quick check may be made by strapping the cathodes and/or grids together, after having removed the colour from the signal. Provided there are no faults in the driver circuits, this will do no harm, and will help to prove any suspicion of a curved gun characteristic.

Abridged specification

White point: Illuminant D6500.
Fluorescent tube rating: 8W.
Power supply: A.C. mains 220/240V, 50/60Hz. (Or 110V)
Size: 41mm dia. x 432mm (1·63 x 17in) plus 3·6m (12 ft) mains lead.
Weight: 0·45kg (1lb).
Price: £18.00 (plus VAT)
Further details are available from Fisher-Karpark Ltd., Brearley Works, Luddendenfoot, Halifax, Yorks. Telephone Calder Valley (042 283) 2711.

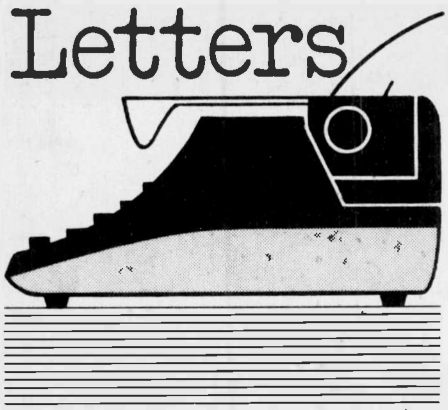
Adjusting Tracking

The correct white for television reproduction is warmer than that displayed on most monochrome c.r.t.s. The problem is to decide when the highlight is right! The Color-Trak is basically a fluorescent tube with three neutral-density filters to give four discrete steps of decreasing intensity light at a colour-temperature of 6,500K. Drive controls are adjusted to match the reference on the brightest part of the picture, and the first anode potentials are set up to ensure that the three guns cut off together at black-level, thus producing correct tracking in the lowlights. When this has been done, it may be found that the mid-greys are tinted (even with a c.r.t. in good condition) in which case a slight compromise is necessary to achieve the best possible overall grey-scale performance.

Construction and Use

The fluorescent tube is mounted in an acrylic tube whose ends are protected by rubber caps, one of which forms the handle. A useful twelve feet of lead is provided, with the control gear in a tough rubber-bound capsule near the cable end. The colour-temperature is a characteristic of the fluorescent-tube phosphor, so that it is independent of mains supply voltage and ambient temperature variations. The tube is replaceable if necessary. This instrument is robust enough for field service, although we found that regular field use was rather a mixed blessing, in that customers expected their receivers to match the reference exactly. This was fine with a receiver in perfect condition, but sometimes, for reasons already explained, perfection could not be achieved, resulting in slightly strained relations!

The reference was found invaluable in the workshop and particularly in the demonstration showroom, where it is somebody's thankless task, once a month, to set up fifteen or twenty colour receivers of divers makes and models, to match each other. Like Gilbert and Sullivan's policeman, the technician's lot is not a happy one under such conditions, and the Color-Trak, by removing the guesswork, made this task a lot easier. ■



BRIDGE RECTIFIER FAULTS

With reference to L. Lawry-Johns' article on the GEC Junior Fineline portable, the symptom of severe hum bars is indeed very common. It is my experience however that the fault appears to be due to one leg of the bridge rectifier going open-circuit internally. If the hum bar is examined it will be seen that it is at 50Hz (one dark and one light band per field scan). This rules out the reservoir capacitor since if this is responsible the hum bar would be at 100Hz. I have noticed on several sets that this fault symptom appears suddenly a few minutes after switching on. Examining the bridge rectifier output with an oscilloscope on one of these sets revealed a sawtooth ripple at 100Hz when the set was first switched on, followed by a large amplitude train of 50Hz pulzes when the rectifier got warm and one leg went open-circuit. – **A. C. Davenport** *(Wilmslow Television Services, Wilmslow, Cheshire).*

L. Lawry-Johns comments: The point made is quite valid. The plastic type bridges do go open-circuit on one leg. Other sets use a metal body type bridge rectifier however and this leaks across one section – as a rule that is!

A point I should have mentioned in the article is that the AD149 voltage regulator transistor is replaced in many later sets with a tab type pnp transistor. This goes short-circuit at the drop of a hat.

EXTENSION PHONEBELL

The circuit shown in Fig. 1 may prove of interest to other readers. At our workshop we find that when the sun comes out the number of service calls drops off. We are a small team at a busy rental and repair business, so when this happens we take the opportunity to do odd jobs in and around the workshop for which time cannot be found during the busy winter months. Servicing the vans, repainting, repairing the roof, modifying aerial installations, etc. Although these jobs need to be done, the customers' main link with us, the telephone, must not be ignored. The need arises therefore for an extension bell that can be placed near where one happens to be working. Since fitting an extension bell across an internal telephone bell is frowned upon we decided to build something external. Some circuits we found consisted of microphone plus amplifier arrangements which are fairly complicated to build and consume a lot of power. So we set to work on designing something that suited us better.

After a delve into the junk box I found an old doorbell of the continuous ring type and decided that there ought to be a way of making it ring in sympathy with the telephone. After several experiments we arrived at the circuit shown.

The pickup coil was wound from wire obtained from a system switch operating solenoid – again found in the junk box. When placed near the telephone it picks up the collapsing magnetic fields around the phone when the internal bell rings. The pulses produced at the ends of the inductor are amplified by Tr1 and fed via capacitor C1 to the gate of thyristor SCR1. The thyristor conducts and brings the bell into operation – note that the bell's make and break contacts must be in circuit otherwise the thyristor will not switch off. R3 controls the amplitude of the gate pulses and thus the sensitivity of the circuit.

Battery life is long as the quiescent current is low (350μA). The device is highly portable and has proved to be quite reliable. Everything except the thyristor was found in the junk box, so the device can be built very cheaply. There are applications in the home as well of course. – **J. J. Herbert** *(Witham, Essex).*

BUSH TV161 SERIES

L. Lawry-Johns was certainly right about the line output transformers used in the Bush TV161 series. If the timebase is working on 405 but not on 625 the fault is sometimes on winding 12-13: disconnecting this at 12 or PS6-3 brings the timebase back to life on 625 lines but this may be only a temporary expedient.

A peculiar fault we had on one of these sets was intermittent loss of picture with the sound remaining o.k. The fault was inside the c.r.t. – grid pin 6 kept connecting itself to pin 5. Although not shown on the circuit diagram,

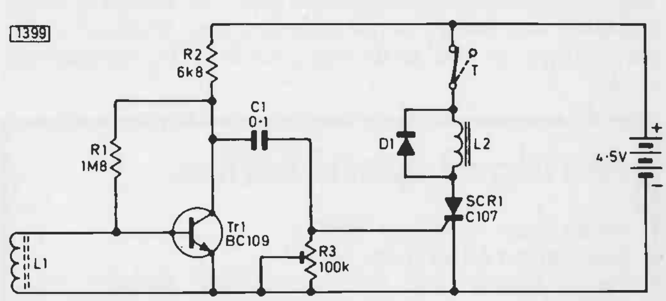


Fig. 1: Circuit diagram of the extension telephone bell, using pickup coil, devised by J. J. Herbert. The pickup coil L1 consists of 300 turns wound on a ferrite rod and placed near the telephone. T is the doorbell make and break contacts – these must be of the normally closed type – and L2 the doorbell solenoid. Diode D1 provides protection against back-e.m.f. spikes. Suitable batteries: three SP2 or a bell battery. The circuit can be easily built on a small piece of Veroboard and the bell made to plug in on a long lead.

pin 5 is connected to chassis. Thus the grid was being intermittently earthed, with loss of picture. Snipping the link cured the fault. – **H. Owens** *(N. Ferriby, N. Humberside).*

Editorial note: Later models in this series use tubes with a ring-trap connection to pin 5. This should not be disconnected.

MAKING SERVICING PAY

It was with great interest that I read your article entitled "making servicing pay" in the March issue of *Television.* As a small country firm, we have been operating on a rental/repair basis for two years since parting from our parent company, now a discount warehouse/electrical contractor. Our turnover has been slowly but steadily increasing since then. On the economic level, the rental income covers our wages, the profit coming from repairs. Overheads are minimal; our workshop is in disused railway premises (with the advantage of a large car park).

Repair work falls into several categories. Apart from the obvious maintenance work on our own sets, we repair items at a special trade rate for a growing number of shops and discount stores in a twenty mile radius. Servicing is also undertaken for members of the public, who are encouraged to bring items to the workshop themselves whenever possible. However, although we have to travel rather farther between calls than the city folk, we manage to make this service viable for less than £4 per call. Where possible, same day service is given on workshop jobs, a monochrome set being loaned free of charge in those cases where spares need to be obtained. Naturally, some repairs cost more than could reasonably be charged, notably those on small audio items; however, we consider that the extra advertising so gained attracts sufficient profitable work to more than offset the initial loss.

May I now be permitted (in true Lawry-Johns' style) to abruptly change the subject – to that of the City and Guilds dilemma? Of our staff of four souls, not one yet holds this qualification! Two of our number are attending the Technicians' course and, I should add, are rather disillusioned with it as they don't find it relevant to the job. Our comedian/boss was formerly an RAF radar technician, and I myself studied organic chemistry! Many thanks for your excellent magazine which, over the years, has supplied me with much of the theoretical background and practical insight necessary to turn a hobby into a trade. – **P. Dobson** *(Senior Engineer, Norfolk Service Centre, Attleborough, Norfolk).*

VIEWS ON COURSE 272

I read with interest the letters regarding the training of television service engineers in your February issue and agree wholeheartedly with Mr. Whitehead that the 272 Technicians' Course is just not suitable for those wishing to make a career out of servicing television sets. In my opinion it is more appropriate for those who aspire to designing electronic equipment.

Regarding the practical ability of students taking the 222 Mechanics' Course, I would like to point out that there is an RTEEB practical examination which is open to those who have passed the third year theoretical examination. The practical examination involves the location of faults in a logical manner on three pieces of electronic equipment – usually an audio amplifier, transistor radio and monochrome TV receiver. There is also a measurements section in which the candidate has to show that he is capable of using various test instruments correctly, including an oscilloscope. Last but not least there is a test on the candidate's soldering ability.

Returning to theory, the Part III (fourth year) examination is of a significantly higher standard than in the preceeding years. It is concerned exclusively with television, and goes into colour circuitry in some detail.

To conclude, while I agree that there is a need for a course along the lines of the old Course 48 I nevertheless feel that anyone who manages to obtain the Part III certificate of Course 222 together with the RTEEB practical certificate should be regarded as reasonably competent, able to repair television sets on his own and certainly not just a panel changer. – **Michael Thomas** *(Brixham, Devon).*

May I as a student who took the City and Guilds 272 Radio, TV and Electronics Technicians' Course described by Mr. Whitehead as "unattainably high to the average TV service apprentice" and "not geared to the requirements of the trade" say that I disagree. I believe that apart from the maths at the beginning of the course it is not very much different from the old Television Servicing Course. The 272 Course seemed very good though lacking in practical work – this can be made up for at work during the course however. It seems to me that the course provides the background knowledge required for servicing modern colour receivers etc.

There will always be some students who lack motivation – but can this perhaps be confused with boredom? A good lecturer will help towards making a good technician. All too often unfortunately lecturers are out of touch with the latest developments, often being five years behind. As a result they skip over some areas, with the result of low passes.

I agree with a course lasting four-five years but think that a pass in the City and Guilds is too easily come by, the lowest pass being 45%. In consequence low grade servicemen are labelled "technicians". **A. J. Green** *(Mundesley, Norwich).*

TANDBERG CTV1

I read with interest your suggestions in the April *Your Problems Solved* for dealing with the problem of intermittent sound on a Tandberg Model CTV1 since I have had extensive experience of this chassis. The fault is in nearly all cases due to a dry-jointed or internally intermittent 2N3055 audio output transistor – which appears to lead a hard life in this chassis. Replacing the transistor effects a cure in almost all cases.– **J. F. Foulkes** *(Sidcup, Kent).*

RELAY STATION OPENINGS

The following three relay stations are now in operation:
Cerne Abbas (Dorset) BBC-1 channel 22, ITV (HTV West) channel 25, BBC-2 channel 28. Receiving aerial group A.
Keswick (Lake District) BBC-1 channel 21, ITV (Border TV) channel 24, BBC-2 channel 27. Receiving aerial group A.
Llandrindod Wells (Powys, Wales) BBC-Wales channel 39, BBC-2 channel 45, ITV (HTV Wales) channel 49. Receiving aerial group B.

These relay transmissions are vertically polarised.

HOW THYRISTOR LINE OUTPUT STAGES WORK

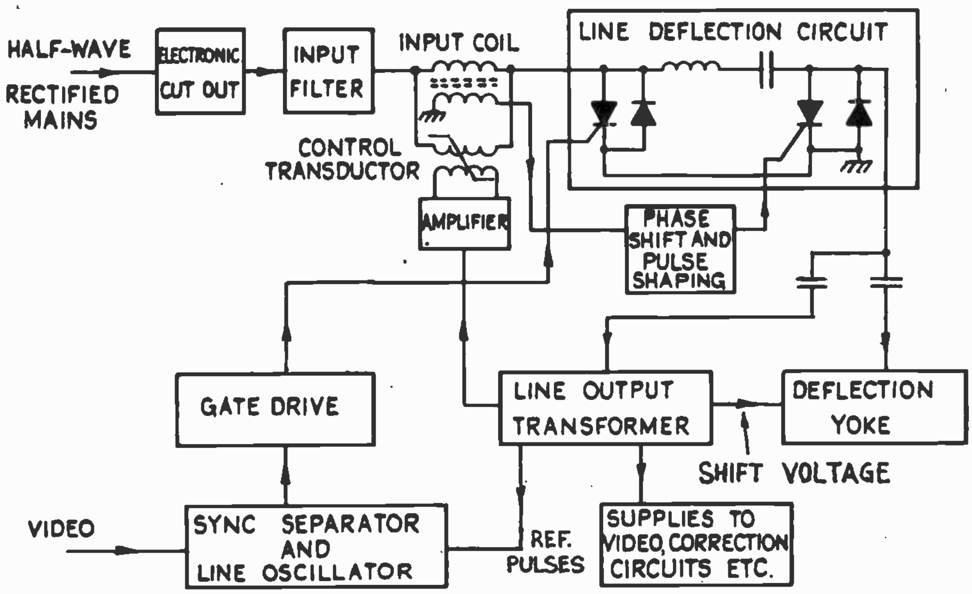
G. R. Wilding and J. A. Reddihough

LINE output stages operate on the same basic principle whether the active device used is a valve, transistor or thyristor. As a starting point, let's remind ourselves of this principle, which was first developed by Blumlein in 1932. The idea in its simplest form is shown in Fig. 1. The scan coils, together with a parallel tuning capacitor, are connected in series with a switch across the h.t. supply. When the switch is closed – (a) – current flows through the coils, building up linearly as required to deflect the beam from the centre to the right-hand side of the screen. At this point the switch is opened. The coils and the capacitor then form a resonant circuit. The magnetic fields generated around the coils during the preceeding forward scan as current flowed through them when the switch was closed now collapse, charging the capacitor – (b). As a result of the resonant action the capacitor next discharges, driving current through the coils in the opposite direction – (c). Once more magnetic fields are generated around the coils. This resonant action lasts for one half-cycle of oscillation, during which the beam is rapidly deflected from the right-hand side to the centre and then to the left-hand side of the screen. The flyback is thus complete. If the switch is now closed again further oscillation is prevented and, as the magnetic fields around the coils collapse, a decaying current flows through them in the direction shown at (d). This decaying current flow deflects the beam from the left-hand side of the screen back towards the centre: the period during which this occurs is often referred to as the energy recovery part of the scanning cycle. When the current has decayed to zero we are back at the situation shown at (a): the current through the coils reverses, driving the beam to the right-hand side of the screen. This is a very efficient system, since most of the energy drawn from the supply is subsequently returned to it. There is negligible resistance in the circuit, so there is very little power loss.

Basic Transistor Circuit

In Blumlein's day valves had to be used to perform the switching action. Two were required since a valve is a unidirectional device, and as we have seen current must flow through the switch in both directions. Nowadays we generally use a transistor to perform the switching action, arranging the circuit along the lines shown in Fig. 2. The line output transformer T is used as a load for the transistor and as a simple means of generating the e.h.t. and other supplies required by the receiver. The scan-correction capacitor Cs also serves as a d.c. block. Capacitor Ct tunes the coils during the flyback when the transistor is cut off. During the forward scan Cs first charges, then discharges, via the scan coils, thus providing deflection from the left-hand side to the right-hand side of the screen.

One advantage of a transistor is that it can conduct in either direction. Thus unless we are operating the stage from an l.t. line of around 11V – as in the case of many small-screen portables – we don't need a second switching device. With a supply of 11-12V a shunt efficiency diode – connected in parallel with the transistor, cathode to collector and anode to emitter, is required because the linearity is otherwise unacceptable. Another advantage of a transistor compared to a valve is that it is a much more efficient switch. When a transistor is saturated both its junctions are forward biased and its collector voltage is then at little more than chassis potential. The anode voltage of a



Block diagram of a thyristor line timebase, showing how it fits into the complete receiver circuit. Stabilisation is achieved by using a transductor to control the input power. Any supplies derived from the line output transformer will also be regulated therefore. Courtesy ITT.

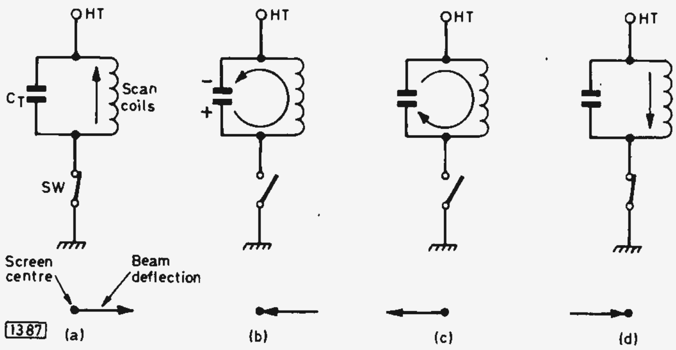


Fig. 1: Basic Blumlein line output circuit, which acts as a tuned circuit during the flyback period. (a) When the switch is closed a linearly increasing current flows through the scan coils in the direction shown, deflecting the beam to the right-hand side of the screen. Magnetic fields build up around the coils. (b) When the switch is opened the magnetic fields collapse, charging the tuning capacitor. The beam returns rapidly to the centre of the screen. (c) The capacitor then discharges via the coils, rapidly deflecting the beam to the left-hand side of the screen to complete the flyback. The circuit energy is once again stored in the form of magnetic fields around the coils. (d) If the switch is now closed, no further oscillatory action can take place and as the magnetic fields collapse a decaying current flows through the coils in the direction shown, deflecting the beam from the left-hand side of the screen towards the centre. This is known as the energy recovery part of the scanning cycle.

saturated pentode however is measured in tens of volts, and this means that there is considerable wasteful dissipation.

Thyristor Switch

If what we need is an efficient switch, why not use a thyristor? Thyristors are even more efficient switches than transistors. They are more rugged, can pass heavy currents, and are insensitive to the voltage overloads that can kill off transistors. In addition, in the sort of circuit we are about to look at the power supply requirements can be simplified (a line output transistor must be operated in conjunction with a stabilised power supply: this is not necessary in the thyristor circuit since regulation can be built in). In the nature of things however there must be disadvantages as well – and there are! First, a thyristor will not act as a bidirectional switch. There is no great problem here however: all we need do is to shunt it with a parallel efficiency diode. More awkward is the fact that once a thyristor has been triggered on at its gate it cannot be switched off again by any further action taken in its gate circuit. In fact it's this problem of operating the thyristor switch that is responsible for the complexity of thyristor line output circuits. A thyristor can be switched off only by reducing the current through it below the "hold on" value, either by momentarily removing the voltage across the device or by passing an opposing current through it in the opposite direction – this latter technique is used in practical thyristor line output circuits. Once the reverse current through the thyristor is about equal to the forward current flowing through it the net current falls below the "hold on" value and the thyristor switches off.

Basic Thyristor Circuit

There is more than one way of arranging a thyristor line output stage. Only one basic circuit has been used so far however, though as you'd expect there are differences in detail in the circuits used by different setmakers. The basic circuit was first devised and put into production by RCA in the USA in the late 1960s. It was subsequently popularised in Europe by ITT, and many continental setmakers have used it, mainly in colour receiver chassis fitted with 110° delta gun c.r.t.s. They include Finlux, Grundig, Saba, Siemens and ASA. Korting use it in their 55636 chassis which is fitted with a 90° PIL tube, while Grundig continue to use it in their latest sets which use the Mullard/Philips 20AX tube. Amongst Japanese setmakers, Sharp use it in their Model C1831H which is fitted with a Toshiba RIS tube.

Reduced to its barest essentials, the circuit takes the form shown in Fig. 3. To start with this looks strange indeed! The right-hand side however is simply the equivalent of the scanning section of the transistor circuit shown in Fig. 2, with TH2 and D2 replacing the transistor as the bidirectional switch. The tuning capacitor however is returned to chassis via the left-hand side of the circuit – in consequence there is no d.c. path between the right-hand and left-hand sides of the circuit. L1 provides a load. The efficiency diode D2 conducts during the first part of the forward scan, after which TH2 is switched on to drive the beam towards the right-hand side of the screen.

The purpose of the left-hand side of the circuit, the bidirectional switch TH1/D1 and L2, together with the tuning capacitor Ct, is to switch TH2 off and to provide the flyback action. The output from the line oscillator consists

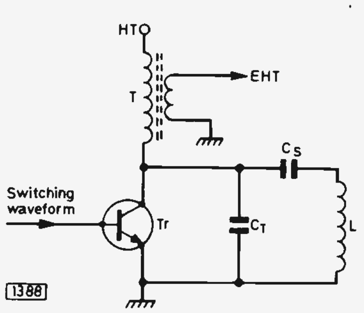


Fig. 2: Transistor line output stages usually take the form shown here. The transistor acts as a bidirectional switch, acting as efficiency diode (energy recovery) during the first half of the forward scan, then driving current through the primary of the output transformer T during the second half of the forward scan. Ct tunes the coils – L – during the flyback, while the scan-correction capacitor Cs charges and discharges during the forward scan to drive current through the scan coils.

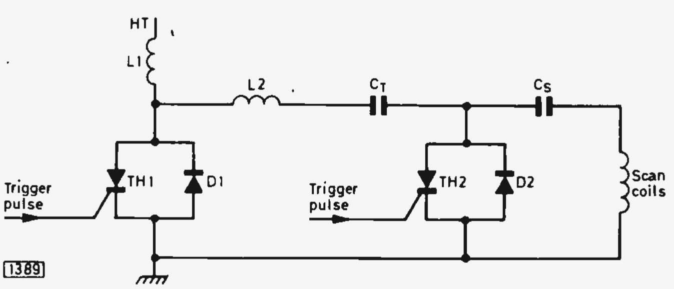


Fig. 3: The thyristor line output circuit developed by RCA, shown here stripped to the barest essentials. There are separate bidirectional forward scan and flyback switches – TH2/D2 and TH1/D1 respectively. The tuning capacitor is returned to chassis via the flyback switch. TH1 is switched on just before the flyback, current then flowing into Ct via L2: L2 and Ct form a tuned circuit, the pulse thus produced being used to switch off TH2. Ct tunes with L2 to produce the pulse to switch off TH2 (the commutating pulse), and with the scan coils to provide the flyback.

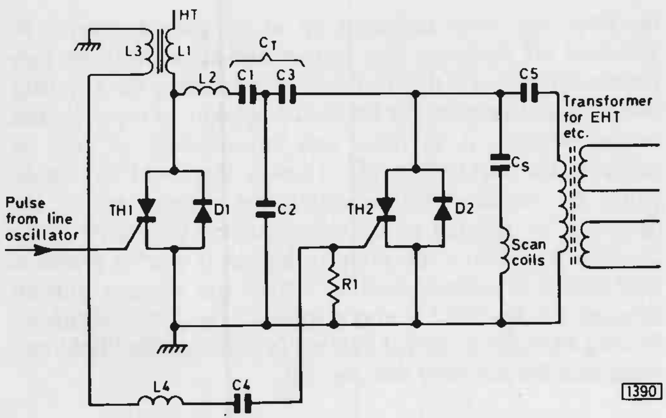


Fig. 4: A more practical form of thyristor line output stage. The tuning capacitor consists of three capacitors in a T network so that the working voltages can be reduced. C5 couples a transformer to the circuit to enable the flyback pulse to be used for the generation of e.h.t. and other supplies. The trigger pulse for TH2 is obtained from a secondary winding wound on L1, with shaping by means of L4, C4 and R1.

of a brief pulse to initiate the flyback. It occurs just before the flyback time (roughly 3μS before) and is applied to the gate of TH1, switching it on. When this happens L2 is connected to chassis and current flows into it, discharging Ct (previously charged from the h.t. line). L2 is called the commutating coil, and forms a resonant circuit with Ct. Thus when TH1 is switched on a sudden pulse builds up and this is used to switch off TH2. In addition to tuning L2, Ct tunes the scan coils to provide the usual flyback action. Roughly speaking therefore D2 and TH2 conduct alternately during the forward scan and are cut off during the flyback, while TH1 is triggered on just before the flyback, TH1 and D1 subsequently conducting alternately during the flyback and then cutting off when the efficiency diode takes over.

Towards a Practical Circuit

A more practical arrangement is shown in Fig. 4. A secondary winding L3 is added to L1 to provide the trigger pulse for TH2: L4, C4 and R1 provide the pulse shaping required. The tuning capacitor Ct is rearranged as a T network: this is done to reduce the voltage across the individual capacitors and enable smaller values to be used, all in the interests of economy. And finally a transformer is coupled to the circuit by C5 to make use of the flyback pulse for e.h.t. generation and to provide other supplies. In many recent chassis TH1/D1 and TH2/D2 are encapsulated together, in pairs.

In practical circuits L1 and L2 generally consist of a single transformer – often a transductor is used, for convenience rather than for the transductor characteristics. This makes practical circuits look at first glance rather different to the basic form shown in Figs. 3 and 4. A further winding is often added to the transformer to provide a supply for other parts of the receiver, making the circuit look even more confusing. In addition e.h.t. regulation, pincushion distortion correction and beam limiting circuitry is required, and protection circuits may be incorporated.

Scanning Sequence

It's time to look at the basic scanning sequence in more detail, basing the description on Figs. 3 and 4. We'll start at the beginning of the flyback. TH2 and D2 have just been switched off – we'll come to how this is done later – while TH1 which was triggered on by a pulse from the line oscillator is still conducting. Energy is stored in the scan coils in the form of magnetic fields. As these collapse, a decaying current flows via the coils, Cs, Ct, L2 and TH1. When this current falls to zero the charge on Ct will have reversed and TH1 will switch off. This completes the first half of the flyback. The left-hand plate of Ct is charged negatively, while its right-hand plate carries a positive charge. D1 is now biased on and Ct discharges back into the scan coils to give the second half of the flyback. Current is flowing via D1, L2, Ct, Cs and the scan coils. At the end of this period the circuit energy will have been transferred once again to the scan coils – in the form of magnetic fields. One complete half cycle of oscillation will have occurred, returning the beam to the left-hand side of the screen. With Ct discharged, D1 switches off. The oscillation tries to continue in the negative direction, but we then get the normal efficiency diode action, i.e. D2 conducts shorting out the tuned circuit. As the fields around the coils collapse a linearly decaying current flows via the coils, Cs and D2. This gives us the first part of the forward scan. Towards the centre of the screen TH2 is switched on by the pulse obtained from L3 and the current in the scan coils reverses to complete the scan.

Switching the Scan Thyristor Off

The tricky part is when it comes to switching TH2 off. As we have seen, TH1 is triggered on about 3μS before the end of the forward scan. Prior to this Ct will have been charged to the h.t. potential via L1 and L2. When TH1 conducts, current flows via TH1, L2, Ct and TH2 (which is on remember). Because of the tuned circuit formed by L2 and Ct, the current builds up rapidly in the form of a pulse – the commutating pulse shown in Fig. 5. When this current, which flows through TH2 in the opposite direction to the scan current, exceeds the scan current TH2 switches off. Once TH2 cuts off D2 is able to conduct – it is no longer reverse biased – which it does for a short period to provide an earth return path for the remaining duration of the commutating pulse and also to enable the scan to be completed (Cs discharging via the scan coils). When the reverse, commutating current falls below the scan current D2 switches off and we then get the flyback action as the magnetic fields around the coils collapse.

Transferring Power

During the forward scan Ct is charged via L1 and L2, its right-hand plate being held at little above chassis potential

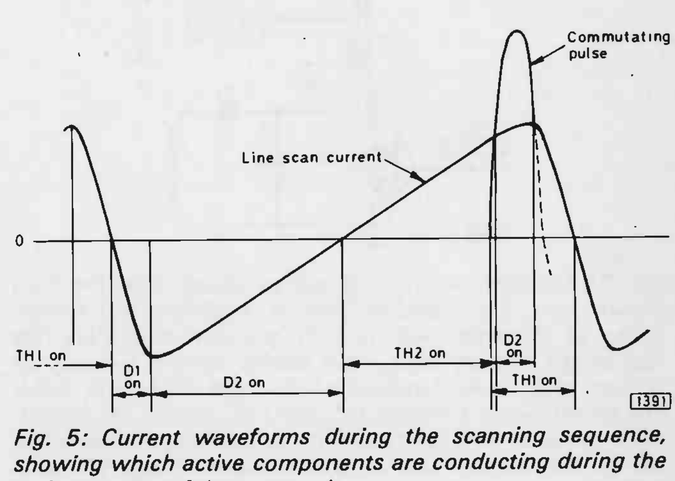


Fig. 5: Current waveforms during the scanning sequence, showing which active components are conducting during the various stages of the scan cycle.

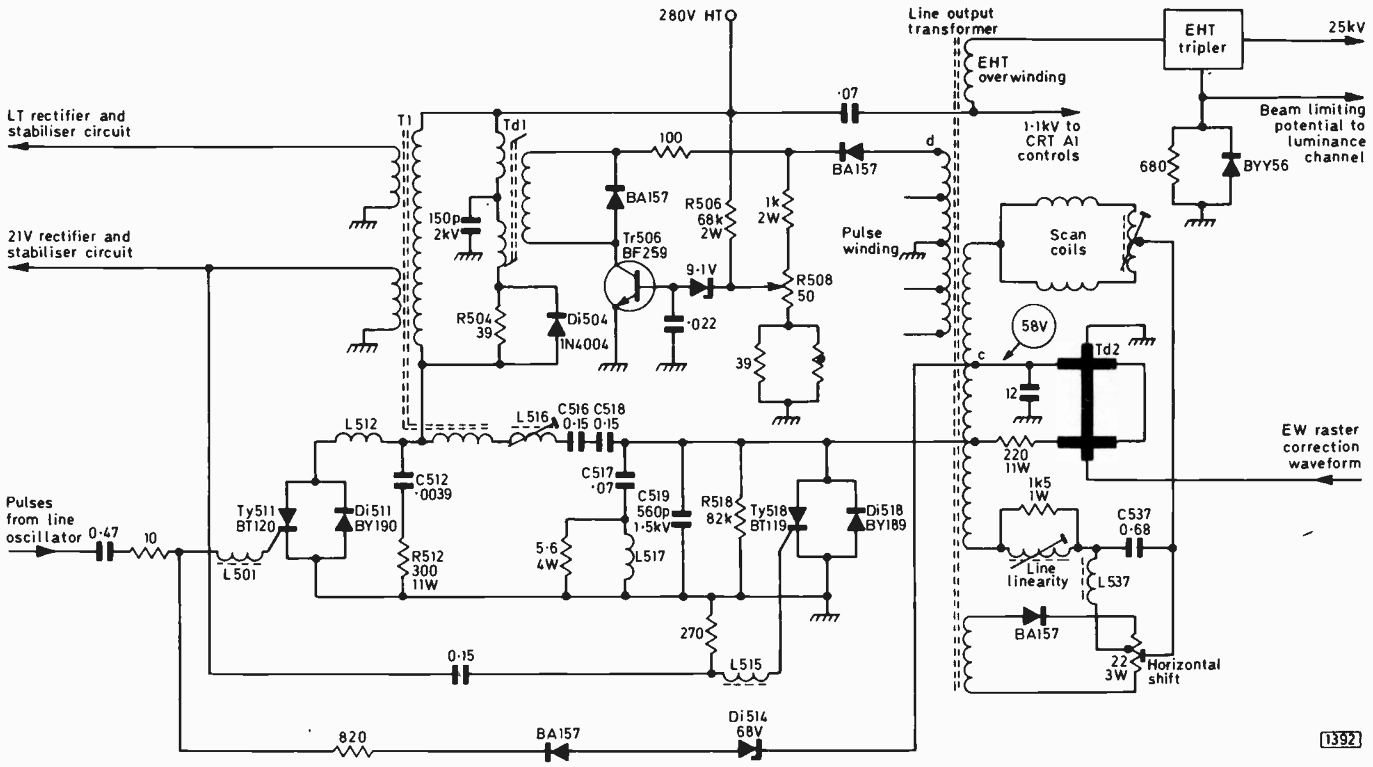


Fig. 6: A practical thyristor line output circuit – as used in the Grundig Models 5011 and 6011. Width/e.h.t. stabilisation is achieved by shunting a transductor (Td1) across the input transformer. The impedance presented by Td1 is controlled by Tr506 which senses the h.t. voltage and the pulse voltage at tag d on the line output transformer. R518 provides circuit damping; C519 provides pulse suppression to remove a shading effect across the screen.

through the conduction of D2 and then TH2. During the flyback, when TH1 and D1 conduct alternately, connecting the junction L1, L2 to chassis, Ct supplies energy to the scan part of the circuit.

Practical Circuit

So much then for the basic circuit and its action. Turning now to a practical circuit, Fig. 6 shows the thyristor line output stage used in the Grundig Models 5011GB and 6011GB. Ty511/Di511 form the flyback switch, T1 is the input/commutating transformer, C516/7/8 comprise the tuning capacitance, Di518 is the efficiency diode and Ty518 the forward scan thyristor. The scan-correction capacitor Cs is C537. As can be seen, the line output transformer circuit is quite conventional. The main complication arises because of the need to provide width/e.h.t. stabilisation. In a valve line output stage it is a simple matter to achieve stabilisation by using a v.d.r. in a feedback circuit to alter the bias on the output pentode. We can't do this with a transistor line output stage, so we have to operate this in conjunction with a stabilised supply. There is a subtle but quite simple method of applying stabilisation to a thyristor line output stage however. As we have seen, the energy supplied to the output side of the circuit is provided by the tuning capacitors when they discharge during the flyback period. During the forward scan they charge via the input coil – or transformer as it is in practice. Now if we shunt the transformer's input winding with a transductor we can control the inductance in series with the tuning capacitors and in consequence the charging time of the capacitors and hence the power supplied to the output side of the circuit.

EHT/Width Stabilisation

The stabilising transductor in Fig. 6 is Td1, whose load windings are connected in series with R504/Di504 across the input winding of T1. The transductor's control winding is driven by transistor Tr506, which senses the h.t. voltage (via R506) and the amplitude of the signal at tag d on the line output transformer. R508 in the transistor's base circuit enables the e.h.t. to be set to the correct voltage (25kV).

Miscellaneous Circuit Details

A fourth winding on T1 feeds the l.t. rectifier and stabiliser which provide the supply for the low-power circuits in the receiver. The trigger pulse winding also feeds a stabilised l.t. supply circuit (21V).

EW pincushion distortion correction is applied by connecting the load windings of a second transductor (Td2) across a section of the line output transformer's primary winding. By feeding a field frequency waveform to the control winding on this transductor the line scanning is modulated at field frequency.

There is a simple but effective safety circuit in this Grundig line output stage. If the voltage at tag c on the line output transformer rises above 68V zener diode Di514 conducts, triggering thyristor Ty511 into conduction with the result that the cut-out operates.

C517 is returned to chassis via a damped coil (L517) so that the voltage transient when the efficiency diode cuts off is attenuated. Likewise L512/C512/R512 are added to suppress the voltage transient when the flyback thyristor Ty511 cuts off. The balancing coil L516 is included to remove unwanted voltage spikes produced by the thyristors.

Conclusion

This Grundig circuit is representative of the way in which thyristor line output circuits are used in practice. There are differences in detail in the thyristor line output stages found in other setmakers' chassis, but the basic arrangement will be found to be substantially the same. ■

FAULT GUIDE: THORN 1580 CHASSIS

John Coombes

THREE mains-only portable sets from Thorn were fitted with the 1580 chassis, the **Ferguson** Model 3805, the **Marconiphone** Model 4805 and the **Ultra** Model 6805. It's a hybrid chassis, using valves in the field (PCL805) and line (PL81A, PY801, ECC82) timebases and the audio circuit (PCF80) and transistors in the rest of the circuitry. Two of the transistors, the video output (BF178) and sync separator (BC117) are operated from a 180V h.t. line, the rest being operated from a 20·5V line derived from the cathode circuit of the field output pentode. One consequence of this latter arrangement is that field collapse due to no current in the output pentode will remove the sound as well, though there will still be hum from the loudspeaker.

Line Output Stage

Most faults, some fairly common, are due to trouble of one sort or another in the line timebase – as you would expect. The circuit of the output stage is shown in Fig. 1.

Lack of Width

Lack of width is very often due to the PL81A line output valve being low emission. The other main cause is R141, which is in series with the slider of the width control, changing value – it goes from the correct 1·8MΩ to a very high value. In stubborn cases check the width control R142, its series resistor R143, and remember that the line oscillator and the coupling capacitor C96 could be responsible. If the scan-correction capacitor C90 goes short-circuit there will be a margin at the left-hand side. The other high-value resistor in the line output valve's grid circuit, R139, produces pincushion distortion when it goes high in value.

No EHT

There are several causes of no e.h.t. The boost capacitor C95 can go short-circuit, often ruining the PY801 boost diode. Very often however the problem is simply that choke L17 is open-circuit: it usually just breaks off at the connection to the top cap of the PY801. If the PL81A is cool check its screen grid resistor R137. If, when checking the line output stage, we find that there is plenty of spark at the top cap of the PL81A and also at the anode of e.h.t. rectifier W11 but no increased spark or possibly no spark at all at W10 cathode then the e.h.t. tray needs replacement. If on the other hand there is negligible or no spark at W11 anode but the PL81A seems to be operating normally the line output transformer is probably faulty. An overheating PL81A means lack of drive of course: check the ECC82 line oscillator valve and its cross-coupling capacitors (it's a multivibrator circuit). The other cause of lack of raster due to absence of e.h.t. is the width circuit pulse feedback capacitor C92: when this breaks down it often results in a local burn up.

Field Collapse

There are several things that can cause field collapse – a horizontal white line across the screen that is. The primary winding of the field output transformer T2 can go open-circuit (removing the sound as well for the reason already given). This is easily checked: the 205V HT4 supply should be present at one end while at the PCL805 end (pin 6) there should be 192V. The HT4 supply could well be absent however due to its smoothing resistor R135 (1·4kΩ) being open-circuit or alternatively the smoothing electrolytic C101 (100μF) being short-circuit. C101 is in the main electrolytic can mounted on the metal framework of the chassis. The valve itself could be responsible of course. Or

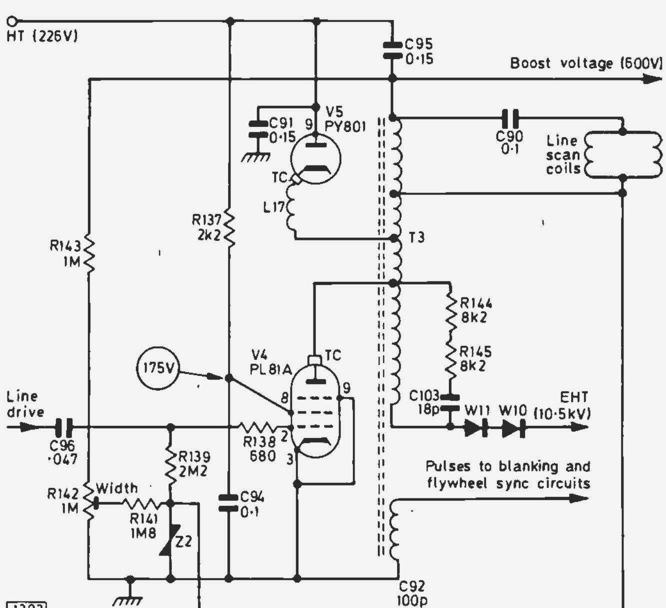


Fig. 1: The line output stage used in the Thorn 1580 chassis. This is quite conventional, with the boost reservoir capacitor C95 returned to the h.t. line. R144/R145/C103 form a damping network, C103 also providing third harmonic tuning.

C71 (1μF) which smooths the boost feed to the PCL805's triode anode (pin 1) could be shorting – C71 can also be the cause of intermittent field collapse. If C71 is short-circuit there will also be no sound – see "power supplies".

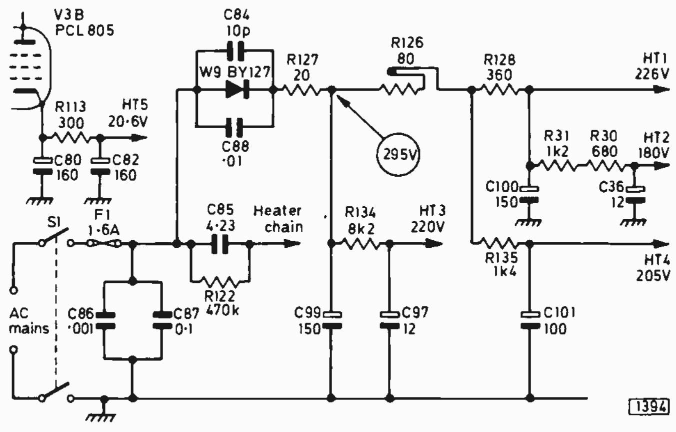


Fig. 2: The power supply arrangements used in the Thorn 1580 chassis. Capacitor C85 forms the heater circuit dropper, with R122 providing a discharge path. The field output pentode's cathode current is drawn via the low-voltage transistor circuits to provide the 20·6V supply (HT5).

Bottom Cramping

Foldover or cramping at the bottom of the picture is generally due to the output pentode's cathode decoupling electrolytic C80 (160μF) going open-circuit. Alternatively the field charging capacitor C81 (0·047μF) which as usual is returned to the cathode of the output pentode can leak with the same result. Whilst in this area note that C82 (also 160μF) which smooths the 20·5V transistor supply line can also dry up, causing hum bars and weak field hold.

In addition to being responsible for field collapse the PCL805 can also cause lack of height and cramping at the bottom due to loss of emission.

Sound Faults

No sound can be the result of the PCF80 audio valve being faulty. When the pentode section's cathode decoupling electrolytic C63 (25μF) goes short-circuit the result is either no sound or very low, distorted sound. Check the associated cathode resistor R90 (330Ω) in case it has overheated and changed value. The load resistor R83 (220kΩ) of the triode section of the valve can go open-circuit to cause absence of sound, and C71 can short to remove the sound – see "power supplies". The loudspeaker is responsible for its share of faults, from an off-centre coil producing distortion to the coil going open-circuit to remove the sound altogether. We've also had cases of no sound due to the primary of the output transformer T1 going open-circuit.

Prior to the PCF80 there is a single 6MHz amplifier/limiter transistor VT9 (BF197) which drives a ratio detector circuit. VT9 can go open-circuit, usually base to emitter, thus removing the sound signals. One of the ratio detector diodes may be found open-circuit – usually W6 – causing an above normal amount of distortion.

Sync Faults

Loss of sync is common on these sets, very often due to the sync separator transistor VT7 (BC117) which can go short-circuit or open-circuit. Its collector load resistor R43 (100kΩ) can increase in value to cause line and field slip. The line frequency is very often incorrect due to faulty flywheel line sync discriminator diodes (W3, W4 which have a common encapsulation), to the ECC82 line oscillator valve or to the cross-coupling capacitors leaking (C50 200pF, C51 47pF).

No Vision

No vision signal can be due to the video output transistor VT6 (BF178), the video driver transistor VT5 (BF197) or the electrolytic C32 (64μF) which couples the signal from the emitter of VT6 to the base of VT7. An open-circuit detector diode W1 (OA91) can also remove the video content.

Grain

The second, third and fourth i.f. amplifier transistors (VT2 BF196, VT3 BF194 and VT4 BF197) can all go faulty, resulting in grainy pictures or just grain. This fault can also be caused by the r.f. amplifier transistor (AF239) in the tuner unit.

AGC Faults

In the a.g.c. circuit the transistor (VT8 BC157) can be faulty, producing an uncontrollable picture with excessive black content. In cases of excessive gain, check whether the preset contrast control R62 is operating normally, then check the a.g.c. reservoir capacitor C54 (4μF). Note that the a.g.c. potential is applied to VT2 base and to VT1 base from VT2's emitter.

Power Supplies

The h.t. rectifier is W9 (BY127). This can short, blowing the mains fuse and removing the sound and the raster. The mains fuse (F1 1·6A) can also be blown by the mains filter capacitor C87 (0·1μF, 300V a.c.) shorting. The various wirewound smoothing resistors can go open-circuit, removing the supplies to various parts of the receiver. The power supply lines are as follows:

HT1 (226V) feeds the line output stage.

HT2 (180V) is derived from the HT1 line and feeds the video output and sync separator transistors and the line oscillator valve.

HT3 (220V) feeds the audio output pentode.

HT4 (205V) feeds the PCL805 field timebase valve. When this line is absent there will be no 20·5V (HT5) rail since this is derived from the cathode circuit of the PCL805's pentode section.

HT5 – see above.

HT6 (17V) feeds the first i.f. transistor VT1 and the a.g.c. amplifier. It is derived from the HT5 line.

The boost voltage is 600V and in addition to supplying the c.r.t. first anode and focus circuits and the field charging circuit supplies the triode anode of the PCF80 audio valve. Thus in the event of C71 which smooths the supply to the field charging circuit going short-circuit there will be no sound output either.

The heater chain is fed via a capacitive dropper (C85, 4·23μF). This must be replaced with an exact equivalent.

Circuit Diagram

The complete circuit was shown in the June 1973 issue of *Television*. ■

LONG-DISTANCE TELEVISION

ROGER BUNNEY

THE most interesting events in recent times have been the reception of the Indian ATS-6 satellite transmissions in the UK. One startling item of news this month is that although frequency modulation is used for the video signal Ian Beckett (Buckingham) has successfully received the signals using an ordinary DX-TV receiver – a former 14in. 405-line GEC set which Ian modified many years ago for more conventional DX reception, i.e. he added positive/negative video signal switching. This must make us think again about the problems of receiving these signals. Ian has constructed a five foot dish aerial and feeds the signals to the set via two masthead preamplifiers and a standard u.h.f. tuner.

Ian first received these signals on March 23rd, at 0555 BST. He comments that long camera shots are difficult to resolve, though close-ups can be made out easily – the spot on the announcer's forehead is quite distinct. The test card, patterns and other captions have been seen, though there tends to be some noise on the picture. Our conclusion is that receiving sufficient signal, not demodulating it, is the main problem. Ian's dish was made of two 80 × 36in. sections of $\frac{3}{4}\times\frac{5}{8}$in. wire mesh. The two sections were joined together and the corners cut off and rounded to form the dish shape. The diameter is some 63in. and the depth 14$\frac{3}{4}$in. The signal is picked up by a three-element array cut to 860MHz, with the dipole mounted at a distance of 27in. from the centre of the dish – the array faces back into the dish. The signal tends to lock at 625 lines with positive vision, but seems to change phase when tuning through the carrier. Initially Ian received signal information using an export type Sony receiver with a wideband i.f. strip. The first pictures were resolved when the narrow i.f. bandwidth GEC set was brought into operation. I'm sure that all enthusiasts will wish to join me in congratulating Ian on his achievement.

Aerials for Satellite Transmissions

Steve Birkhill, who was the first person to receive the satellite transmissions back in December, has sent us the basic circuitry he is using to receive and demodulate the signals (see Fig. 1). After passing through the masthead amplifier the signal is fed to a standard u.h.f. tuner. Steve comments that it may be necessary to repeak the oscillator circuit very slightly in order to reach ch. 70 (860MHz) and that all the other tuned circuits can be peaked towards the top end of the band since it is assumed that the tuner will be used only for this purpose. The tuner's i.f. output then passes via a simple two-stage i.f. amplifier to an NE561B phase-locked loop i.c. for demodulation. The output from this is at video frequency and can either be fed into a monitor or modulated back on to a u.h.f. channel for feeding to the aerial socket of a normal receiver. Since with most u.h.f. tuners the oscillator frequency is above the signal frequency it may be necessary to use a video inverter stage – a simple circuit using a transistor such as a BC147, with the signal fed to the base and the output taken via a switch from either the emitter or collector, can be used.

So far, I have not myself had success with my attempts to receive the ATS-6 signals. I am trying with a modified backfire array plus a two-stage masthead amplifier, mounted at 30ft. (to clear nearby buildings at my location), feeding a u.h.f. tuner taken from a Bush Model TV125. The i.f. output from this is fed to vision selectivity and gain modules from the Philips G8 chassis. The gain unit has been modified by removing the detector diode, the output

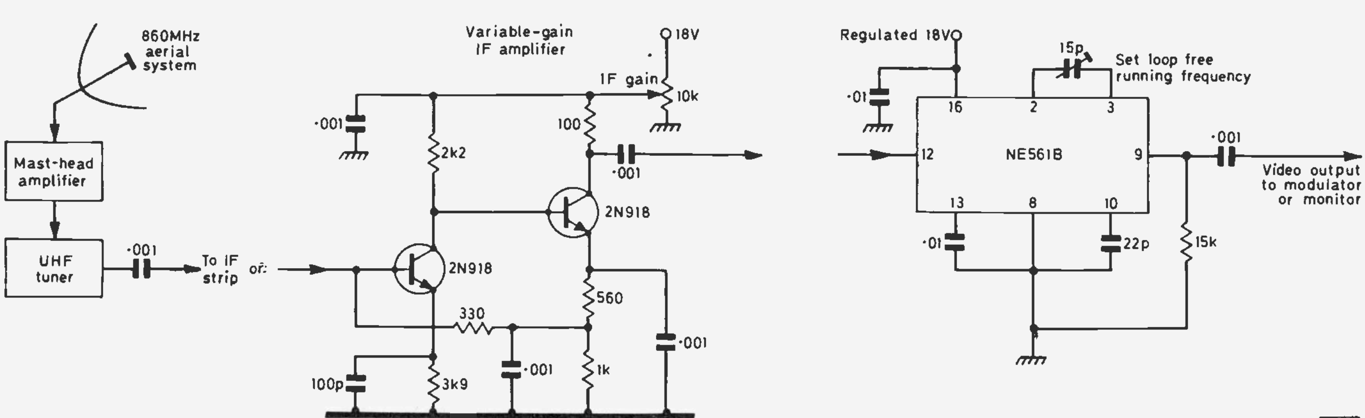
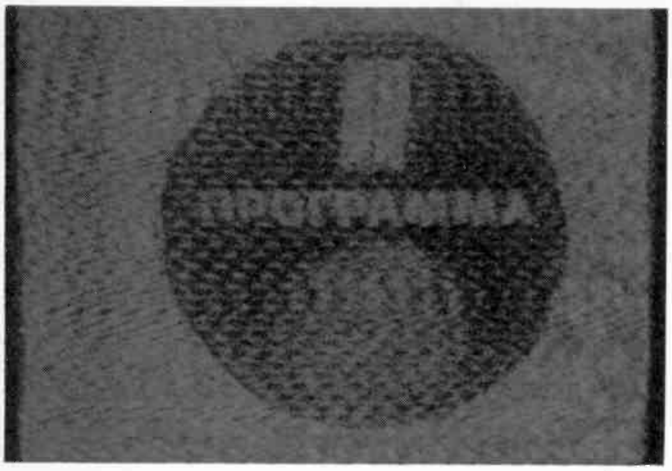
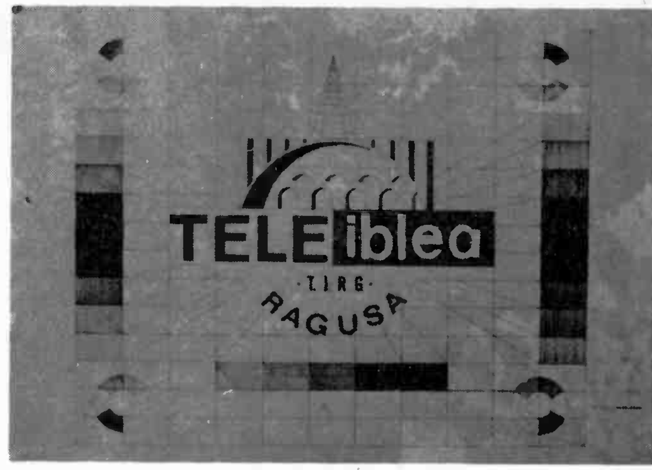


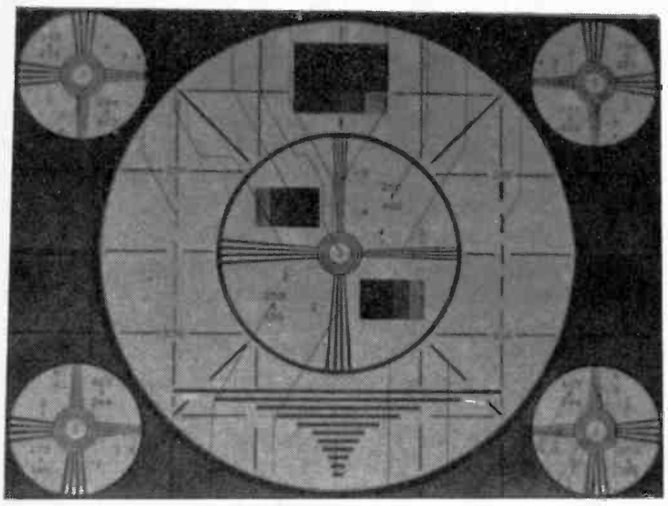
Fig. 1: Steve Birkhill's receiving system for the Indian ATS-6 satellite transmissions. The signal picked up by the dish passes via a mast-head amplifier to the u.h.f. tuner and then to either the two-stage i.f. amplifier shown above or a conventional i.f. strip. The amplified i.f. signal is demodulated by an NE561B phase-locked loop i.c.



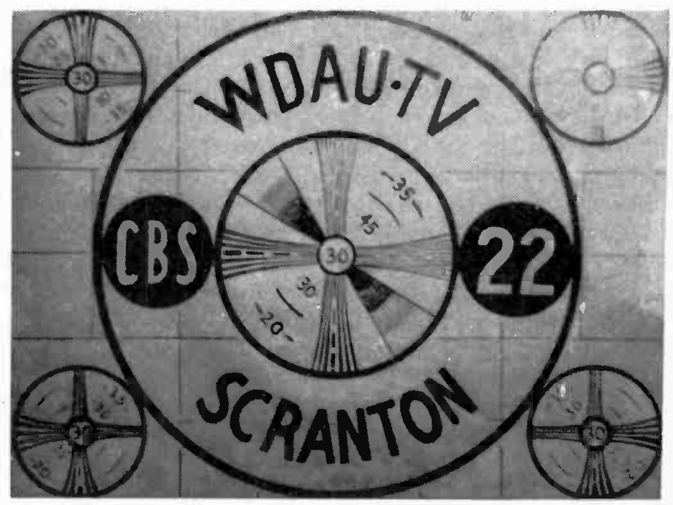
Clive Athowe's 1000-mile Band III Russian signal (ch. R12) received in the late 1975 'Great Tropospheric Opening'.



Test card of Tele Iblea 'Free TV station' on ch. E5. Photograph courtesy Michele Dolci.



An electronically generated Japanese version of the "Indian Head" test card.



A variant on the "Indian Head" test card, commonly used in the USA. Photograph courtesy Keith Hamer.

being coupled to an NE561B i.c. via a 10kΩ preset. The demodulated output from this passes through a video amplifier, inverter and emitter-follower (all BC147 transistors) to a Manor Supplies u.h.f. modulator as used in their crosshatch generator kit. The receiver was completed last Sunday, but after seven days all I have successfully received are several signals originating on terra firma – mainly BBC-2 – considerable noise but nothing of a space nature! I hope to align the contraption using Ian's array, with its known performance, and then try again here. Any developments will be reported of course, and meanwhile our grateful thanks to Ian and Steve for their information. The March *Wireless World* contained an interesting report on reception of the ATS-6 transmissions in Eire and the UK.

Monthly Report

March wasn't a good month for reception here. MS (Meteor Shower) reception left much to be desired. There were SpE (Sporadic E) openings on the 2nd and 13th, with signals from the USSR on ch. R1 during the morning period. I also noticed CST (Czechoslovakia) on ch. R1 using the blank Fubk card, often floating with ORF (Austria) using the T05 card (0731 GMT). The Tropospherics lifted towards the end of the month, bringing in some W. German u.h.f. transmitters, E. German (DFF) Band III transmitters and many TDF (French) stations – one new one for me was the ch. E37 Boulogne outlet.

Clive Athowe (Norwich) and Keith Hamer (Derby) experienced Auroral reflections in the late afternoon of the 26th. There was characteristic reception from the North, including YLE (Finland), NRK (Norway), SR (Sweden) and TSS (USSR) on Band I channels. Auroral noises were heard up to the lower end of Band III.

News Items

The Canadian Technology Satellite was launched on January 17th with the aim of evaluating domestic reception of TV signals in the 11·7-12·2GHz band – the transmitter power is 200W. There will be ground tests during the spring and summer, and several hours of programmes daily during July and August.

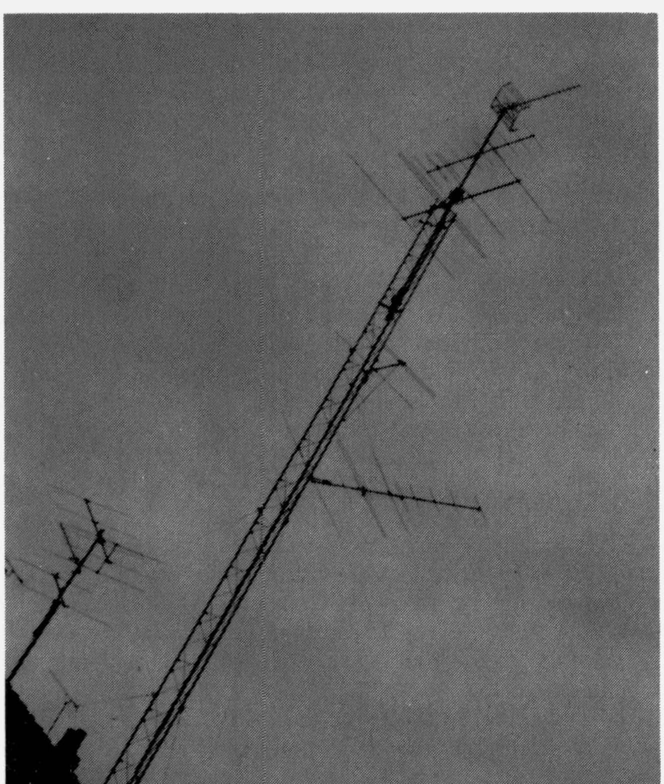
The Canadian broadcasting authorities have ruled that cable TV operators who receive and relay US TV signals must delete the commercials before piping the programmes through their networks. This has upset some US TV stations which have been obtaining considerable advertising revenue from Canada. Three stations have applied to the FCC for permission to radiate co-channel jamming signals

LONG-DISTANCE TELEVISION

in the direction of Canada in order to deprive the Canadian CATV operators of signals – in fact this has gone as far as application for permission to erect a 500ft. tower for the purpose on the Lake Ontario coast. This would radiate a blank carrier, rendering the programme material unintelligible. The FCC has not refused the application so far, but the CATV operators are confident that even if the jamming is permitted relay operations can be maintained, if not off-air at Toronto then from elsewhere along the border with a relay back to Toronto via the Anik satellite. The proposed jamming on channels A2, 4 and 7 is still at the discussion stage and isn't likely to commence for several months. The FCC has checked the legal aspects to see whether such an application is allowable and says that such a licence could be issued. Our thanks to the WTFDA for this interesting insight on operations in N. America.

The first of a new series of ten synchronous satellites has been launched in the USSR. It's known as Ragouda (or Stationar 1) and is to be used to bring Moscow TV to all outlying areas of the USSR and to the whole of Europe. Two more will be launched this year and the remainder before 1980. It is intended that they will give global coverage of the 1980 Moscow Olympics.

Steve Birkhill has received signals at 1,100MHz from the Molniya-1 satellite network, but no TV. All television is thought to be handled by the Molniya-2 network.



New aerials and mast in my back garden. The guy wires are at 20 and 30 feet. (No, the mast isn't really at the angle shown here!)

From satellites to balloon TV. The Korean Educational Development Institute has purchased two quarter million cubic foot balloons to carry TV transmitters and aerials – and also an f.m. stereo radio transmitter. Two simultaneous TV services from the Seoul studio centre will be transmitted from the mooring site at Check-On. Each balloon will carry its own generator, telemetry and microwave link equipment: they will be tethered to the ground, riding at 10,000ft. Such a system has already been tried and tested – last year a similar balloon system was put into use in the Bahamas and remained stable even during hurricane force winds. The height of the balloons should give line-of-site coverage over almost 120 miles.

The French broadcasting authority TDF has announced plans for the start of first chain (TF-1) colour transmissions. The TF-1 service is at present transmitted on the 819-line system, but is also duplicated at times on 625 lines over the FR-3 network transmitters. A new chain of u.h.f. transmitters is to be installed for the TF-1 service, intended for completion in 1983. The 819-line transmissions will continue till then, after which the v.h.f. band will be reorganised.

Michele Dolci tells us that there has been an increase recently in the activities of "free" radio and TV stations in Italy. Of particular interest to us is the fact that two of the free TV stations could possibly be received in the UK during a suitable SpE opening. The powers used aren't known, but if Iceland ch. E2 with only 20W e.r.p. can be received here I'm sure those Italian outlets are possibles! Tele Bari and Tele Brindisi both operate on channel B (E4). They are both shown in an officially printed list. Apparently each station has its own test card, and although we have no photos of those used by the ch. E4 outlets the photos I have of cards used by other outlets are certainly distinctive. According to the list these transmitters operate in Bands I and III, at u.h.f., and an "in between" frequency – Tele Marsica on 300MHz.

In Brief

A bulletin in English/Dutch has been published by the European Testbeelden Foto Vereniging, and another is expected shortly. I hope to be able to give further news on this in a following column. The present bulletin reports that there is a Greek transmitter at Thessaloniki operating on channel E3.

Dieter Scheiba tells us that he has seen the Bayerischer Rundfunk on ch. E3 using the Fubk card with no identification. He's also seen the "SWF BADN 1" identification on ch. E2, the signal assumed to have originated from the SR transmitter at Gottelborner Hohe.

Bernard Lindenberger (W. Germany) tells us that he's seen the US Forces TV network using the SMPTE test card, though AFN generally use the RETMA 1956 card. He also tells us that the W. German second and third programme transmitters radiate identification slides at the full and half hours, the ZDF second chain discontinuing this at noon however. ZDF usually identifies each transmitter site, and the third programme generally shows the coat of arms of the area.

Finally, during the Tropospheric opening at the end of February the conditions were so good that the Hannington transmitter, which normally receives Rowridge ch. 27 off-air and relays it on ch. 42, actually relayed the Dutch ch. E27 Lopik transmitter test transmission! Hannington is unattended and is switched on by Rowridge. That'll give some idea of the strength of the Lopik transmission!

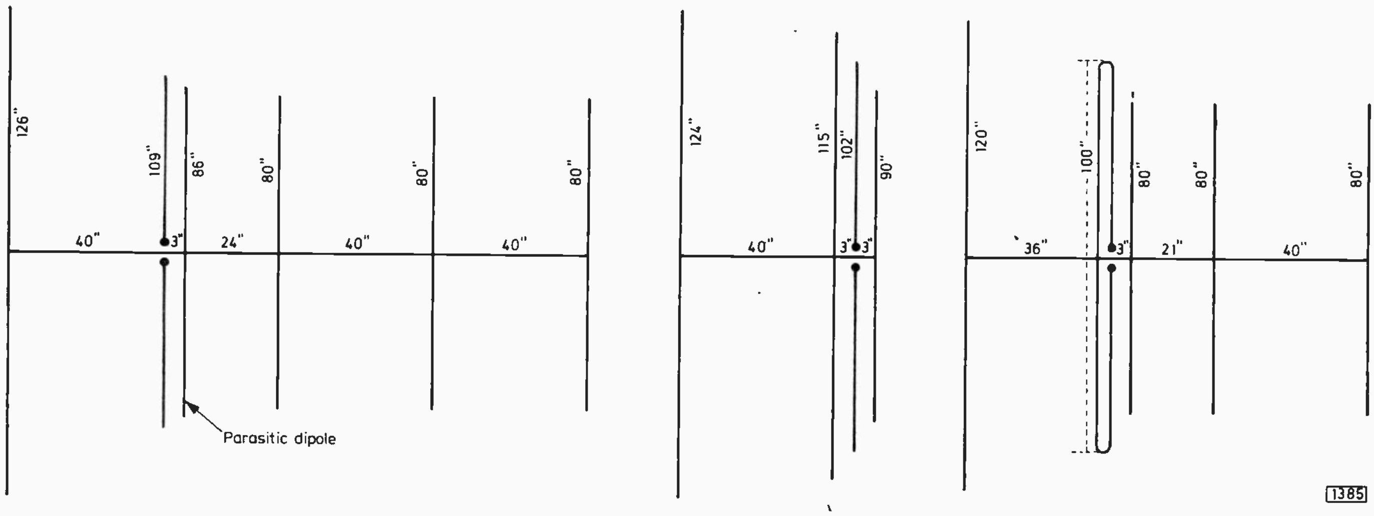


Fig. 2 (left): The Doug McFayden Band I aerial, covering New Zealand channels 1-3. Fig. 3 (centre): Ian Beckett's design for a small, wideband Band I array. Fig. 4 (right): My own recently-constructed Band I design, using a folded dipole.

Wideband Band I Aerials

The main problem with DX-TV reception in Band I is how to receive signals throughout the wide bandwidth. I last reviewed wideband Band I aerial theory and practice in the May 1972 *Television*. Since then Antiference have introduced a combined wideband Band I/III array which is known as the Interceptor MH308. It's an export model but we understand it's available to special order, the recommended price being £15·00 plus VAT. It certainly represents the easiest answer to wideband reception over the two Bands. I am testing one of these aerials at present and will report in due course.

If one has the time and aptitude one can always construct a wideband Band I array. All such arrays are a compromise of course, with the reflector cut to the low-frequency end of the required spectrum, the dipole cut to the mid-band frequency and the director(s) to the high-frequency end. There is also the problem of maintaining a good match to the cable over the bandwidth: quite sophisticated arrangements can be used to keep the feed as nearly resistive as possible. What I tend to do is to watch current commercial practice, read any books that become available on aerial theory, and from the two try out various experiments that I'm always hopeful will give even better performance!

Three new designs (see Figs. 2-4) are shown this month. They are variations on established themes however. Several other designs have been featured in past columns and those interested should find it worthwhile checking back. All have proved themselves to be effective during recent seasons.

The Doug McFayden aerial (Fig. 2) is designed to cover the New Zealand channels 1-3 (45·25-67·75MHz). Doug comments that reducing the parasitic dipole and the first director to 86in. gave good overall gain except at the h.f. end – this restricted the ch. 3 sound. Reducing the first director to 80in. broadened the bandwidth to include this. The spacing between the parasitic dipole and the first director seemed very critical: 24in. gave best performance, increasing this to 27in. affecting the overall definition. The reflector was eventually reduced to 126in., which set the l.f. limit without affecting the ch. 1 performance. Experiments were carried out using 27 and 30in. spacings for the first and second directors. These showed promise but problems arose over the spacing for further directors – it proved difficult to maintain good phase coupling along the director chain. It seems therefore that the design as shown provides the optimum performance over the operating bandwidth for this particular array.

Ian Beckett had been giving thought to a smaller wideband Band I array, and evolved the design shown in Fig. 3. This has a three-element dipole assembly and a reflector spaced at 40in. The three dipole elements are cut to channels E2, E3 and E4, the feeder being coupled to the E3 dipole. Like Doug's aerial, this is a variation on the "Tru-match" design (Antiference). Ian comments that the array performed very well during the 1975 season and has been left in position for the present season.

My own recently constructed aerial (Fig. 4) uses a mid-band folded dipole (a folded dipole has an inherently wider bandwidth) closely coupled to an h.f. parasitic dipole. Due to the 75Ω cable matching requirement very tight coupling between the dipoles had to be used in order to drop the centre impedance – a folded dipole will multiply the impedance by four times. To help further, the reflector spacing was reduced to $0{\cdot}15\lambda$ at the l.f. end and $0{\cdot}1\lambda$ spacing is used between the director and dipole elements. This is again a variation on the "Tru-match" principle.

Obtaining Aerial Parts

Many enthusiasts considering aerial construction may be deterred by the apparent problem of obtaining the necessary aerial hardware. Some aerial manufacturers will supply components, but none welcome orders for odd items. The simplest approach is to obtain a new Band I array and modify it, or alternatively obtain from your "local friendly aerial rigger" an old TV v.h.f. array he may have had to take down. Such an array will generally be corroded and in need of cleaning with emery cloth etc. The hard work involved will nevertheless be justified by the results.

We would be pleased to hear from anyone else who has constructed successful wideband arrays, with the hope of featuring in later columns further variations on this theme.

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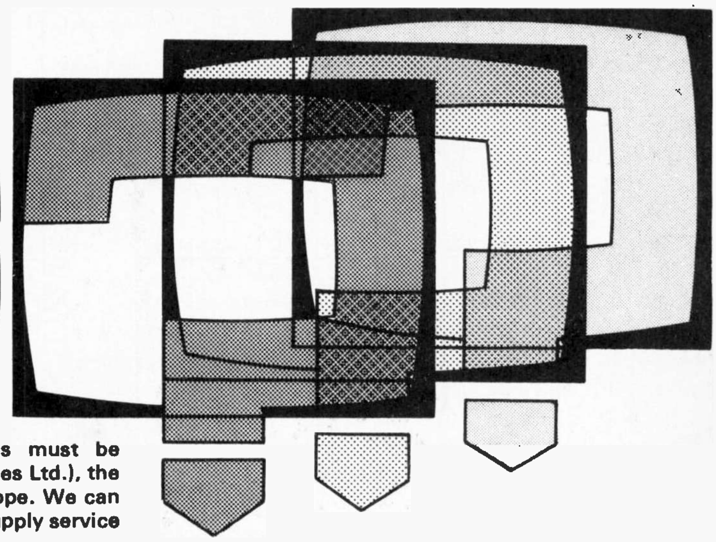

Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 443 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

GEC C2112

The picture develops the jitters shortly after switching on – the motion seems to be up and down. It will stop for a while if one of three things happens: a quick change to another channel and back; detuning and then retuning the channel; or a camera change. When the trouble is present there is a clicking sound from the mains input filter coil.

The fault could be due to one of several components: the trigger diac D701 in the regulated power supply (use an RCA type 17000 or ITT type V413M replacement), the regulator thyristor SCR701 (type BT106), the regulator control transistor Tr701 (BC147), the silicon controlled switch field oscillator SCS451 (type BR101), or the sync/line oscillator i.c. TBA920's starter diode D401 (BA154). (GEC C2110 chassis.)

HMV 2650

The picture constantly jumps up from the bottom of the screen – by approximately three inches. I have tried replacing the PCL805 field timebase valve and the capacitors in the field linearity feedback circuit, but the fault persists.

This is the dreaded field jitter! It could be caused by any one of several components in the field timebase. Check for dry-joints and loose connections in this area. We have known the coupling capacitor C93 between the triode anode and pentode control grid cause the trouble. Other suspects are C95 which smooths the bias applied to the pentode's control grid (this bias is obtained from a point along the heater chain), and the height compensating thermistor X1 in series with the field coils on the scan yoke. The thermistor can be checked by temporarily shorting it out. (Thorn 1400 chassis.)

PHILIPS G22K511

The focus control on this set cannot be adjusted for correct focus. When it is fully anti-clockwise the edges of the picture just become sharp, the centre remaining blurred. In the opposite direction of the control the whole picture is badly out of focus. One gets the impression that if the control could be adjusted a little farther in the anti-clockwise direction the whole picture would come into focus.

If the PL509 line output valve and PY500 efficiency diode have not been replaced recently it would be a good plan to start by doing so. If these do not turn out to be responsible for the condition you will have to check the high-value resistors associated with the focus control and the EY51 focus rectifier. There are two 1·8MΩ resistors, three 2·7MΩ resistors and two 3·3MΩ resistors in the focus control chain: only one need change value to produce the effect described. (Philips G6 chassis.)

PYE 86

About a month ago the brightness started to decrease. Then the picture started to balloon. Replacing the valves in the line output stage made no difference so I fitted a new line output transformer. This brought the picture back to normal, but after a week the picture became very dark with ballooning to give a very large picture when the brightness control is advanced. The boost voltage is correct: do you think the transformer has gone again?

If the boost voltage is correct it is likely that the transformer is o.k. If so, the picture size will be correct at the lowest usable brightness level and the fault probably associated with the DY802 e.h.t. rectifier's heater circuit. Check for poor contact in the valveholder, for corrosion or dry-joints. Check the 1·2Ω series resistor. If necessary, try another DY802. (Pye 769 chassis.)

TANDBERG CTV1

The problem with this set is striations on the left-hand side of the screen – alternate light and dark vertical stripes. The linearity coil damping resistor R368 and line output transformer damping resistor R392 have both been checked and found to be in order. There are also slight, slow ripples on the vertical lines of the test card, and some colour confetti on monochrome transmissions.

For the striations we suggest you check the PL509 line output valve's screen grid decoupling capacitor C356, R371 which damps the horizontal shift circuit a.c. blocking coil and if necessary C376 which forms part of the damping network with R392. The ripple is due to impaired smoothing, probably faulty h.t. electrolytics but possibly shorting turns on the h.t. smoothing choke L404. The confetti is likely to be due to a colour-killer fault: check the transistor Q875 and diode D875 in this circuit.

HITACHI P32

The 2SB337 series stabiliser transistor was faulty, causing hum on sound and loss of line hold. I switched to battery, and the set worked with the line hold control at maximum, though it was difficult to tune in the channels. An AD149 was fitted as a replacement for the 2SB337 and the set worked for a few weeks though with a flywheel sync fault, i.e. the picture was displaced to the left, with slight tearing on the left-hand side. When the 2SB337 was replaced one of the diodes in the bridge rectifier was also replaced, but now the 2A fuse on the secondary side of the mains transformer has blown. Can four 1N4001 diodes be used as the bridge?

The stabiliser operates with the set battery powered as well, so don't run it for long in the fault condition with excessive l.t. voltage. High l.t. rail voltage could be responsible for the flywheel fault, but check whether the discriminator diodes CR701/CR702 are leaky. Repeated failure of the series stabiliser transistor could be due to the error detector transistor TR902 (2SC1213) or its reference zener D905 (AW01-07) being faulty. Alternatively, c.r.t. flashovers could be the root of the problem. The current demand through the mains bridge rectifier is a little excessive for 1N4001 diodes. Many excellent bridge rectifiers rated in excess of 2A are available however, for example the RS Components type. Restore the l.t. rail voltage to its correct level of 11·4V at the collector of the series stabiliser transistor, then if necessary adjust the line hold control T701 for correct lock.

KB CK600

I've serviced many sets fitted with the CVC5-9 series chassis and have found them most reliable, so much so that I own one myself. One thing that seems to mar an otherwise excellent picture however is an interference pattern or stobing along vertical edges, especially if the edge marks a change between high and low luminance value, black edged captions being an example. The fault is not present on monochrome transmissions or when the colour control is reduced, pointing to some defect or other in the decoder.

The symptoms suggest that the chrominance amplifier response is tilted to favour the higher frequencies, or that the i.f. alignment is awry. Confirm that an identical receiver does not show the symptom, then check these points. The chrominance amplifier bandpass response is shaped by C148, C150 and C156 in conjunction with printed coils. (ITT CVC5 chassis.)

MARCONIPHONE 4703

There is uncontrollable brightness when the set is first switched on. The brightness control seems to be working since there is a reasonable amount of brightness drop, but there is no control whatsoever over the contrast. For the first five minutes the picture remains completely smeared, with pulling on whites, then the fault clears completely and the controls work normally.

If there is no response at all from the contrast control during the fault condition and the picture is then over-contrasted the brightness control will not work because of the action of the beam limiter. The only possible cause of this is a dry-joint at the contrast control or poor contact in the associated plug/socket 16 on the video panel – make sure it is fully seated on the chassis mounted pins. (Thorn 3000 chassis.)

GRUNDIG 5011GB

This set operates normally except for an occasional fault which occurs when the set is switched on and usually clears within five minutes. Operating the channel selector or switching off and on again does not clear it. The fault consists of reduced width, about an inch on each side, along with excessive field scan with foldover at the bottom. The picture remains perfectly synchronised when the fault is present. It has occurred twice in a week, otherwise three weeks or so apart.

The supply voltage for the field timebase is derived from the line output stage, so lack of width will involve accompanying field scan symptoms such as you describe. Check that the 14·3V supply to the line driver stage and the 282V supply to the line output stage are present and correct when the fault occurs, then concentrate on the line output stage. We have known the fault to be caused by dry-jointed inductors here – the symptoms suggest a poor joint. Check particularly the waveform shaping coil L517 and the input commutating transformer 9245-834·21.

ULTRA 6661

There is lack of field scan, with the bottom two or three inches inverted. The supply to the primary winding of the field output transformer should be 215V, but the reading I get is only 110V. Disconnecting the primary winding produces an increase in voltage to 240V. The PCL805 has been replaced: is the transformer suspect?

Insert a milliammeter between the h.t. feed resistor R135 and the primary winding of the transformer. The consumption should be about 30-40mA. If it turns out to be grossly excessive suspect the transformer or a leaky output pentode control grid coupling capacitor (C93, 0·1μF). If the current is well below the above figure, suspect the h.t. smoothing components in this feed, i.e. R135 and C121. (Thorn 1400 chassis.)

KB FEATHERLIGHT SUPER

There is a raster but no picture on any channel. The sound is o.k. on all channels until the contrast control is operated: then the raster fades and reappears, and the sound is intermingled with foreign stations.

There could be a break in the track of the contrast control, but it is much more likely that the synchronous demodulator i.c. (IC6, type TDA1330 etc.) has failed. This fault is common on these sets. First check that the d.c. supply (22·5V) to pin 6 of the i.c. is present however in order to eliminate the 100Ω feed resistor R46. (ITT VC300 chassis.)

BUSH CTV25

There is an intermittent fault on this set – the sound comes and goes. The trouble does not appear until the set has been on for half an hour or so. Turning the volume up fully restores the sound, but the control itself seems to be o.k. The fault does not show up every time the set is on.

The audio panel is at the bottom left-hand side of the set. Tap and probe around on it for dry-joints and loose connections. If all seems to be o.k. in this respect, any of the transistors could be faulty. Cautious use of freezing compound and a warm hair-dryer usually helps track down this type of fault.

DEFIANT 9A52U

After replacing the line output transformer it was found that there was only a very faint picture, on a bright raster. On measuring the c.r.t. voltages approximately −7V was found at the grid – the lead to this point comes from the line output transformer via a series resistor which seems to be o.k. As a temporary measure this lead has been disconnected and the c.r.t. grid returned to chassis. Also, after setting up the boost voltage the width is found to be exact on 625 lines but slightly lacking on 405 lines – it was set up on 625 lines.

The line output transformer winding concerned supplies line flyback blanking pulses to the c.r.t. grid. One end goes to the series resistor and the other to chassis: reverse the connections. If necessary set the width on 405 lines, but reversing the winding connections may help with this also. (Early Plessey dual-standard chassis.)

SOBELL 1060

To obtain a normal brightness picture the brilliance control has to be advanced excessively. The trouble seems to be around the PL802 luminance output valve which is drawing very little cathode current – its cathode voltage is only 0·2V instead of 1V and its anode voltage is way up at 340V. The PL802 and the blanking components TR434 and D402 in its cathode circuit have been replaced. The brightness control should vary from −2V to −5V at its wiper but the voltages I obtain are −4·5V to −6V. The voltages around the beam limiter transistor TR535 seem to be correct and the −20V supply to the brightness control network is present. All resistors in this area appear to be in order. The boost voltage seems to be rather high.

The operating conditions in the beam current limiter/brightness circuit don't seem to be correct. Check the voltage at the cathode of the line output valve. This should be approximately 2·7V. Make sure that the cathode resistances are correct, and check the decoupling electrolytic C529 for leakage – this is on the timebase panel. The other end of the brightness control network should be at +20V (D501 cathode). If this is not so check D501 and its associated reservoir capacitor C527. If this voltage is present check that the emitter voltage of the beam limiter transistor is 2·7V. If not the transistor itself or the reference zener diode D504 could be faulty. Check the values of the resistors in the brightness control chain – they do sometimes change value. Finally, make sure that R414 which biases on the PL802's cathode transistor in the absence of flyback blanking pulses has not increased in value (should be 330kΩ).

GEC 3135

The line sync on this monochrome portable is poor when changing stations, but settles after a few seconds to give a good picture but with the field unlocked. The field hold control is operative and will slow the picture slip but does not lock it. The SN76544N/07 i.c. which combines the sync and timebase oscillator functions has been replaced without success.

Check the capacitors in the coupling network to pin 9 (video signal input) of the i.c. These are C251 (0·1μF) and C253 (220pF). Also make sure that R253 (1MΩ) which supplies bias to this pin has not increased in value and that the supply decoupler C252 (47μF) is in order. If necessary check the field timing capacitor C256 (0·22μF) which is in series with R256 and the field hold control.

DECCA CS2630

The picture is all right except for a blueish-mauve background which is also present on a black-and-white picture. The RGB background controls on the convergence panel have to be set at minimum – a slight increase in the blue control's setting turns the whole picture bright blue, the same thing happens with the red control but not with the green one.

The blue and red background controls – c.r.t. first anode presets – should be replaced. Almost certainly their tracks are cracked. (Decca 30 series chassis.)

KB KV105

The picture is excellent, but the field tends to roll when the set is switched on. It can be locked by slight movement of the field hold control, but when the set has been on for half an hour or an hour the picture again tends to slip very slowly. A further slight movement of the hold control is sufficient to lock the picture and keep it locked till the set is switched off. The picture can be made to slip upwards or downwards by adjusting the hold control, but the correct setting seems to be very critical. All the valves associated with the sync and field timebase circuits have been renewed – the PCL84, PCF80 and PCL85.

We suggest you check the value of the video amplifier's screen grid feed resistor – R51, 3·9kΩ – and also its decoupling capacitor C61 (220pF). Then check the value of the two resistors in the sync separator's screen grid circuit, R63 (330kΩ) and R62 (68kΩ) – a value change here will also affect the field sync pulse amplifier stage (triode section of the PCL84). Check the hold control itself for value and continuity. If this doesn't reveal the cause of the trouble you will have to check all the valve pin voltages in the video, sync and field timebase circuits. The field oscillator is of the cathode-coupled multivibrator variety: leakage in the single cross-coupling capacitor C78 (0·01μF) could be responsible for the fault. (ITT/STC VC3 chassis.)

TELEFUNKEN 743GB

There are thin, horizontal lines spaced 1cm apart on the screen, presumably flyback lines. They are most apparent on low light scenes and are aggravated when the brilliance control setting is reduced – conversely, the lines tend to disappear when the brilliance is increased (to a level where the colour and focus are degraded). The power supplies have been checked and the voltages are normal.

The trouble could well be lack of flyback suppression, possibly due to an internal failure in the luminance/chrominance amplifier i.c. – IC201, type TBA560A – since flyback suppression is carried out in this i.c. The flyback lines can appear however if the c.r.t. first anode voltages are set too high with the grey-scale adjustment controls. Operate the service switch to collapse the field, and adjust R584 (red), R583 (green) and R582 (blue) so that the horizontal red, green and blue lines can be just seen, then return the service switch to the "operate" position. A fault in the "flyback blanking impulse former" circuit can also cause the same effect: check diodes D242, D243 and D244 for failure – these components shape the flyback blanking pulses applied to pin 8 of IC201. Also check R231 (33kΩ) for correct value – the amplitude of the blanking pulses is determined by this resistor. (Telefunken 711 chassis.)

PHILIPS G22K511

The picture is perfect for the first hour after switching on. Then the white portions of the picture become too bright and also blurred – white captions very blurred. Coloured and darker portions of the picture become too dark, and faces very red. Distant shots are very blurred, close-ups not too bad. The fault is still there if the set is switched off and left for a time before switching on again: it seems to clear only when the set is left switched off long enough to cool down completely.

Turn the brightness and contrast down when the fault occurs: if the picture becomes clear again the c.r.t. is being overdriven due to an a.g.c., beam limiter or luminance output stage fault. Start by checking the PFL200 luminance output valve. If the scanning lines are poorly defined during the fault, suspect a change in the focus voltage, due possibly to leakage in the spark gap on c.r.t. pin 9 or a defective resistor in the focus control network. Finally, signal compression in the early i.f. stages is a possibility, betrayed by incorrect voltage readings around the first two i.f. transistors T2124 and T2143. (Philips G6 single-standard chassis.)

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TELEVISION JUN. 1976

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

The start of the problem with a Sobell Model 1040 was that the colour would intermittently fail. For quite long periods the colour would be perfect, but towards the end of the evening the colour would blink off and on in a random manner, leaving a perfect monochrome display during the "off" periods. The customer tolerated this for several months. Then the symptom increased in frequency, finally becoming permanent so that reception was possible only in monochrome.

The bias from the colour-killer circuit is applied to the base of the second chrominance amplifier transistor (TR319) and is adjustable by means of a 10kΩ preset (P304). This sets the threshold at which TR319 comes into conduction. The setting of P304 was checked, and it was found that no matter how the control was adjusted the colour could not be restored. A test meter connected to the slider proved that the preset control was operating normally. The base voltage of TR319 was way below the correct figure however.

An oscilloscope was then brought into action and it was discovered that with a colour-bar signal applied to the aerial socket from a colour generator the signal was present up to the base of TR319, while the reference oscillator output, though slightly low in amplitude, was healthy.

Attention was then redirected to the biasing of TR319, but the colour-killer rectifier and its reservoir capacitor proved to be in order. What could cause the symptom? See next month's TELEVISION *for the solution and for another item in the Test Case series.*

SOLUTION TO TEST CASE 161
Page 387 (last month)

The trouble with the Murphy Model V153U was in its vertical linearity correction circuit. It will be recalled that while making tests in the feedback circuit with an Avo Model 8 the technician discovered that a marked worsening of the symptom occurred when the meter was connected across a certain component. This was an 0.022μF feedback coupling capacitor which links the feedback loop to the grid of the field output valve.

With the meter thus connected the equivalent to a capacitor leak condition was created, and since this made the linearity worse it was logical to conclude that the capacitor itself had slightly defective insulation. This proved to be the case, but when the capacitor was removed from circuit and measured for insulation resistance a leak could not be detected (high-impedance grid circuits are much more sensitive to capacitor leaks than are resistance meters!). The fault was completely cured by replacing the capacitor (3C33).

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Makes available:– GEC, Bush, Decca, Thorn 2000, Baird, Philips. Mail Order Only. Cash or Cheque with Order. Regret no personal callers. Please allow 14 days for delivery.

Any enquiries with SAE please, to:

"WESTRONICS"
15 CROSS GREEN LANE, HALTON, LEEDS 15 LS15 7SR.

APPROX: 500 COMPONENTS. Resistors, Capacitors, Diodes, Transistors, Pots, Coils, etc. Identified, formed leads, fall-out, and surplus. Good value at £1.60. All inclusive (U.K. postal rates only). CWO please to L. PENSENEY, T. Bankhead Farm, South Queensferry, West Lothian.

EX RENTAL TV

23", 19" 3-Channel £4. Colour £60.

TRANSISTORS – SPECIAL OFFERS

AD145 25p	BU108 £4	BD184 40p
AD147 25p	BD116 £1.20	BU204 £1.80
AD148 40p	BD131 85p	BU126 £1.80
AF139 20p	BD126 £1	

Thousands more at ½ price. Call:

EDWARDS & SONS
103 Goldhawk Road, London, W.12
Tel. 01-743 6996

THORN 850:900:950:1400:1500: Line output transformers £4·20 Scan coils £2·00. Panel Repairs/exchanges most makes. LTS Television Services Ltd., 10 Canning Road, Wealdstone, Harrow, HA3 7SJ. Tel: 01-427 0422.

MAINS DROPPERS

37-31-97-26-168Ω	50p.
25-35-97-59-30Ω	50p.
14-26-97-160Ω	50p.
14-26-97-173Ω	50p.
15-19-20-70-63-28-63Ω	50p.

Post free. C.W.O.

Durham Supplies
367 Kensington Street, Bradford, 8, Yorkshire

250 New Resistors, well assorted, $\frac{1}{8}$-2 Watts, Carbon-Hi-Stab Oxide, etc. **£1.50** post free. Whitsam Electrical, 33 Drayton Green Road, London, W13.

BRC 2000, 3000, 3500, 8000, 8500
Phillips G8

Panel Repair/Exchange Singles or Bulk

MODULAR ELECTRONICS
160 Brabazon Road, Hounslow TW5 9LP
Tel. 01-897 0976

VALVES

Radio-TV Industrial Transmitting
2200 Types. 1930 to 1975, many obsolete. List 20p. S.A.E. for quotation. Postal export service.
We wish to purchase all types of new and boxed valves. Wholesaler's, Dealer's, etc., stocks purchased.

COX RADIO (SUSSEX) LTD.
The Parade, East Wittering, Sussex
West Wittering 2023

PRIME semi-conductors by return, at low prices. Catalogue 15p. SPECIAL, 10mfd/12V 100/£1, inc. Audio-Optics, 19 Middleway, Chinnor, Oxon.

VALVE BARGAINS

ANY 1–12p, 5–50p, 10–90p, 50–£4.00

ECC82, ECH84, EH90, DY86/7, EF80, EF183, EF184, PC86, PC88, PCF80, PCF802, PCL82, PCL84, PCL85/805, PCL86, PY81, PY800, PY88, PL36, PL504, 6F28, 30PL14.

COLOUR VALVES 25p EACH

PY500/A, PL508, PL509.

Postage & Packing 25p, no VAT

VELCO ELECTRONICS
9 Mandeville Terrace, Hawkshaw, Via Bury, Lancs.

PANEL REPAIRS

Philips G8 : Bush-Murphy : 823A : 823AV
BRC : 3000 : 3500 : 8000 : 8500
Panels exchanged – fully guaranteed

LTS Television Services Ltd.
10 Canning Road, Wealdstone, Harrow HA3 7SJ
Telephone: 01-427 0422

TECHNALOGICS

PATTERN GENERATOR MODEL PG3

This compact unit generates SIX invaluable video patterns for setting up

COLOUR T.V. RECEIVERS:

*CROSSHATCH GRID	Advanced circuitry. Coated
*DOT MATRIX	Glass Fibre P.C.B. Housed
*VERTICALS	in TOUGH CASE 5" x 4" x 2"
*HORIZONTALS	(approx.). Low consumption
*WHITE RASTER	from standard 9V batteries
*GREYSCALE (STEPWEDGE)	(not supplied).

Use when adjusting: Static Convergence, Dynamic Convergence, Picture Geometry, Colour Purity, Focus, Beam Limiting, Grey-Scale Tracking, Black-level Clamping, etc. etc. Single direct connection to set; large output for valve or solid state sets. Available as a kit plus instructions £11.75, or built and tested £14.75, inclusive. Still available, our 6 Channel Touch Tuning Unit, £9 inclusive. 6 LEDS £1.20.

TECHNALOGICS,
8 EGERTON STREET, LIVERPOOL, L8 7LY, MERSEYSIDE.

Enquiries SAE please. Mail Order Only.

FOR SALE

BRC 3000, one power, one line board. Working condition. £12 each. Beaumont 01-897 0927 Evenings.

'TELEVISION' Colour Receiver P.C.Bs. RF, IF, AMP, Decoder. Time-Base, Audio, CRT & convergence. £75 ono. Phone Sedgefield 20668 (Co. Durham).

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TWO C60 Cassettes entitled
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£5.44 plus 55p VAT/P&P

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P.O. Box 99(E),
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Tel: Milton Keynes (0908) 77710.

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio & TV Servicing (Mono & Colour) for beginners with GCE (or equivalent) in Maths. and English.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

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Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

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Dept 801T, Intertext House, London SW8 4UJ
Or Phone 01-622 9911 (All Hours)

WANTED

NEW VALVES (pref. BVA) of popular types, PCL805, PFL200, PL504, etc. Cash waiting, Bearman, 6 Potters Road, New Barnet, Herts. Tel: 449 1934-5.

WE buy old colour and 20"/24" mono C.R.T.'s. Best cash prices, quantities preferred. We collect. Phone: Bedlington 822790.

TOP PRICES PAID for NEW VALVES and TRANSISTORS

Popular T.V. and Radio types

KENSINGTON SUPPLIES (A)
367 Kensington Street, Bradford 8, Yorkshire.

WANTED – Radio and Television Servicing volumes: 72/73, 73/74, 74/75: COLOUR/BAR GENERATOR AND OSCILLOSCOPE, must be good condition. The Bungalow, Church Street, Ashbourne, Derbys. Telephone (03355) 2497.

A RECEIVER to pick up Amateur Television Transmissions also a Philips LDH 0050 Camera. Mr. R. S. Wood, 40 Ashville Gardens, Pellon, Halifax, W. Yorkshire. HX2 0PL.

SITUATIONS VACANT

130 Lovelace

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.35
AC117	0.24
AC126	0.25
AC127	0.25
AC128	0.25
AC141	0.26
AC141K	0.27
AC142	0.20
AC142K	0.19
AC151	0.24
AC152	0.25
AC153K	0.28
AC154	0.20
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
BD123	0.98
BD124	0.80
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
BD144	2.19
BD145	0.75
BD163	0.67
BD183	0.56
BD222	0.78
BD234	0.75
BD410	1.65
BD519	0.76
BD520	0.76
BD599	0.75
BDX18	1.45
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
MC 1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC 1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC 4000B	0.43
MFC 4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN 76001N	1.45
SN 76003N	2.92
SN 76013N	1.95
SN76013 ND	1.72
SN 76023N	1.95
SN76023 ND	1.72
SN 76033N	2.92
SN 76227N	1.46
SN 76530P	1.05
SN 76533N	1.20
SN 76666N	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
TBA 560CQ	4.10
TBA570	1.17
TBA641	2.30
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA 810AS	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-10M 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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