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Television

JULY 1976

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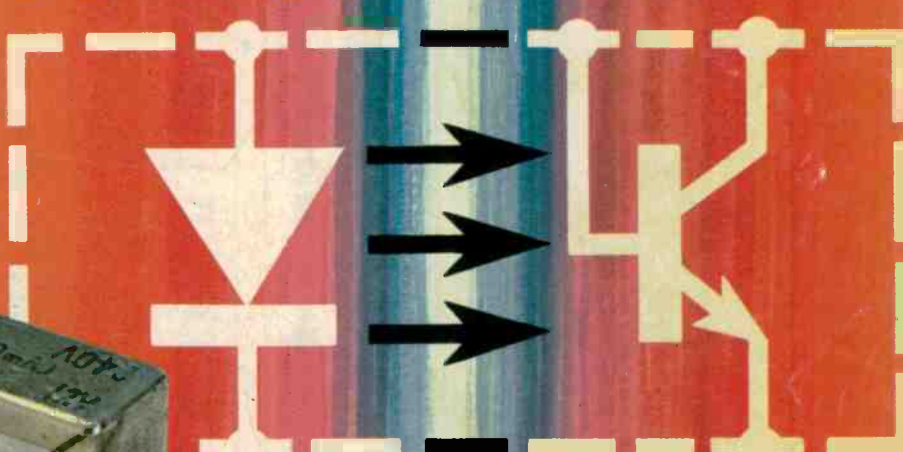

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CORRESPONDENCE

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BACK NUMBERS

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

QUERIES

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

this month

OUR NEXT ISSUE DATED AUGUST 1976 WILL BE PUBLISHED ON JULY 19

Held over: We regret that due to pressure of space in this issue we have had to hold over the article on patching printed circuit boards. This will appear next month.

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Television

THE CHANGING SCENE

When we were somewhat younger our boss at the time used to put the fear of God into us by commenting "wait till you have to deal with colour as well!" We used to read the US magazines and ponder over the strange and mysterious things that happened to the colour sets there. The crack in those days was that when the colour telly was delivered the service engineer moved into the spare room! In the event, things turned out very much better in the UK than anyone looking apprehensively ahead could have expected. We soon got used to the idea of three drives to the c.r.t. instead of one, and with a little brushing up on which colours mix with each other to give various other ones were soon able to diagnose what was missing or lacking in a colour display. Timebases and power supplies were found to be prone to the same faults as monochrome ones, only more so. The initially strange PAL decoder was found to have a simple diagnostic key which tells you a great deal about what is or isn't happening in it – the presence or absence of the ident signal. Convergence was easily understood once the effect of twiddling the knobs was appreciated, though getting good results was often more of a problem.

Reliability was better than expected, certainly than anticipated by those reading about the early US NTSC receivers with forty or so valves throbbing away, since from the start much of the circuitry was operated at low voltage levels, with transistor i.f. strips and decoders. It all seemed too good to be true, and it was! The real challenge to servicing knowledge and skill came not with colour but with the subsequent gradual changeover to the all solid-state chassis. In fact it would probably be true to say that many engineers found the first all solid-state monochrome chassis more confusing than the first generation of hybrid colour sets. Gradually we became used to the fact that a line output transistor without drive is a cold rather than a hot and bothered device however, while the field department has proved remarkably trouble free.

As we mentioned in a leader not long since, it's the power supply section of a receiver, once the simplest section to trouble-shoot in – with your trusty neon – that has proved to be the most confusing part of the modern solid-state colour receiver. First we had to get used to various regulation techniques. Then we had to learn about over-voltage and excess-current protection circuits, about how and why they remove the power supply or take other precautionary action, and about the various new faults they themselves contribute in their turn. And finally came switch-mode power supplies: efficient indeed, but a real trap for the unwary!

For those in a workshop dealing with a limited range of makes and models servicing probably soon becomes a fairly routine affair – except for those odd intermittent faults that never show themselves until a couple of days after you've got the set back to the customer's home. But bear in mind the truly brave, your independent service operator who will tackle anything that comes his way. At this particular point in time his problems are likely to be accelerating. You all remember the great colour bonanza of 1973, when sales and rentals of colour sets in the UK exceeded $2\frac{3}{4}$ million. Imports seemed to come from everywhere to meet the extraordinary demand that the then chancellor unleashed. There were Finnish, Norwegian, Danish, German, Austrian, Swedish, French and Italian colour receiver imports, not to mention the Japanese sets which started to arrive in large quantity rather later due to the long period of PAL patent negotiations. The point we are making is that these sets are now beginning to develop faults, and service engineers can expect to find all sorts of strange beasts turning up on their workbenches. We know, because we have the same problem, though indirectly! The query service nowadays is receiving increasing numbers of enquiries on all manner of less well known colour sets – Kuba, EMO, ASA and Autovox for example. Often all we can possibly do is to hazard a guess as to what is wrong rather than pounce on a known stock fault. Yet we get the occasional shirty letter from a reader to the effect that because a couple of hundred or so of an unusual receiver were sold off at his local discount store we should know all about them! Now we appreciate the thought that we are all knowing. But there are limits – both to what we know and the facilities available to us. In particular we would like to disabuse those who seem to think that we have a vast staff sitting around waiting to start lengthy research once an enquiry comes their way. It would be nice, but economics do not permit it. Our entire full time and shared editorial staff appears each month to the left of this column. We don't need to say any more!

teletopics

THE VIDEO PLATE

Methods of storing video signals for domestic playback seem to be multiplying. The latest suggestion, proposed by the Digital Recording Corporation of Scarborough, New York, is to record the signal in digital form on a 5 × 7in. card. This would give a programme time of half an hour. The system is put forward as a low-cost one suitable for development for the domestic market. The Corporation say that work is in progress on the production of a prototype player and that this is expected to involve a development period of a year or so.

The following technical details of the system have been released. The TV signal (colour) is converted into digital form using a delta modulation technique, i.e. the initial analogue video signal is sampled at regular intervals, each sample being converted to a digital signal which registers any *change* in light level between samples. The digital samples comprise a four bit word, with three bits used to indicate luminance change and one to indicate chrominance change. The sound signal is also digitised, then compressed and inserted in the sync period (i.e. the sound in sync system as adopted for line distribution by the BBC in the late 60s). The encoded data signal thus produced is then optically recorded in the form of concentric tracks across the narrow diameter of the plate, the tracks consisting of light and dark spots – each about a micron in diameter – which for playback are scanned by a low-power laser. The laser is mounted in a fixed position, a rotating disc and a group of optical fibres being used to convey the beam to and from the plate. The rotating disc is moved across the plate in track increments. Various materials for the plate are being investigated.

VIDEODISCS

Meanwhile it seems that the development of RCA's videodisc system is going ahead successfully. RCA report that they have now started manufacturing test runs for both the discs and the players – having apparently "solved every technical problem that has arisen so far". Briefly, a double-sided 30·5cm grooved PVC disc coated with metal and dielectric layers is used. The signal is recorded in the form of slots of varying length and spacing in the bottom of the groove. The metal stylus tracks the upper surface, responding to the capacitance variations produced by the slots in the groove. Since the stylus is in contact with the disc there is no need for an elaborate servo control system. RCA have also announced that they are now licensing foreign firms to produce their videodisc system, and it is understood that in the UK Plessey have entered into such an agreement.

THUMBS DOWN TED

Since the Ted (Telefunken-Decca) videodisc system was introduced on the German domestic electronics market a year ago, the first videodisc system to be marketed anywhere (since Baird's 78 r.p.m. discs in the late 20s!), only about 3,000 players have been sold – and this figure is said to include "institutions and interested parties". In other words, it's been a resounding flop. The reasons for this put forward by independent observers are too high a price for the player (about £245), too short a playing time per side (ten minutes) and the limited number of discs available (around 150). A new marketing approach is being sought before the attempt is made to launch the Ted system on the Swiss and Swedish markets.

VIDEODISC SUMMARY

To summarise the present situation it seems that development of the Philips/MCA and RCA disc systems is going ahead neck and neck while the one essential to making the Ted system practically acceptable – extended playing time – looks nowhere closer to being achieved. The digital system mentioned above appears to be a very promising approach. Some twenty or so other systems are understood to be under development – several intended for studio use – but few of these are likely to see the light of day.

RETRA AGAINST RRP

The Radio, Electrical and Television Retailers' Association (RETRA) has come out strongly in favour of abolition of the recommended retail prices at present quoted by dealers and setmakers. The argument is that the prices are not realistic and are used only to show large discounts. This is perfectly true of course, but we nevertheless feel that the practice of showing recommended prices does help the busy customer who by now has got used to comparing discounts along with the prices. To do away with recommended prices altogether would leave purchasers completely in the dark. The recommended price does after all give some guidance as to the comparative worth the manufacturer attaches to particular models, and "lack of realism" is almost entirely a matter of the more obscure imported equipment. Those who advocate complete freedom of pricing always say that customers can shop around. But how many people have time to do any real detailed checking – i.e. a mini market survey! To our mind the abolition of recommended prices would merely give greater scope to the unscrupulous.

TRANSMITTER OPENINGS

The following relay stations are now in operation:
Beecroft Hill (Near Leeds) ITV channel 59 (Yorkshire Television programmes). Receiving aerial group C/D.
Blandford Forum (Winterborne Strickland, Dorset) BBC-1 channel 40, BBC-2 channel 46. Receiving aerial group B.
Chesham (Bucks.) BBC-1 channel 40, ITV (Thames Television and London Weekend Television) channel 43, BBC-2 channel 46. Receiving aerial group B.
Cupar (Fife) ITV channel 41 (Grampian Television), BBC-2 channel 44, BBC-1 (Scotland) channel 51. Receiving aerial group B.
Dunkeld (Tayside) ITV (Grampian Television) channel 41, BBC-2 channel 44, BBC-1 (Scotland) channel 51. Receiving aerial group B.
Girvan (Strathclyde) BBC-1 (Scotland) channel 55, ITV channel 59 (Scottish Television), BBC-2 channel 62. Receiving aerial group C/D.
Haddington (Lothian) BBC-1 (Scotland) channel 58, ITV channel 61 (Scottish Television), BBC-2 channel 64. Receiving aerial group C/D.
Haydon Bridge (Northumberland) ITV channel 41 (Tyne Tees Television), BBC-2 channel 44, BBC-1 channel 51. Receiving aerial group B.
Keswick (Lake District) BBC-1 channel 21, ITV channel 24 (Border Television), BBC-2 channel 27. Receiving aerial group A.

All these transmissions are vertically polarised.

WEAK FIELD LOCKING

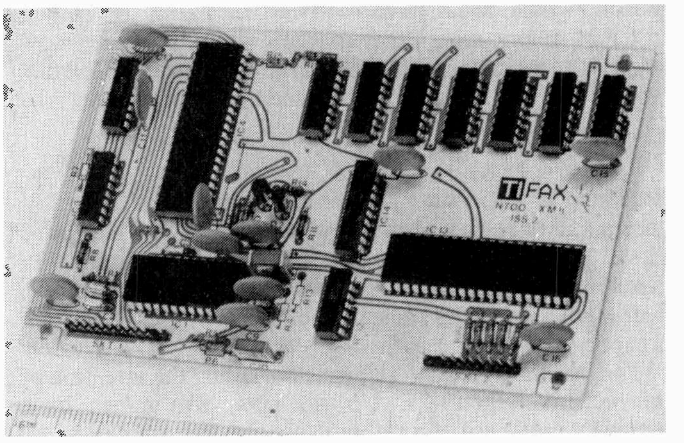
It's fairly well known that on earlier RRI solid-state colour sets fitted with the A809 i.f. panel the a.g.c. smoothing capacitor 2C37 (125μF) can be responsible for weak field hold – though this part of the circuit is perhaps not the most obvious place to look for the cause of this fault. The same sort of trouble, ripple on the a.g.c., is now showing up on the various Pye group solid-state colour chassis (713, 731 and derivatives). The capacitor responsible here is C194 (68μF) which smooths the a.g.c. applied to the tuner unit. Incidentally, the small-screen Pye colour chassis is now being used in certain Philips models.

THE PL519

While we're on about service hints here's another point. Some imported colour sets with hybrid chassis are fitted with a PL519 line output valve, a type not used in any UK produced sets. Cases have been encountered where the better known – and rather less expensive – PL509 has been used as a replacement. It won't last long however. The PL519 is an up-rated version and the point is that the chassis using it are fitted with 110° c.r.t.s.

32in. TRINITRON

Sony have unveiled in Tokyo two colour TV models – one a monitor, the other intended for the domestic market – fitted with a 32in. 114° Trinitron tube. This is the largest colour tube to go into production anywhere and is particularly interesting since the Trinitron was originally conceived as a small-screen tube. The 32in. version is called



The latest Teletext decoder from Texas Instruments, the Tifax XM-11, consists of a set of l.s.i. circuits specifically designed for this application and mounted on a printed circuit card. It provides a total of 96 alphanumerical display characters in addition to graphics for maps and diagrams, a seven colour display, boxed presentation of newsflashes or subtitles plus updating and concealed display facilities. Keyboard entered data can also be displayed.

the New Trinitron tube and uses a newly designed gun structure to give improved resolution – the beam spots are about half the size in previous designs. There is also a new deflection yoke to minimise beam spot distortion.

UK COLOUR TUBE PRODUCTION

Maybe we should all forget the sad story of the closure of Thorn's Skelmersdale colour tube plant. The moral still seems worth keeping on about however as the aftermath develops. Sidney Parker, managing director of Thorn Rentals and chairman of the National TV Rental Association, said recently "I forecast – and am willing to be quoted on this – that very soon the Japanese colour tubes coming into this country will cost considerably more than the price that Thorn needed to stay in business". If nothing else, the devalued pound will ensure that. Yet colour tubes are just the sort of high technology product that the present economic strategy depends on to spearhead an export led recovery. While we've been closing colour tube plant – you can blame the gyrations in credit and VAT terms for that to a large extent – what are others up to? A couple of months ago we reported that Finland was to set up a colour tube industry in conjunction with Hitachi. Now we learn that RCA have reached an agreement with the Polish electronics organisation Unitra to set up a plant to produce 110° PIL colour tubes – precisely the tubes that Skelmersdale was about to start producing. The initial capacity is to be 300,000 a year, with the proposal that this could be doubled. All this is not going to help UK colour TV setmakers. We must hope that Mullard's 20AX tube turns out to be a roaring success.

Sidney Parker also pointed out that the colour set replacement market is now making a significant contribution to sales and rentals. This he says could mean a "hump" in disposals around 1980-81, with production rising to around two million sets.

RRI TV EXPORTS

We have suggested before in this column that the UK colour TV set industry is now highly competitive, and there is increasing evidence to confirm this. Rank Radio International for example are now supplying colour sets to Italy and have received a repeat order from a German TV manufacturer. More interesting still is the order, worth £6 million, which Rank have received from Iran for 30,000 SECAM colour sets. Other markets which Rank are now supplying include the Scandinavian countries, Holland, Belgium, Spain, Austria, Switzerland and Hong Kong.

TV GAMES

Videomaster report considerable success with their TV games and have moved to a new address – 14-20 Headford Place, London SW1 (telephone 01-235 5444). Production is said to have increased by 160% in the first quarter of this year compared to the same period last year – and 60% of it is exported.

The popularity of TV games is attracting the attention of the i.c. manufacturers. Up till now TV games have generally made use of a rather expensive custom made l.s.i. chip plus several standard i.c.s. It seems however that some of the latest microprocessor chips could be used instead, for example the Intel 8048. This could result in a significant overall cost reduction. It is understood that several i.c. manufacturers now have their eye on this field.

ANTIQUE TV ON VIEW

Readers interested in seeing a genuine 30-line spinning disc televisor (as they were known) made by J. Logie Baird in the late twenties should visit the National Wireless Museum at Arreton Manor near Newport, Isle of Wight. As well as this antique televisor, there are crystal sets with catswhiskers, old-fashioned receivers with bright-emitter valves and horn loudspeakers, and 405-line TV sets with 5in. tubes dating back to the mid-thirties.

The National Wireless Museum is under the auspices of the Wireless Preservation Society, a non-profit-making organisation devoted to the collection, restoration and preservation of old wireless, television and sound-reproduction equipment for educational, cultural and historical purposes. The curator and honorary secretary is Douglas Byrne, G3KPO.

ON-SCREEN PROGRAMME INDICATION

The Germans with their love of novelty have recently been introducing sets incorporating digital circuitry which enables the time or the channel number to be shown on the screen at the press of a button on a remote control unit. It seems that such ideas are spreading to UK sets. Granada Rentals have announced a remote controlled set with a "channel query" switch on the hand-held remote control unit. On pressing this the programme to which the set is tuned, i.e. BBC-1, BBC-2 or ITV, appears in the top right-hand corner of the screen.

NEW EHT CONCEPT

A simplified approach to the generation of the e.h.t. voltage for a colour receiver is being developed by General Instrument. Basically, the idea is to combine the line output transformer and e.h.t. multiplier. The e.h.t. overwinding is split into several sections with each feeding one of the rectifier diodes, the whole lot being connected in series. The inter-winding insulation provides the capacitance required. The reliability of this composite component is understood to be under evaluation by setmakers.

RRI TO INTRODUCE TELETEXT RECEIVER

Rank is the first setmaker to announce plans to introduce on the UK domestic market a TV set incorporating a Teletext decoder. The 22in. Bush Model 6333 is expected to become available, at about £1,150, in September. Rank comment that when a new decoder design based on l.s.i. devices becomes available the price of a set with a built-in Teletext decoder should fall to around 40% above the price of a standard set. The time scale for this is expected to be around two years however.

NEW ITT COLOUR CHASSIS

A completely new colour chassis, based on a PIL in-line gun/self-converging c.r.t., has been introduced by ITT. It's known as the CVC20 chassis and the first model to use it is the 20in. ITT Model CK505. The 90° PIL tube is being supplied by Hitachi.

Circuit features include a Mullard three-i.c. decoder (TBA560C / TBA540 / TCA800), Telefunken / SGS TBA440N i.c. in the i.f. strip, BU208 transistor line output stage and a Mullard type switch-mode power supply using a BU126 chopper transistor and a TDA2640 i.c. to provide the control action.

The chassis is constructed on the mother-daughter board principle, with one main mother board and seven plug-in daughter boards. To aid servicing, the daughter boards can be withdrawn and then plugged in on the reverse side of the board. This and other features have been introduced with ease of servicing in mind. It's certainly a neat and accessible arrangement.

The switch-mode power supply incorporates protection circuitry. Excess current will disconnect the circuit for half a second and then reconnect it. This pulsing cycle is repeated several times after which if the current has not returned to normal the power supply shuts down. Well, at least you now know what the symptoms are!

Model CK505 has a recommended retail price of £293·50.

PERFECT PICTURE/IDEAL COLOUR

A feature of several recent sets, including the ITT CK505 (ideal colour) and the new Skantic Model 51512 (perfect picture), is a button which can be pressed to restore the picture conditions to the correct optimum. It's felt that viewers find difficulty in adjusting the colour and contrast controls correctly, or in returning them to the optimum settings once they have been altered. In the ITT CK505 the ideal colour button switches factory preset colour and contrast controls into circuit in place of the user controls to restore correct settings. The new Skantic Model 51512 is fitted with a 110° in-line gun tube and has a recommended retail price of £349·45.

IMPROVE YOUR AUDIO

A newly formed associate of Chromasonic Electronics, Chékits Ltd., has been formed to manufacture kits for industrial, educational and domestic purposes. The first two kits introduced are audio modules and are almost identical except that one employs a TCA940 i.c. while the other uses a TBA810AS i.c. (both SGS-Ates types). The former produces a maximum of 10W r.m.s. while the latter has a maximum output of 7W r.m.s. The modules are well suited to improving the performance of a TV set's audio side and are based on the circuits shown in our September 1974 issue (see "Audio ICs for TV"). Chékits say that the modules have superseded a whole series of discarded prototypes. Details of a suitable bass/treble/volume control arrangements accompany the kits. The address of Chékits Ltd., is 56 Fortis Green Road, London N10 3HN.

Solid-State field oscillators

G. R. WILDING

CONVENTIONAL transistor multivibrator field oscillator circuits are used in a few solid-state television chassis, while in a couple of the latest chassis the field oscillator is within one of the timebase i.c.s. The most common form of solid-state field oscillator circuit however is based on the use of a silicon controlled switch (SCS). Chassis using this device as the field oscillator include the Philips G8/G9 colour series and 320 monochrome chassis, the RRI A823 and Z179 colour chassis, the GEC C2110 colour series, the Pye 713 colour and 176 monochrome chassis and the Decca 40 series colour chassis. There is also a discrete component version of the circuit, the complementary relaxation oscillator circuit. This is used in the Thorn 8000/9000 series chassis and the RRI Z718 colour chassis. As usual, the field scan waveform itself is produced by charging a capacitor via a resistor. The active component(s) in the circuit, i.e. the SCS or the transistors, initiate the discharge of the capacitor at a given point in the scanning cycle in order to produce the flyback. The purpose of this article is to describe the SCS and the type of field oscillator circuit in which it is used.

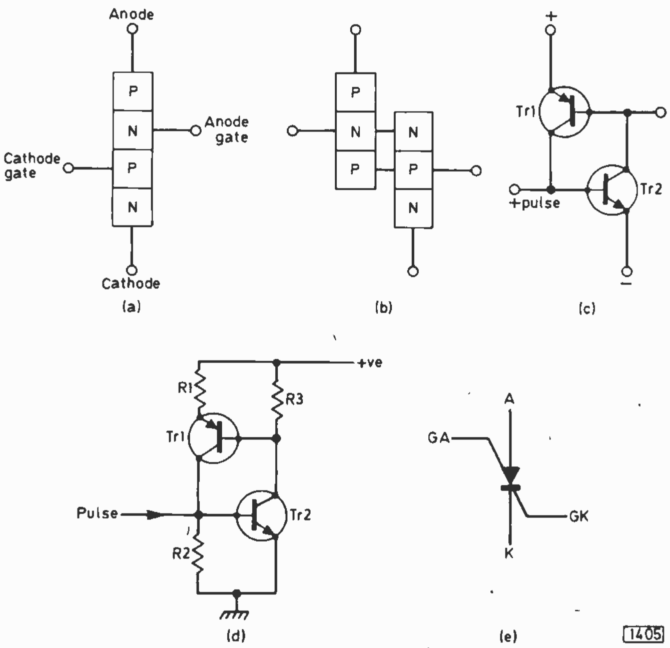


Fig. 1: The four-layer pnpn structure of the silicon controlled switch (SCS). (b) The structure can be regarded as a complementary pair of pnp and npn transistors. (c) Complementary transistor circuit. The transistors will conduct and latch on if a positive pulse is applied to the cathode gate or a negative pulse to the anode gate; or, alternatively, if the anode is made positive with respect to the anode gate or the cathode is made negative with respect to the cathode gate. (d) Discrete component version of the SCS – the complementary relaxation oscillator. (e) SCS circuit symbol.

The Silicon Controlled Switch

The SCS is really a small thyristor, i.e. it's a four-layer (pnpn) semiconductor device. In fact it's often referred to as a thyristor in service manuals. Fig. 1(a) shows it schematically: the outer p section is the anode, the outer n section the cathode, and there are gate connections to the inner n and p sections – the anode gate and cathode gate respectively. Only one of the gates is used for control purposes, the other if it is externally connected simply being taken to chassis via a medium-value resistor.

Operation

As with a thyristor, the four-layer structure can be regarded as two complementary (i.e. pnp plus npn) transistors d.c. coupled together – see Fig. 1(b) and (c). By applying a pulse to the emitter-base junction of either transistor both transistors will switch on and remain conducting until the current through them falls below the "hold-on" value, when they will both switch off. Alternatively a sawtooth waveform can be used to trigger the device.

When the anode is connected to the positive side of a d.c. supply and the cathode to the negative side the centre np junction will be reverse biased and only a very small leakage current will flow across it – unless the voltage across the device exceeds its "breakover" voltage. In field oscillator circuits however this mode of operation – breakover triggering – is not used. Instead, the device is triggered on by making the anode gate instantaneously negative with respect to the anode (by applying a negative pulse to the anode gate of a positive pulse to the anode) or by similarly making the cathode gate instantaneously positive with respect to the cathode.

If, considering Fig. 1(c), a positive pulse is applied to the base of Tr2 (i.e. the cathode gate) then the base-emitter junction of Tr2 will be forward biased and it will deliver current to the base of Tr1, thus biasing this transistor on. The action is cumulative, Tr1 maintaining Tr2's base current flow. The transistors lock into the fully conductive condition and remain that way until the current flowing through them falls below the value required to hold them forward biased.

Discrete Component Version

The basic discrete component version of the circuit, the complementary relaxation oscillator, is shown in Fig. 1(d). If a positive pulse is applied to the base of Tr2 the voltage developed across R3 forward biases Tr1, the resultant current through R2 providing forward bias to hold Tr2 conductive. R1 is there simply to prevent the fuse blowing!

Practical Circuits

The SCS is such a simple device that you would not expect to find much variety in the field oscillator circuits which use it. As usual however different designers have gone their own way so that one does find significant circuit differences. We will next consider some practical circuits.

Pye

The straightforward SCS field oscillator circuit used in the Pye 713 chassis is shown in Fig. 2. Positive-going sync pulses obtained from a TBA920 sync separator/line oscillator i.c. are integrated by R702/C701 and applied to the base of the sync pulse amplifier/inverter VT704. As a result negative-going field sync pulses appear at the junction of R709/R705 for application to the anode gate of the SCS D711. Following the SCS are two *RC* charging networks, R716/R717/C714 which times the circuit and R721/R719/C718 which develops the sawtooth field waveform. At the end of the flyback both capacitors will have been discharged via the SCS and since the current flowing through it will have fallen below the hold on value it will switch off. This permits C714 to charge towards rail potential via R717 and R716, C718 likewise charging via R719 and R721. Since the time-constant of the timing circuit is clearly shorter than that of the field charging circuit the voltage across C714 will rise more rapidly than that across C718. Throughout the forward scan therefore D715 will be reverse biased and it will be the voltage waveform developed across C718 that drives the emitter-follower VT722 and the subsequent stages – an emitter-follower is required here because its high input impedance will not restrict the voltage developed across C718, and to provide matching to the following driver stage.

In the absence of sync pulses D711 will be triggered on when the voltage at its anode, developed across C714, exceeds the voltage at its anode gate – set by the potential divider R709/R707. It will then rapidly discharge C714 and, via D715 which then becomes forward biased, C718. In practice however D711 is triggered just before the end of the forward scan by the negative-going sync pulse which appears at its anode gate.

Rank

The circuit used in the RRI Z179 110° chassis is shown in Fig. 3 and differs in two main respects. First there is only one *RC* charging circuit, 4C47/4R58/4R57, which thus provides both the timing action and generates the field scan waveform, and secondly the hold control is connected in the SCS's anode gate circuit. The sync pulses are again derived from a TBA920 i.c., 4VT6 providing amplification and

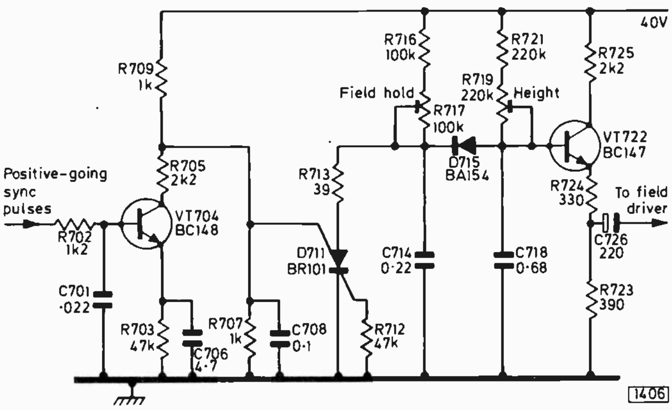


Fig. 2: Straightforward SCS field oscillator used in the Pye 713 chassis. During the forward scan the timing circuit R716/R717/C714 charges more rapidly than the field charging circuit R721/R719/C718 and in consequence D715 is reverse biased.

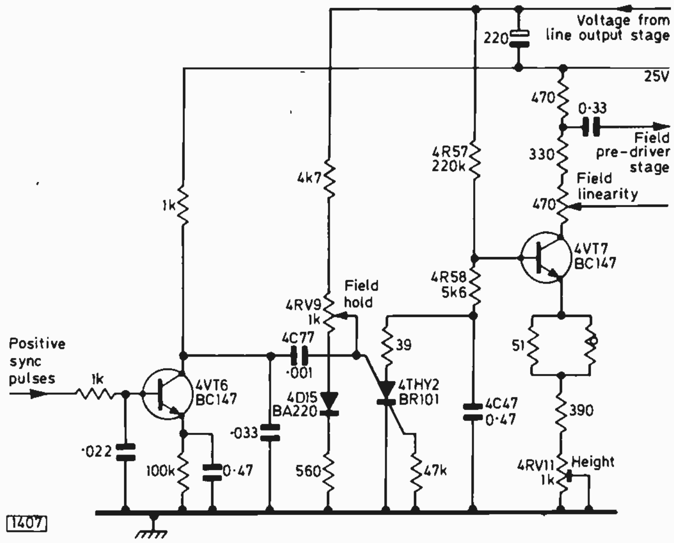


Fig. 3: SCS field oscillator circuit used in the Rank Z179 110° colour chassis. There is only one charging circuit, 4C47/4R58/4R57.

inversion. The hold control 4RV9 sets the d.c. level at the anode gate of the SCS, so that in the absence of a sync pulse it fires when the voltage developed across 4C47 rises above the voltage set by 4RV9. Both the charging circuit and the hold control network are fed from a voltage source obtained by rectifying line flyback pulses. This has the advantage that the height tracks with e.h.t. variations. Diode 4D15 in the hold control circuit provides compensation for variation in the SCS's triggering point with temperature. The waveform developed across 4C47 drives the following stages, height being controlled by varying the negative feedback applied to 4VT7 by means of 4RV11.

Monochrome Circuit

Things are arranged rather differently in the new Pye 176 solid-state monochrome chassis. The circuit is shown in Fig. 4, and it will be seen that the *RC* charging circuit is turned upside down compared to the previous examples while the triggering action in the absence of sync pulses occurs in the cathode circuit of the SCS. C704 charges via R709, R710 (the height control) and R711 when the circuit is powered, the voltage at the cathode of D702 moving negatively as it does so. The d.c. voltage at the cathode gate of the SCS is set by the potential divider network R706/R703/R705. When, as C704 charges, the voltage at

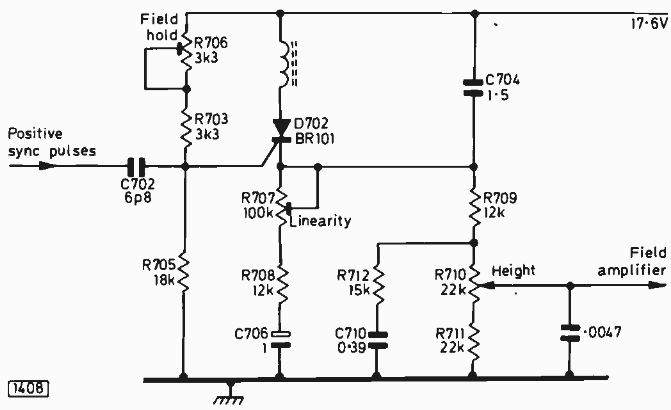


Fig. 4: SCS field oscillator circuit used in the new Pye 176 monochrome chassis. Here the triggering is carried out in the cathode/cathode gate circuit of the SCS.

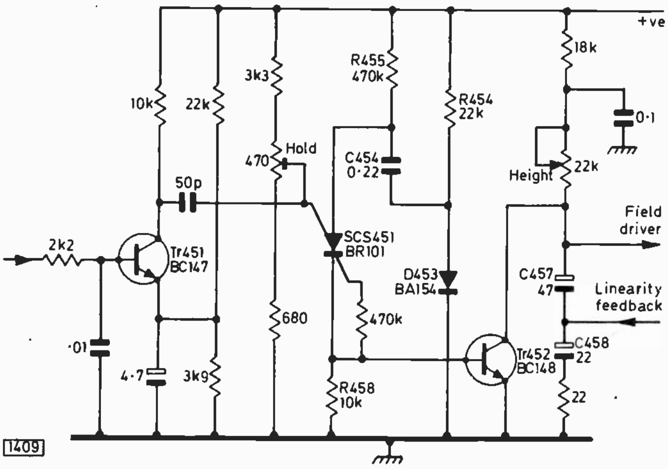


Fig. 5: The "original" SCS field oscillator circuit has been used in a number of chassis. This example is taken from the current GEC C2110 series. There are two time-constants in the timing circuit and the SCS is used to switch on a separate discharge transistor, TR452.

the cathode of D702 falls to about 0·7V below its cathode gate voltage it is triggered on. Positive-going field sync pulses obtained from a TBA890 i.c. trigger the cathode gate just before this point is reached. C704 is discharged when D702 fires. The networks R707/R708/C706 and R712/C710 determine the shape of the sawtooth waveform generated by the circuit.

Original Circuit

One of the first and still widely used SCS field oscillator circuits is shown in Fig. 5, this particular example being taken from the current GEC C2110 series of solid-state colour receivers. Similar circuits are used in the Philips G8, G9 and 320 chassis and in the RRI A823 chassis. It's somewhat more complex than the previous circuits since there are two charge and discharge networks while the timing circuit has two time-constants. During the forward scan D453 is held fully conductive since its anode is connected to the positive supply line via R454. The timing capacitor C454 charges via R455 and when the voltage at the anode of the SCS SCS451 rises above the voltage at its anode gate, set by the hold control, it switches on. The resultant voltage developed across R458 in turn switches TR452 on to discharge capacitors C457/8 across which the

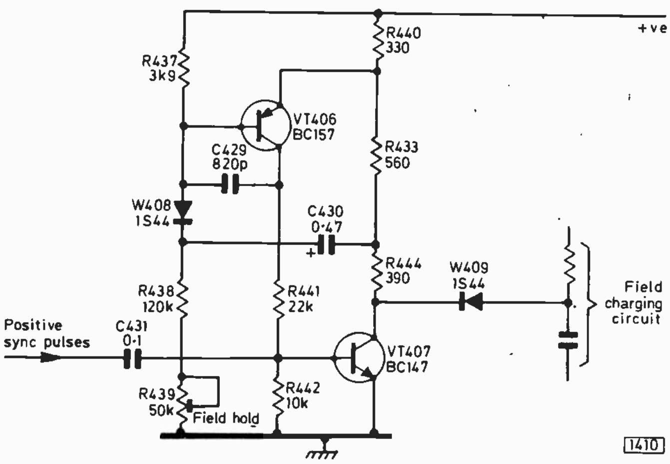


Fig. 6: Complementary relaxation oscillator circuit used in the Thorn 8000/8500/8800 chassis. This is a discrete component version of the SCS circuit. Thorn continue to use this basic arrangement in their latest 9000 chassis.

field scan waveform is generated. The discharge path for C454 is via R458, SCS451 and R454; D453 cuts off. Thus while the duration of the forward scan is basically determined by the time-constant R455/C454, the duration of the flyback is determined by the time-constant C454/R454. Once C454 has discharged, SCS451 switches off, D453 switches on again and the cycle of events repeats.

As in the examples shown in Figs. 2 and 3, negative-going sync pulses are fed to the anode gate of the SCS to trigger it on at the correct time. The main difference with the Philips' circuits is that positive-going sync pulses are fed to the anode of the SCS to trigger it on, an extra diode being required in series with the SCS to prevent the pulses being short-circuited to chassis.

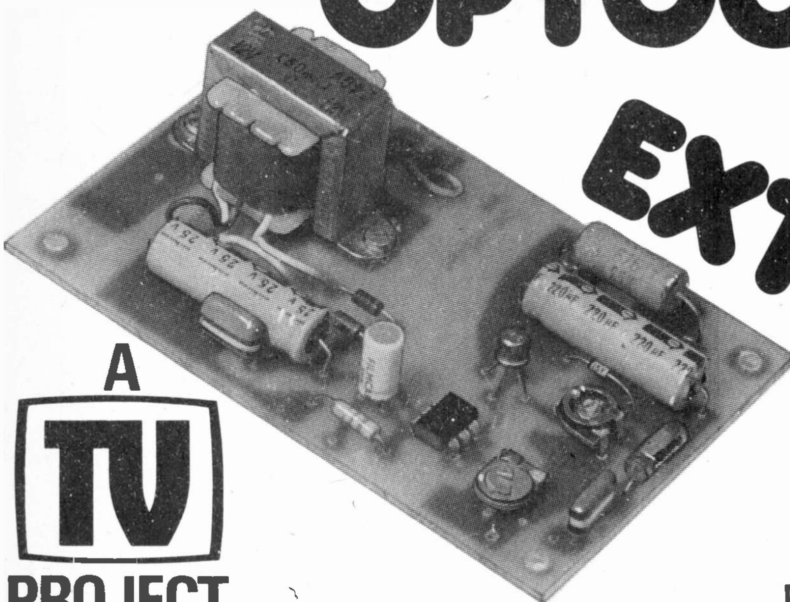
Faults

So quite a variety of SCS field oscillator circuits are in use. The device itself has proved to be reliable. The main fault it causes when defective is no field scan. In some circuits this can damage the field output transistors. Field jitter and incorrect field frequency (too fast, i.e. picture rolling downwards) are less common faults for which it is occasionally responsible. Taking voltage measurements around the device is not recommended: odd things can happen in the timebase if you do so. Certainly never connect a low-resistance meter to any of its pins. If an SCS is suspect, the only reliable course is to replace it.

Complementary Relaxation Oscillator

Finally, let's look at an example of a discrete component version of this type of circuit – the complementary relaxation oscillator circuit used in the Thorn 8000/8500 series colour chassis, see Fig. 6. The complementary pair of transistors is VT406/VT407, connected in a similar manner to the arrangement shown in Fig. 1(d). The main change is that we require a timing capacitor, which in this circuit is C430. This capacitor and diode W408 in fact are the key components in the operation of the circuit. At the start of the forward scan the left-hand plate of C430 carries a positive charge, as indicated. In consequence W408 is reverse biased, there is no voltage across R437, VT406 is cut off, there is no current flowing through R441/R442, so VT407 is also cut off. The cathode of W409 has a positive voltage on it so that it too is reverse biased, isolating the oscillator from the charging circuit which charges in the normal manner. The charge on C430 gradually falls however as current flows via the hold control R439 and R438 to discharge C430. Eventually the voltage at the cathode of W408 will have fallen sufficiently for it to become forward biased; the current through R437 will result in VT406 conducting, in turn driving VT407 on as a result of the voltage appearing across R442. C429 simply speeds the action up. This is the flyback period: W409 is now forward biased, and the field charging capacitors discharge via W409 and VT407. At the same time however C430 is being charged via R440, VT406, W408, R444 and VT407. As C430 approaches full charge W408 is once more reverse biased, the transistors switch off, W409 is reversed biased, and the forward scan commences. The flyback is initiated under normal conditions by the application of a positive-going sync pulse to the base of VT407. The resultant fall in its collector voltage is a.c. coupled via C430 and W408 to the base of VT406 so that both transistors latch on. The basic forward scan time is set by the time-constant C430/R438/R439, while the time-constant R440/C430/R444 determines the flyback time. ■

OPTOCOUPLED AUDIO EXTRACTOR



A TV PROJECT

R. MacCLAY

THERE are a number of ways of extracting from a television receiver an audio signal suitable for tape recording or for feeding into HiFi equipment. The principal problems are safety and hum loops, as most sets have their chassis connected to one side of the mains supply – sometimes (incorrectly) to the live side. Some more recent sets have a bridge rectifier directly at the input, so that the chassis is always live no matter how the mains lead is connected! There are various methods of overcoming these problems; most however are expensive, bulky or difficult to use.

The audio signal at the volume control is suitable for extraction for tape recording or HiFi purposes if it can be isolated from the chassis. An isolation transformer to do this would require a frequency response of some 20Hz-20kHz with a minimum insulation rating between windings of 400V and a linear response for low distortion. It would need an input impedance of up to 2MΩ to prevent undue loading of the volume control circuit, and a low output impedance for feeding into the audio system. All in all a rather expensive component.

A new device now available can be used to meet these requirements at low cost. This device is called an optocoupler, or sometimes an opto-isolator. An optocoupler consists of a light-emitting device, typically a gallium arsenide infra-red emitting diode (l.e.d.) and a light-sensitive device, typically a silicon phototransistor, mounted in close proximity. These two parts are optically coupled (hence the name) but electrically isolated from each other, see Fig. 1. Some advantages of an optocoupler are:

1. High insulation values between input and output, typically $10^{10}\Omega$ in parallel with 1pF at $\pm 2{\cdot}5$kV.
2. Good linearity between input and output currents, see the transfer characteristic of Fig. 2(a).
3. Good frequency response, typically d.c. – 300kHz.
4. Long life.
5. Unaffected by magnetic fields.
6. Very small size and low cost.

In order to achieve the high input impedance required, some form of input buffer amplifier is necessary. A bipolar transistor could be used in an emitter-follower configuration

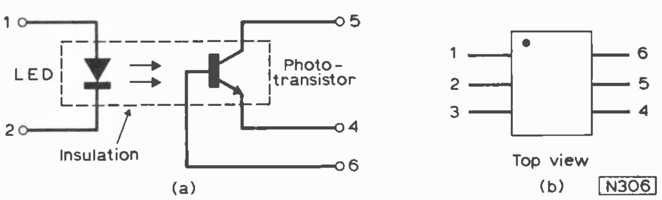


Fig. 1: (a) The circuit symbol for an optocoupler also illustrates its mode of operation. Pin numbering is that of the TIL117. (b) The TIL117 uses a 6-pin DIL package. Note that input and output connections are separated for good insulation.

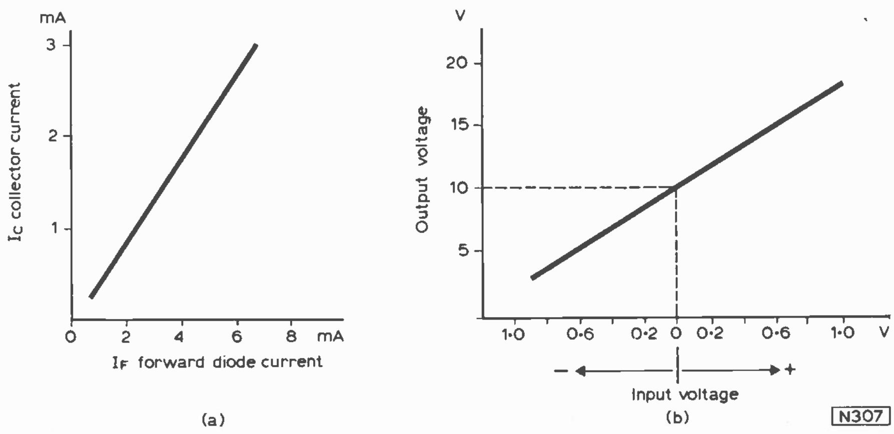


Fig. 2: (a) Transfer characteristic of the TIL117 optocoupler. (b) Overall transfer characteristic of the circuit of Fig. 3 with VR1 set to maximum.

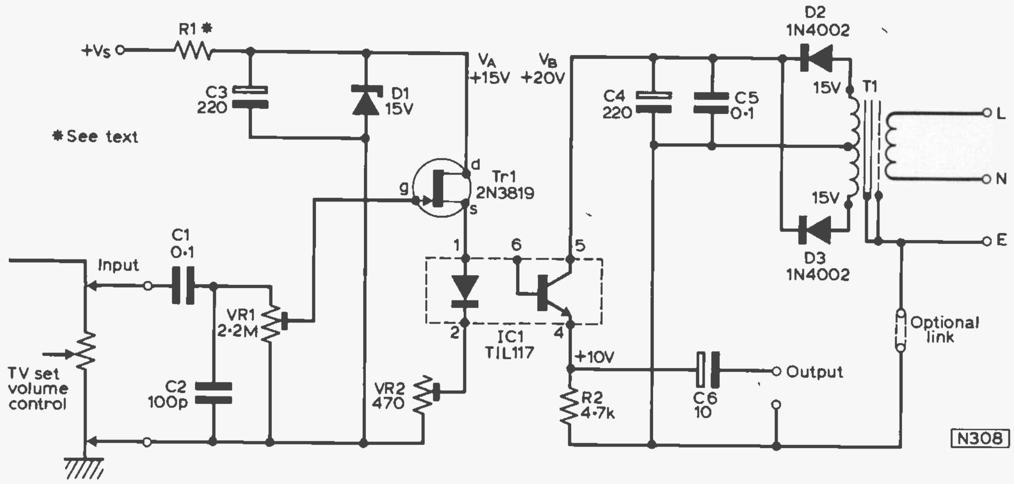


Fig. 3: Complete circuit of the audio takeoff unit, including typical input connection arrangements.

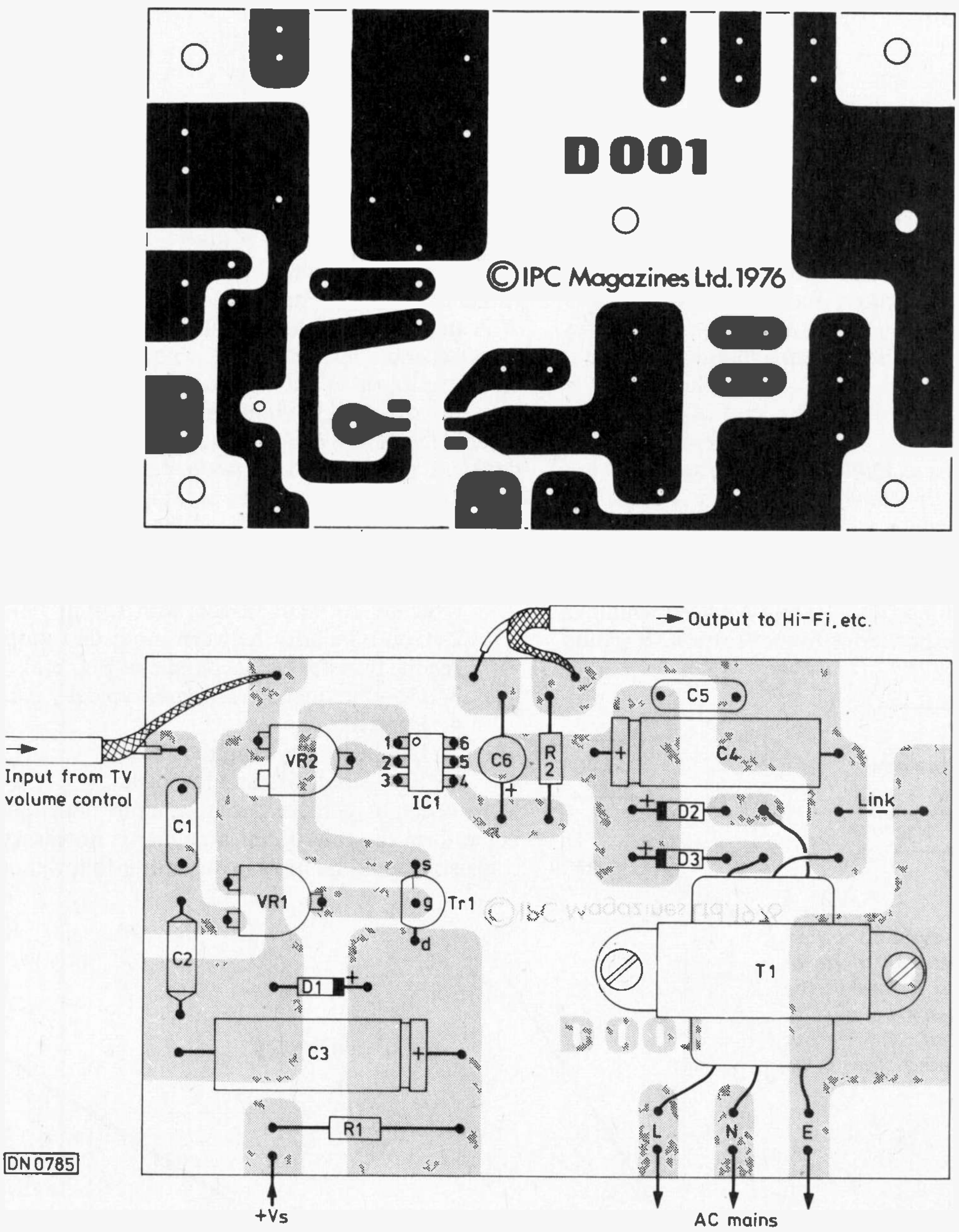


Fig. 4: Printed board pattern and component layout for the audio takeoff unit, both drawn full size. Note that some of the components have been slightly repositioned compared with the prototype board shown in the photographs. Fibreglass laminate should be used for the board to ensure good insulation.

to raise the input impedance to about 100kΩ. This would be adequate for most transistorised TV sets, but not for many valved types. If an f.e.t. is used, an input impedance of 2MΩ can be easily achieved, and fewer components are needed.

Circuit

The complete circuit (Fig. 3) uses a 2N3819 JUGFET input stage to drive the l.e.d. The sensitivity can be varied by means of VR1 to cater for different input levels. The overall voltage transfer characteristic for the circuit with VR1 set to maximum is shown in Fig. 2(b).

Power supplies

If good isolation between input and output circuits is to be achieved then obviously separate power supplies are required for each. The input circuit can be supplied from the TV set – any supply rail between 20V and 300V d.c. can be used. This voltage (V_S) is dropped to 15V (V_A) by means of R1 and zener D1. The value of R1 required is calculated from:

$$R1 = \frac{V_S - V_A}{10\text{mA}} \times 1000$$

For example, for a 200V supply

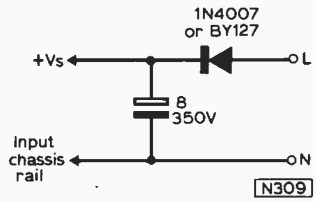
$$R1 = \frac{(200-15)}{10} \times 1000 = 18{\cdot}5\text{k}\Omega.$$

The output part of the circuit uses a conventional mains-powered fullwave rectifier circuit to provide the required 20V. One safety point – do not be tempted to use a transformer with two secondaries for the two supplies, as the windings could have full mains voltage between them if the TV chassis was live. Not all transformers are designed to cope with this sort of voltage between secondaries. It is also safer to use a transformer with an earthed screen for the output circuit supply.

Construction

To preserve the high insulation between the input and output circuits it is desirable to use a fibreglass printed board (Fig. 4). Take the usual precautions with the f.e.t., keeping its leads shorted together until it is soldered into the circuit.

Fig. 5: Temporary supply arrangement for making initial adjustments.



When construction is complete, the f.e.t. bias resistor VR2 should be adjusted to obtain the correct operating point for the phototransistor. Before connecting any supplies set VR2 to maximum resistance. Make a temporary supply for the input circuit, using the arrangement shown in Fig. 5 or a battery. Connect a voltmeter across R2, switch on both supplies and adjust VR2 for a reading of $\frac{1}{2}V_B$=10V.

★ Components list

Resistors:
R1 see text R2 4·7kΩ ¼W
VR1 2·2MΩ min. horizontal preset
VR2 470Ω min. horizontal preset

Capacitors:

C1, C5	0·1μF	250V	polyester
C2	100pF	160V	polystyrene
C3, C4	220μF	25V	electrolytic
C6	10μF	25V	electrolytic

Semiconductors:
Tr 1 2N3819
D1 BZY88 C15V 400mW zener
D2, D3 1N4002
IC1 TIL117 optocoupler (Texas Instruments) obtainable from SDS-WEL Components Ltd., Gunstore Road, Hilsea Industrial Estate, Portsmouth, Hants. Price £1·18½ + 30p post and packing (plus 8% VAT).

Miscellaneous:
T1 Min. mains transformer with interwinding screen, secondary 12–0–12V 50mA. Printed circuit board. Stand-off pillars.

Connection and installation

The audio input signal can be taken from across the volume control, as shown in Fig. 3, and is unaffected by the setting of the control. On some sets the volume control adjusts the gain of the audio module; in this case the unit can be connected across the input to the module. The audio output can either be taken to a socket on the back of the TV, or else via a long lead fitted with the appropriate plug to mate with the amplifier or recorder being used. Screened leads should be used for input and output connections.

Mounting arrangements for the printed board will depend upon the TV set layout. The input lead should be kept as short as possible to avoid loss of top note response due to cable shunt capacity, bearing in mind the high input impedance. If the board is screwed to the set cabinet, spacing pillars should be used to prevent any possibility of leakage from input to output circuits via the woodwork.

The two-core lead to the television set should be replaced by a three-core lead, the earth lead being used for the electrostatic screen and frame of transformer T1. The mains input for T1 should be taken from the set side of the receiver on/off switch, allowing the one switch to remove all power.

Earth link

The optional earth link between the mains earth connection and the output circuit negative rail should normally be omitted if the unit is to feed a mains-powered HiFi system. The multiple earth connections might otherwise form a hum-producing loop. When used with battery-powered equipment, for instance a cassette recorder, the earth link should be connected as an extra safeguard against the output lead becoming live under possible fault conditions. ■

Servicing The TELEFUNKEN 711 CHASSIS

PART 1

P. C. MURCHISON

THE Telefunken 711 chassis is used in a series of solid-state 110° colour sets. Receiver model numbers are 623, 733, 743, 753, 763, 773, 783 and 793. It has a transistor line output stage (BU108/BU208) and employs a number of i.c.s. The i.f. strip consists of a TBA440 or TDA440 i.c., the sound channel comprises a TBA120S intercarrier sound i.c. followed by a TBA800 audio i.c., while the decoder is of the four-i.c. variety – TBA540/TBA560A/TBA520/TBA530. There is also a later, very slightly modified version called chassis 711A. Models using this are the 624, 734, 743, 753, 7044, 764, 7064, 844, 864, 8064, 874, 884 and 984.

These sets have been around for several years now, during which time various stock faults have become known and standard servicing procedures established. The purpose of this article is to describe these and also the operation of the more unusual circuitry found in the receiver – such as the bridge field output stage!

Receiver Assembly

The basic receiver consists of a touch-sensitive tuning arrangement, a signal board which incorporates the four-i.c. decoder, the tuner, the i.f. strip and the RGB output stages, a main chassis which houses the timebases, raster correction and power supply circuitry, and an auxiliary convergence panel. All basic units are unpluggable and the complete chassis can be easily removed from the cabinet to facilitate servicing. This is perhaps just as well since some rather nasty faults can develop and it is often easier to remove an entire subassembly in the field and take it to the workshop for more detailed examination.

Convergence

Both the static and dynamic convergence can be adjusted from the front of the receiver since the convergence board is situated in the base of the cabinet, beneath the c.r.t. The convergence housing can be slid out by inserting a screwdriver into the slots at the left- and right-hand ends of the housing. By pressing the plastic clips inwards and downwards the housing can be slid out of the front of the set, revealing 28 clearly marked controls which are to be adjusted in numerical order. Convergence is easily adjusted and needs no more mention save just to point out that static convergence is achieved by passing d.c. through the coils.

Power Supplies

The heart of the set is the power supply unit, where many of the faults occur. There are four basic power supply lines in the receiver, designated U1, U2, U3 and U4.

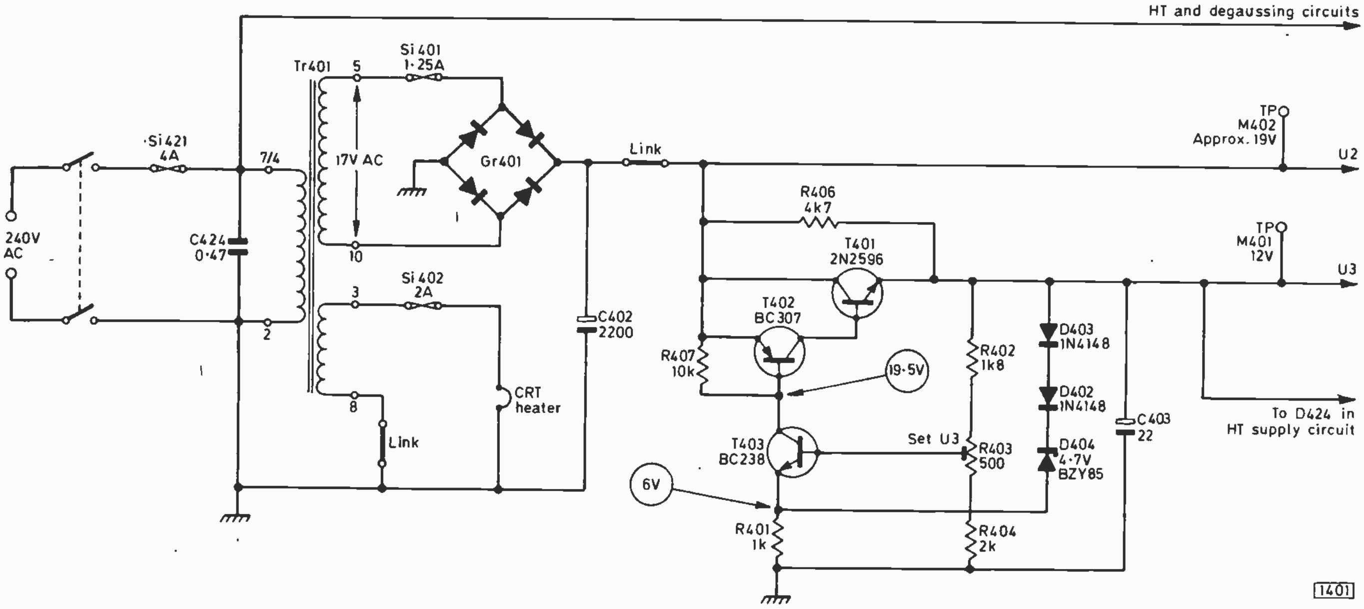


Fig. 1: The mains input and low-voltage power supply arrangements. The U2 voltage should be within the limits 18-20V, depending on the sound level. The U3 (12V) supply is set up by connecting a voltmeter from test point M401 to chassis and adjusting R403 for 12V.

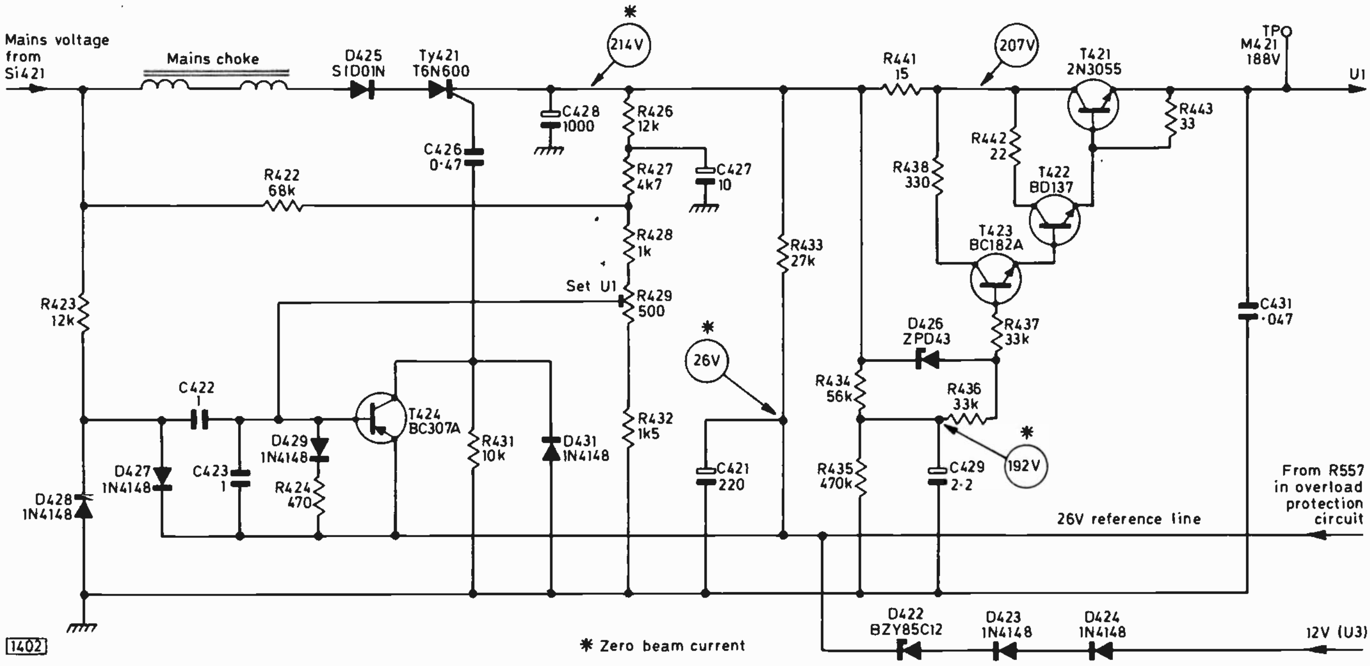


Fig. 2: Circuit of the U1 188V stabilised power unit and the electronic smoothing circuitry, which feed the line output stage and the RGB output stages. In later production D425 was replaced by a shorting link. The 26V reference line is provided by R433/C421 and is stabilised by returning it to the stabilised 12V line via the 12V zener diode D422 and the temperature compensating diodes D423/D424. The control transistor T424 is protected by diodes D429 and D431.

The U4 stabilised 28V line is derived from the line output stage and feeds the field timebase and the convergence circuits. The EW diode modulator acts as the rectifier for this supply.

The U2 supply is an unstabilised 19V line obtained from a bridge rectifier fed from the secondary of the mains transformer (see Fig. 1). The voltage is smoothed by a single 2,200μF electrolytic (C402) before being fed to the audio output stage which has an average current consumption of 150mA.

The U3 supply is a stabilised 12V line obtained by applying the U2 supply to a conventional series regulator circuit (Fig. 1). It feeds mainly the decoder and i.f. circuits.

HT Line

The basic stabilised h.t. line is designated U1. It's a 188V supply produced by a stabilisation circuit which is followed by an electronic smoothing circuit. The arrangement is shown in Fig. 2. The electronic smoothing circuit – transistors T421/2/3 and associated components – consumes less power and is more efficient than a conventional smoothing circuit.

Regulator

It will be seen from Fig. 2 that the gate of thyristor Ty421 is fed from the collector of the pnp transistor T424, via C426. A reference voltage is applied to the base of this transistor from the potential divider network R426-9 and R432 which is connected between the 214V appearing at the thyristor's cathode and chassis. The reference voltage at T424's base is approximately 30V.

Also fed to the base of T424 is a clipped, sinusoidal 50Hz waveform sitting just below the 0V level (see Fig. 3) and of

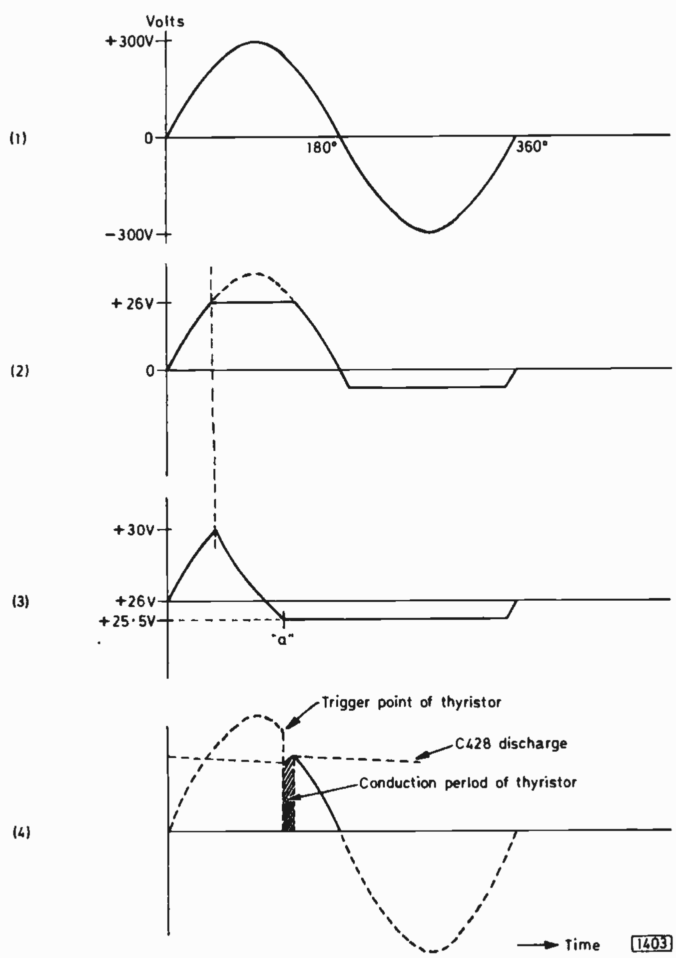
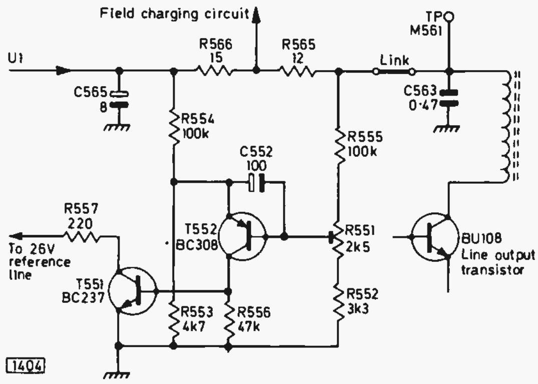


Fig. 3: Waveforms associated with the U1 188V regulated supply. (1) Mains input, 680V peak-to-peak approximately at 50Hz. (2) Waveform produced by the action of the clipper diodes D427 and D428. This is applied to capacitors C422 and C423 which are charged by the positive-going edge. (3) The waveform at T424 base, showing the initial charging of capacitors C422/C423 followed by their discharge via R429 and R432. At point "a" T424 conducts and the thyristor is triggered. (4) Conduction period of the thyristor – its reservoir capacitor C428 charges to the peak value shown when Ty421 conducts, then discharges until the thyristor is again triggered.



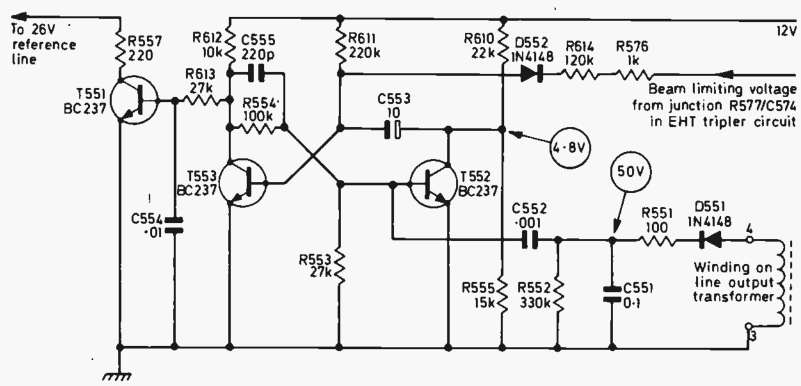


Fig. 4 (left): Excess current protection circuit used in early versions of the 711 chassis. The current consumption of the line output stage is monitored by sensing the voltage developed across R566/R565. If this voltage rises excessively the protection circuit shuts off the U1 supply.

Fig. 5 (right): The overload protection circuit used in later models, using a monostable multivibrator (T522/T553). Under normal conditions T553 is conductive and T552 is cut off. If the amplitude of the line flyback pulses rises excessively the voltage produced by D551 will be sufficient to switch T552 on. If the c.r.t. beam current is excessive, due for example to a short-circuit RGB output transistor, the beam current limiting reference voltage will fall. In consequence D552 will conduct and T553 will cut-off. Once either of these actions occurs a normal monostable multivibrator circuit action follows – see text.

26V amplitude. This waveform is obtained by applying the a.c. mains input via R423 to the clipper diodes D427 and D428. Both the cathode of D427 and the emitter of T424 are connected to a constant voltage line of 26V.

The positive flanks of the clipped sinewaves charge C422 and C423. R429 and R432 provide a discharge path. When the base of T424 is approximately 0·5V lower than its emitter it conducts, feeding a positive pulse to the gate of Ty421 to fire it (see waveforms in Fig. 3).

The point at which T424 conducts depends on the load current and on any variation in the mains supply, thus providing stabilisation. Load current variations are reflected back to the base of the transistor via the potential divider chain.

Electronic Filter

There is considerable ripple (approximately 12V at 50Hz) on the voltage at the cathode of the thyristor. This is applied to the collector of T421 in the electronic filter circuit. T423 and T422 are a pair of emitter-followers, T422 driving T421 and in turn being driven by T423. The smoothing circuit R434, R435 and C429 holds the base voltage of T423 steady and in consequence the base of T421 is fed with a smooth d.c. As a result the ripple on the U1 output is only 300mV.

Setting Up

To set up the U1 supply, connect a voltmeter between test point M421 and chassis and adjust R429 to give a reading of 188V. This should be done with the brightness, contrast and colour controls set to minimum. Once the U1 supply has been correctly set up both the e.h.t. voltage and the picture width should be satisfactory.

Faults

The main faults are as follows.

If the mains fuse Si421 has blown, either the thyristor Ty421 or the mains filter capacitor C424 is short-circuit or there is a short-circuit in the line output stage – generally the line output transistor going short-circuit.

A hum bar on the picture occurs when T421 goes short-circuit, T422 is low in gain (gives normal resistance readings) or R442 goes open-circuit.

If there is no 214V reading at the cathode of the thyristor the most likely causes are that either zener diode D422 or transistor T424 has failed.

Another cause of no 214V reading at the cathode of the thyristor however is when the protection circuit comes into operation and cuts off the power supply. When the protection circuit comes into operation the 26V reference voltage at the emitter of T424 drops, shutting down the U1 supply. This will occur should the c.r.t. pass excessive beam current, due for example to failure of one of the RGB output transistors. The protection circuit itself can be the cause of no U1 supply however and we must next look into this.

Protection Circuits

Two overload protection circuits have been used. The first (see Fig. 4) is a simple two transistor circuit which provides a safeguard against excessive current being drawn and causing damage to the line output transistor, the c.r.t., the power supply, etc. The protection circuit (Fig. 5) used in later versions of the chassis employs three transistors and gives excess voltage protection. We will deal with these in turn.

Excess Current Circuit

The reference voltage for the operation of the first circuit is obtained from the line output stage breather resistors R566-R565. Should the voltage across these rise to an unacceptable level, due to excess current in the line output stage, the base of the pnp transistor T552 will move negatively and it will turn on. In consequence the 26V line to the power supply is reduced via T551 and R557.

Fault Finding

Common failures in this circuit usually cause the U1 supply to shut off and are as follows. The transistors T551 and T552 going short-circuit. R554 or R555 going open-circuit. R551 being incorrectly adjusted.

To adjust R551, connect a voltmeter from the base of T552 (negative lead) to its emitter (positive lead) and set R551 to give a voltage reading of 0·35V. Do this with the brightness and contrast controls turned fully up (maximum beam current).

The protection circuit can be over-ridden by lifting one end of R557 – after checking that there are no obvious faults in other sections of the set.

As an example of the more awkward type of fault that can arise, we had a case where the picture size reduced after the set had been on for about ten minutes. The U1 supply was found to be low at 160V and the fault was traced to T551 developing a leak when warm.

Excess Voltage Circuit

The later circuit (Fig. 5) makes use of a monostable consisting of T552 and T553. Under normal conditions T552 is cut off while T553 is conductive. The flyback pulses as tag 4 on the line output transformer are rectified by D551 and smoothed by R551 and C551 which under normal conditions charges to 50V. Should the amplitude of the line output pulse suddenly increase, C551 will receive a sudden positive voltage increase. The voltage pulse is differentiated by C552-R553, the voltage peak thus produced being fed to the base of T552 which switches on.

T552's collector voltage drops, cutting off T553, and we then get the normal monostable circuit action. When T553 cuts off, its collector voltage rises and T551 is driven on. This pulls down the 26V reference voltage line, via R557, and the power supply unit shuts down.

The monostable action continues however, with C553 discharging via R611, until a point is reached when the monostable circuit returns to its original condition – with T552 cut off and T553 conducting. This occurs after about 1·5 seconds, and if the flyback voltage pulse is still excessive the whole cycle recommences. The resultant effect is usually seen as a rapidly pulsating picture varying in height and width. If the U1 line is monitored with a voltmeter the needle will be seen to flicker back and forth between 100V and 150V, a most perplexing state of affairs for the uninitiated!

Excessive Beam Current

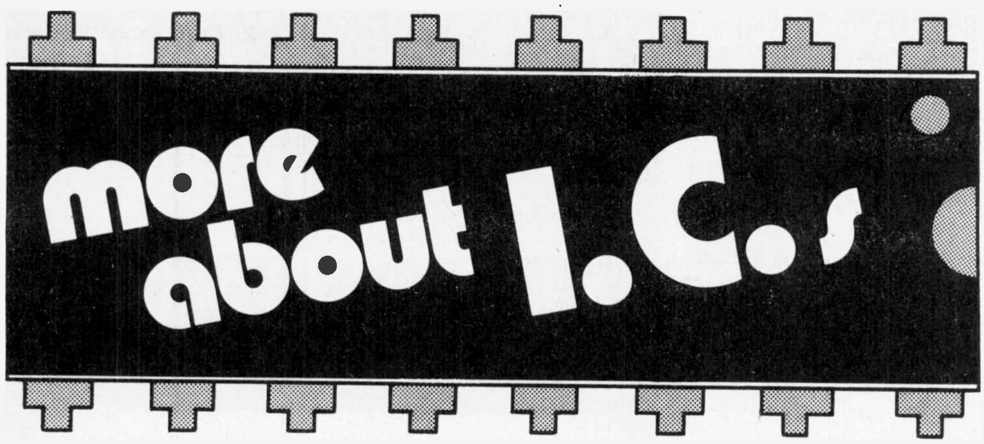
The same conditions arise when there is excessive beam current, since there is also a feed to the circuit from the beam limiter via D552 and R614. This again brings the circuit into action when the beam current is excessive.

Servicing

If the picture seems normal but the protection circuit is operating it can be over-ridden as with the earlier circuit – by lifting one end of R557 – to see whether a normal, stable U1 line and picture are then produced. If all is well, check transistors T552 and T553 for shorts and leakage and replace as necessary.

Next Month

So much then for the workings of the power supply unit and the protection circuits. The second article in this series will deal with the signal circuits, the touch-sensitive channel selection system and the beam limiter and list the faults encountered in these parts of the set.



more about I.C.s

Harold PETERS

IT doesn't seem like three years since we took an initial look at the i.c.s finding their way into domestic television sets, yet here we are already having to survey the second generation of devices. Please don't expect as much constructive information as the "Coping with I.C.s" series provided. The mechanics of fitting and removing the little horrors are pretty much the same as they were three years ago, but familiarity has bred a little contempt – or else an air of resignation has set in. We now debate the merits and demerits of i.c. holders, some of us finding that QUIL holders are more trouble than they are worthwhile most of us are getting used to the idea of finding that the next logical place we ought to check turns out to be right in the middle of the little black lozenge, with no pin at that point to stick in a probe!

A new hazard

We were about to comment that there were no new techniques to be mastered when we noticed from the corner of our eye that the touch-tune i.c.s from Emihus are in fact MOSFET devices (the integrated transistors are of the metal-oxide-silicon field effect variety). MOSFETs are widely used in electronic apparatus, but this is their first major foray into domestic television sets.

MOSFETs are touchy. They hate static electricity. That's why they come plugged into metal foil or a conductive sponge, or are wrapped in a conductive bag: they abhor polyester tiles, polythene bags, synthetic fibres, and the like. They are perfectly safe in their correct packing, and also when used in the set. The trouble comes when you have to get them out of the former and into the latter. Production techniques used in TV plants include static-free areas with the soldering irons earthed to the benches which are chained to the floor which is chained to the chairs which can be chained to the operators' wrists. The operators wear cotton overalls and gloves.

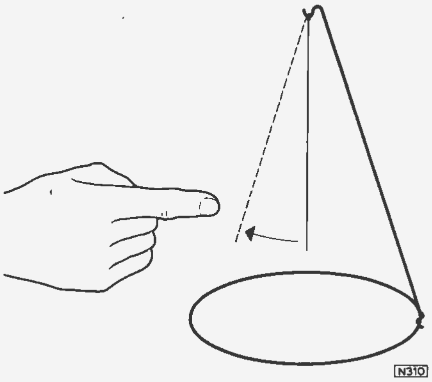


Fig. 1: A simple charge indicator for use when handling MOSFETs.

Obviously you cannot simulate these conditions domestically, but you are now aware of the problem. Refuse to buy MOSFETs not properly packed. Avoid the cat. Wear thin cotton gloves, and don't touch the pins of the device. Discharge everything first. Don't be nonchalant, these recent i.c.s are as touchy as we were scared to believe the earliest types were.

To check whether you are charged is easy. The indicator shown in Fig. 1 is only a length of bent solder and a cotton thread. If the thread comes out to greet you, you are charged up so keep away from MOSFETs – but we digress.

General survey

If you look into the works of industrial electronics equipment you are immediately impressed by the neat rows of i.c.s, without a peripheral component to spoil the symmetry. It looks as if the consumer electronics divisions will not rest content until the insides of TV receivers look the same. So the next generation of sets will feature or suffer from Large Scale Integration (LSI), or "let's put everything inside one chip", a philosophy which certainly makes sense considering the reliability of the first generation of i.c.s. Besides compacting the stages, the devices are spreading into areas traditionally reserved for discrete devices, such as timebases and output stages. Try and visualise a switched-mode field timebase running at 85kHz – one is mentioned later on. Since last time, touch button tuning has given us a new approach to channel selection difficult without i.c.s. There is certainly plenty of variety.

What there isn't is compatibility. Large-scale integration leads the i.c. manufacturers along their separate ways so that the present state of the art is less compatible than the situation when LP records began! The laboratory work on these new devices was being done in the golden age of boom CTV, and they couldn't have arrived on the market at a worse time. I cannot see dealers, beset with competition from discount houses, VAT and the general hard times, giving a warm welcome to an unproven package with no second source – particularly as they are still smarting from consumer rejection of the 110° colour tube. The writer realises that bias should not temper his technology, but he always cherished the desire to write an "I told you so" letter to the editor and reckons he is in with a chance this time! But to detail.

Decoder packages

Most colour sets use an i.c. or two in the chrominance stages, certainly for demodulation/matrixing. Mullard have

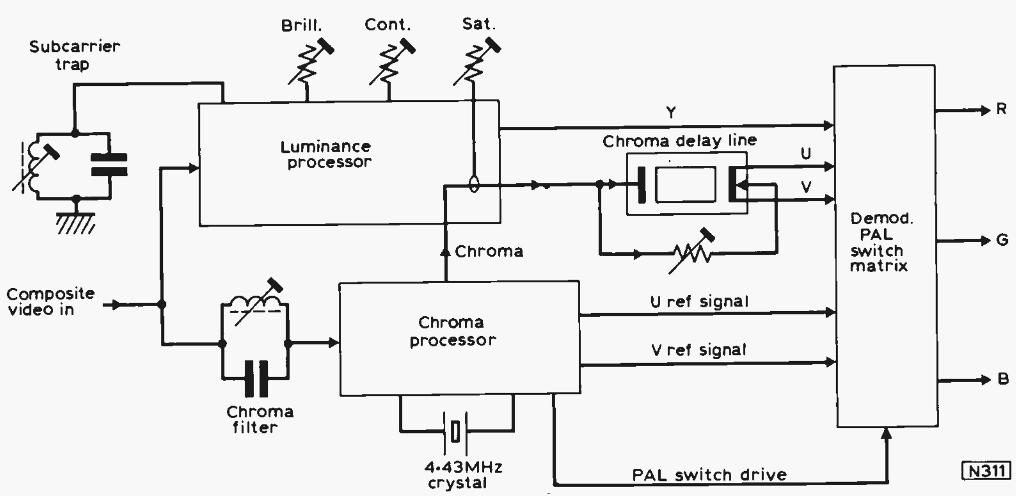


Fig. 2: Basic block diagram of the Texas Instruments and Motorola three i.c. decoder. Minor differences have been omitted.

their four i.c. package in use by Philips, Pye, GEC, etc., and the Rank Z718 and ITT CVC20 chassis use the three i.c. version with a TCA800 combining the functions of the TBA990 and TBA530.

Texas

Texas Instruments have a three i.c. decoder package based upon the proven SN76227N demodulator. To this is added a luminance processor (SN76226N) and a chroma processor (SN76228N). The SN76227N and SN76228N have 14 pins while the SN76226N has 16. They all run from a 24V supply. Fig. 2 shows the arrangement in block diagram form.

The SN76226N luminance processor takes the composite video from the sound trap, controls the brightness, contrast (ganged to colour) and beam limiting, and provides outputs of luminance, chrominance, sync, and a shaped a.g.c. gating pulse.

The SN76228N chroma processor takes the filtered chroma signal, locks an integrated reference oscillator to it, and provides subcarrier, half line frequency squarewave and chrominance outputs, the latter being routed back via the luminance processor for ganged saturation control.

The SN76227N is a conventional demodulator/matrix i.c., detecting R – Y and B – Y from the V and U signals, matrixing G – Y from proportions of the other two colour-difference signals, and adding Y to all three to give R, G and B outputs.

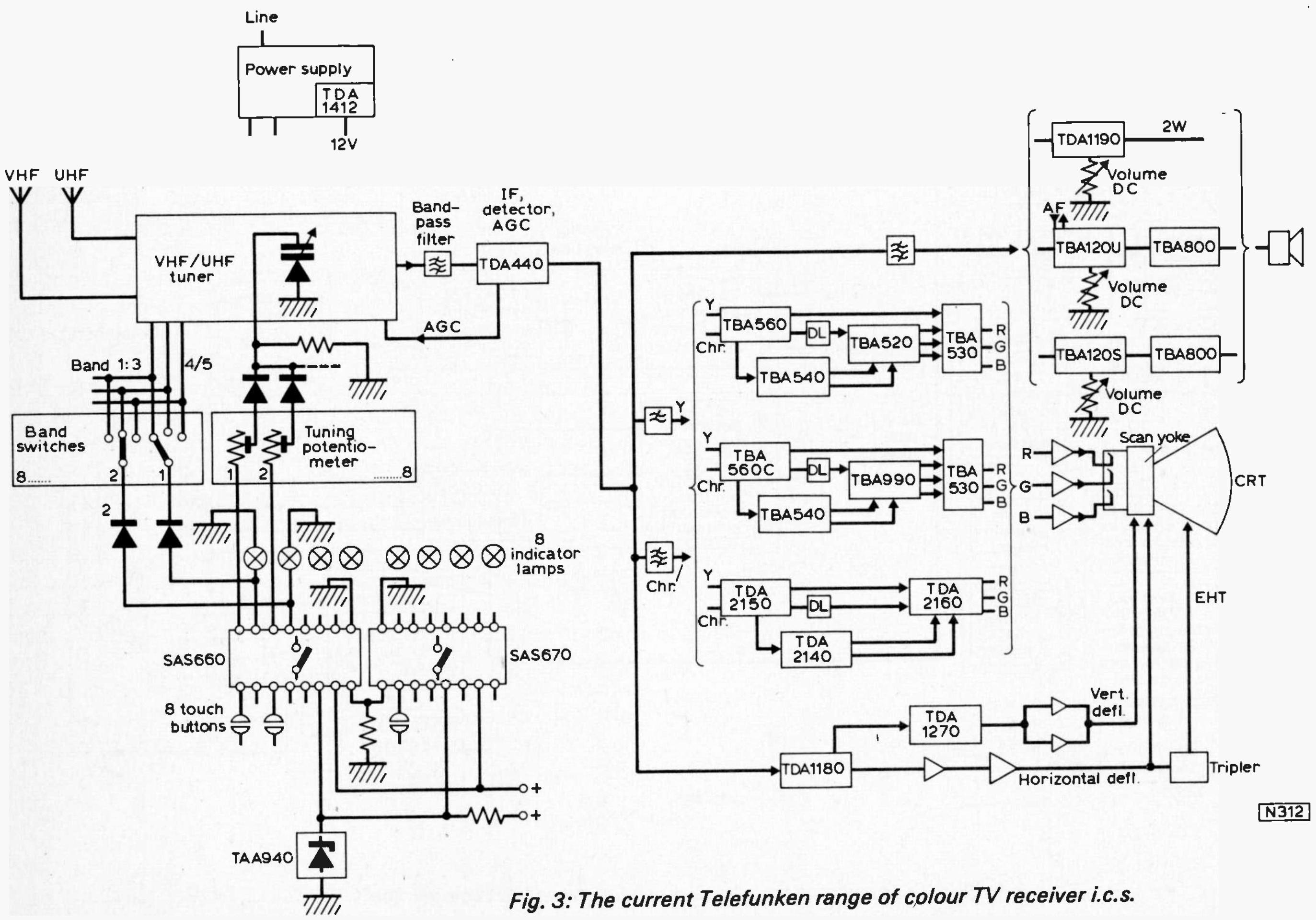


Fig. 3: The current Telefunken range of colour TV receiver i.c.s.

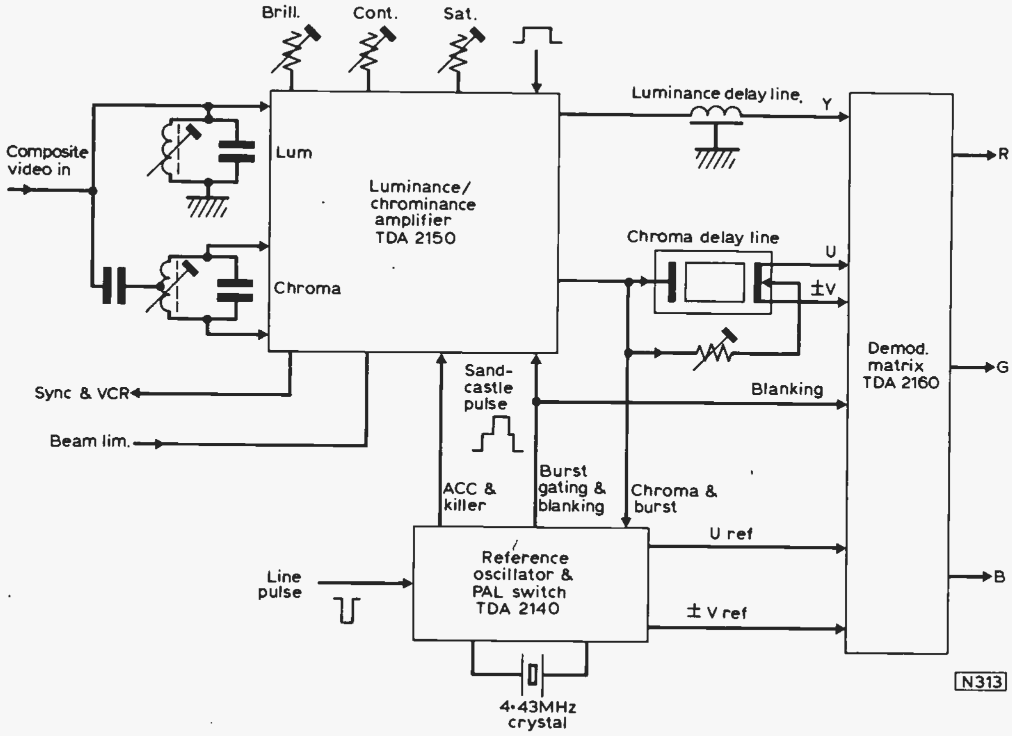


Fig. 4: Arrangement of the Telefunken three i.c. decoder. The V reference output from the TDA2140 is PAL switched.

Motorola

The three i.c. decoder from Motorola again uses a proven demodulator, the MC1327 (or TDA1327), which has the same pinning as the SN76227N. The luminance device is the TBA396 and the chrominance device the TBA395. Their functions are similar to the Texas ones mentioned above. They are 14-pin chips running off 24V, but as the pinning is different there is no compatibility. The new Decca 80 chassis uses this package.

Telefunken

The latest Telefunken (also SGS/Ates) decoder package once again has three i.c.s, but this time they have 16 pins and run off 12V. Fig. 3 shows the current range of Telefunken colour receiver i.c.s while Fig. 4 shows the latest decoder arrangement.

The TDA2150 luma/chroma processor functions very much like the present TBA560, clamping and controlling the luminance and chrominance signals. Similarly the

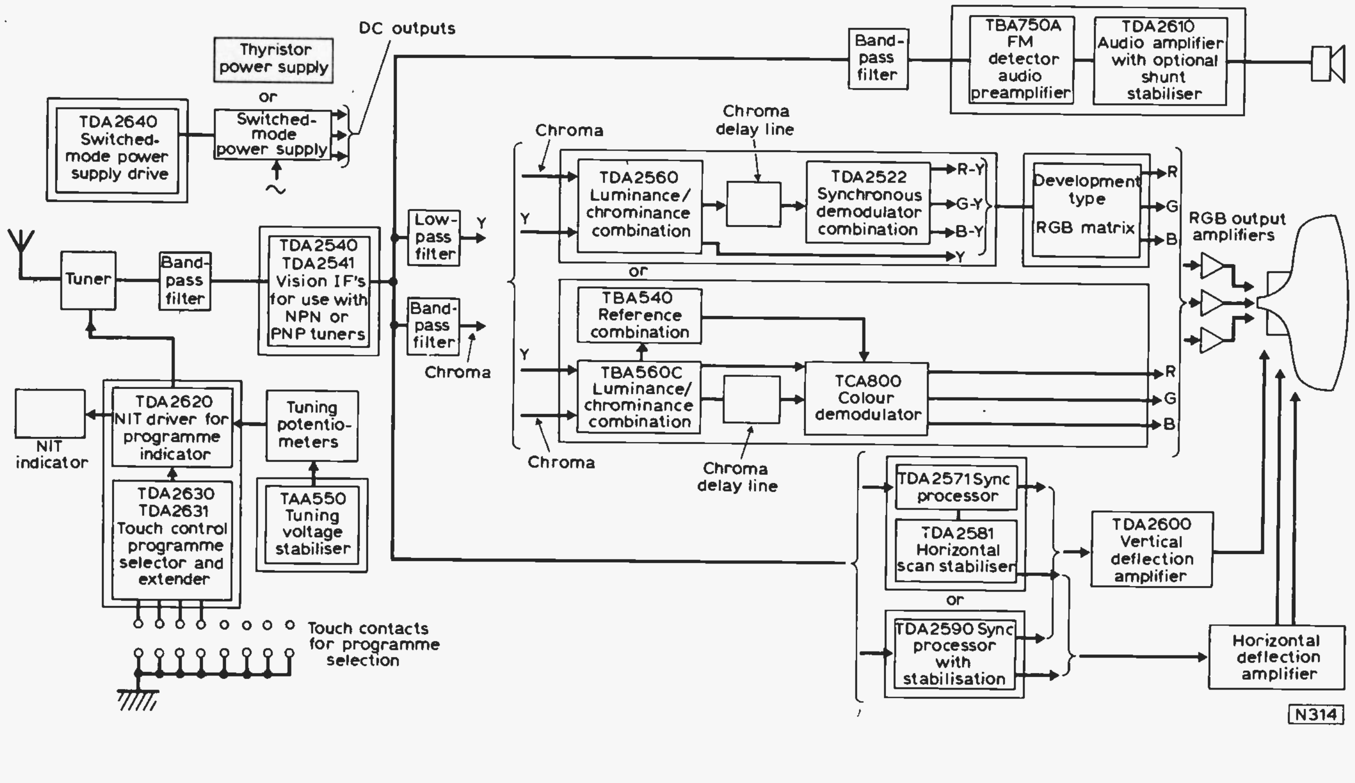


Fig. 5: The second generation of Mullard colour receiver i.c.s.

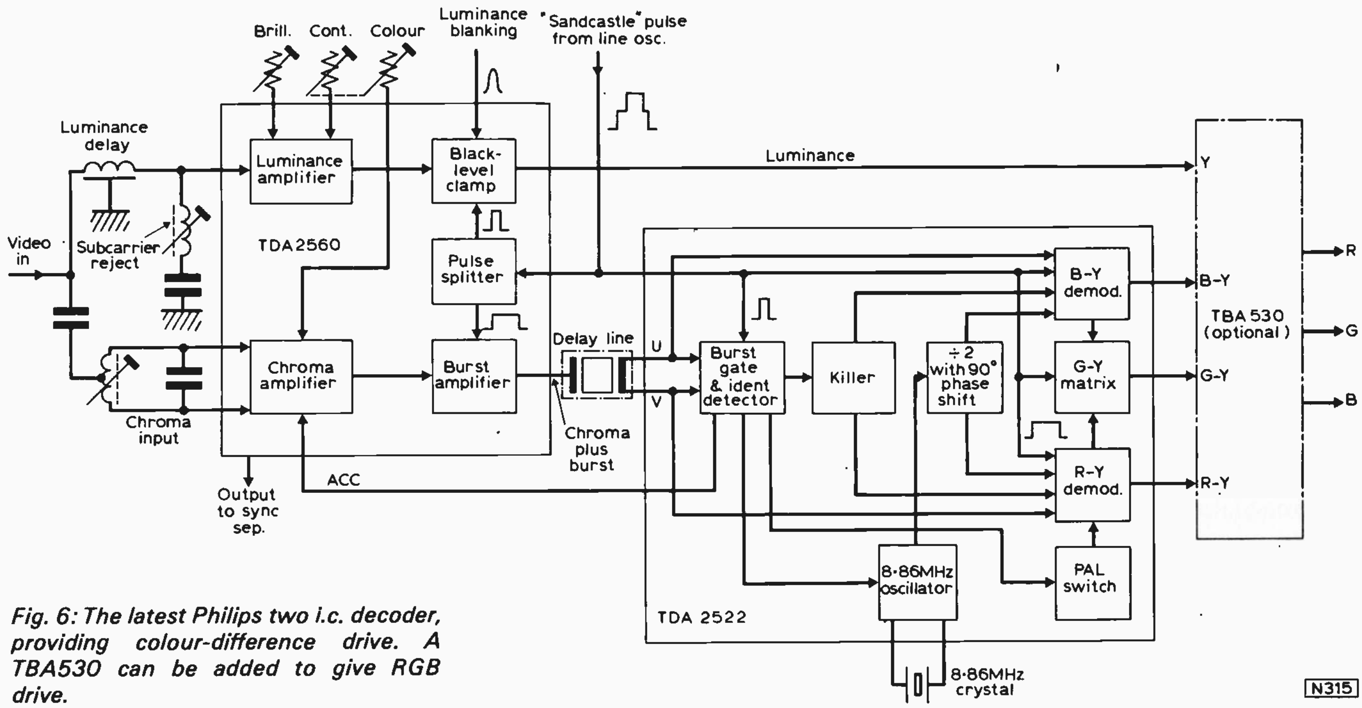


Fig. 6: The latest Philips two i.c. decoder, providing colour-difference drive. A TBA530 can be added to give RGB drive.

TDA2140 takes the role of the existing TBA540 reference subcarrier generator i.c. but gates out the burst using line flyback pulses and delivers, as well as 4·43MHz subcarrier signals in U and V phase, a combined blanking and burst gating pulse ("sandcastle pulse" – more anon). The TDA2160 demodulator combines the functions of today's TBA990 and TBA530, as well as blanking the signal during flyback. You know what is coming: the package has three 16 pin i.c.s running from 12V and is incompatible with the others.

Mullard/Philips

The second generation range of Mullard colour receiver i.c.s is shown in Fig. 5.

The parent Philips group has no less than three decoder packages on offer, one of which is unlikely to come here. Another, using a TCA800 to replace the TBA990 and TBA530, has already been mentioned earlier as in use by Rank and ITT. The third package (see Fig. 6) is a two i.c. decoder for colour-difference drive, becoming a three i.c. decoder if the TBA530 or its successor is added to give RGB drive. It has several interesting features and its evolution from the present decoder can be clearly seen. Block diagrams of i.c. functions are not the easiest things to follow, but bear with us while we go through the stages shown in Fig. 6. You will see that the TDA2560 does similar work to today's TBA560 while the TDA2522 combines the functions of the TBA990 and TBA540. To retain all existing features, make improvements, and keep to a 16-pin package requires some crafty circuitry, tantalising enough to merit a closer look.

Starting at the back end, the B – Y and R – Y demodulators conventionally matrix the G – Y signal, giving outputs of about a volt. The R – Y demodulator is reversed on alternate lines by a bistable circuit to give the PAL switch action. So much is conventional. Now the burst wasn't gated out by the front-end i.c., so it comes through the delay line with the chroma signal, split into its U and V phase components by the delay line action. These components are reconstituted in the i.c. phase detector and burst gate to drive the reference oscillator locking circuit and produce the half line frequency ident squarewaves to drive the PAL switch. Because the burst travels through the circuit with the chrominance signal there is no phase change and thus no need for a burst phase tuning adjustment.

You will also note that the reference oscillator crystal resonates at 8·86MHz (a small thing, but neat). At twice the subcarrier frequency, the positive-going peaks are alternately in U and V phase. You can if you prefer look at this another way: a 180° phase shift at 8·86MHz is the same as a 90° phase shift at 4·43MHz. Whichever way you look at it the end result is the same. If the 8·86MHz oscillation is squared and then divided by two in a bistable circuit the outputs from the two bistable collectors will be at 4·43MHz and exactly 90° apart – the ideal feed for the synchronous demodulators. The half line frequency ident signal provides the basis of the a.c.c. voltage just as in the current TBA540.

At this point, with blanking, killing, and gating still on the agenda, our 16-pin i.c. runs out of pins. Blanking and killing are therefore performed at the demodulators, by a combined pulse derived *directly from the transmitted signal* in the line oscillator i.c. (to follow). This pulse, called the "sandcastle" pulse (maybe they build them that way at Zandvoort) has its bottom 2V 12μs broad to coincide with line blanking, whilst the top, nominally 7V peak, is 3μs wide centred on the colour burst. It is only necessary to set the trigger levels of the appropriate circuits at say 1V and 5V and the two components will separate within the TDA2522 i.c. The advantages of this system are independence of gating from line phasing, and avoidance of spurious tripping of the circuits due to the presence of sync end or picture information in the burst gate. A further safeguard against spurious operation of the colour-killer is given by the inclusion of a delay stage in the killer amplifier. So much for the reference oscillator/demodulator i.c.

The TDA2560 is really the TBA560's grandson. It does more or less the same work, amplifying and controlling the luminance and chrominance signals. Beam limiting is conventionally applied to the contrast circuits, which are in turn conventionally ganged to the saturation. A negative-going video feed is available to drive the sync separator as this is no longer available in the new generation i.f./vision demodulator i.c. – it too ran out of pins.

The sandcastle pulse is also fed to this (TDA2560) i.c. The burst part is used for sampling the luminance back porch for black-level clamping, whilst the blanking part is used to override the saturation control during blanking. This has to be done to maintain the burst at nominal amplitude regardless of the colour level selected by the user. If this were not done the a.c.c. would work against the saturation control now that the burst travels through with the chroma signal to the demodulator i.c. It is perhaps unfair to dwell too much on one decoder package, and to take it out of context from its peripheral i.c.s, but this one is such a good example of the trends mentioned in the opening paragraphs.

Channel selection

Touch-button control arrangements didn't even get a look in three years ago. Now all the prestige sets have them. You may wonder why they are needed, especially as modern push-buttons require only a featherlight touch. The truth is that designers of electronic wizardry will not rest content until the last tiny mechanical item has been designed out of the set. Right now they must be furiously attacking the on-off switch! Reverting to touch-tuning, the principle is simple. Six preset potentiometers across a zener diode regulated 30V line can be set to give six different voltages at their respective sliders. To a varicap tuner each voltage represents a station, with Ch.21 low and Ch.68 high.

All we need is an electronic switch to select the desired voltage. An i.c. can do this, and although some are capable of up to eight selections the ones we have shown (see Fig.7) can select four channels each (they then run out of pins!). Touch a button and the associated pin of the i.c. is grounded via a safety resistor network and your finger. You are usually allowed to be 20MΩ or less. Inside the i.c. a 14-stage circuit acts as a flip-flop/amplifier; it flips, allowing 30V to be applied to the top of the selected potentiometer. When a bistable flips it holds as well, at the same time passing current through a common resistor which flops all the other channels, thus resetting the one previously selected. As well as applying 30V to the resistor, 12V appears at another pin for band switching and lighting a display lamp or LED.

At switch-on, anything could happen, so within one i.c. an extra transistor is given to button 1 and is arranged to bias that channel on. This ensures that the set comes up on the same channel each time from cold. If small capacitors are fitted from one lamp pin to the next touch-button pin, the tuner can be clocked round by remote control, simply by putting positive pulses on to the common resistor.

Packages available include:

Siemens SAS560, SAS570 (to be superseded by the SAS580/590).

Telefunken SAS660, SAS670.

Emihus ETT6016, BTT8024 (these are MOSFETs – see earlier remarks).

Mullard TDA2630, TDA2631, with the TDA2620 to provide Nixie indication.

I.F. devices

Synchronous demodulators are becoming the rule rather than the exception in the i.f. strip. The TCA270 was with us last time. Unlike the demodulators in the colour decoder circuits, the i.f. devices are not strictly synchronous demodulators. The problems of getting a local vision carrier locked in frequency and phase to the 39·5MHz i.f. carrier are enormous, so instead use is made of the composite i.f. signal. This is amplified and limited, most of the modulation being removed by a high Q tuned circuit. The signal thus formed is analogous to the output from the 4·43MHz crystal in the decoder but contains a few vision sidebands. Thus it's bound to "wag" about the carrier frequency somewhat. The distortion this produces is usually corrected later on. Other facilities generally provided by such i.c.s besides composite video output are noise limiting, tuner a.f.c., a "positive sync" output and a.g.c. with crossover adjustment.

A newcomer from Mullard (the TDA2540) adds to this three i.f. stages so that the only tuning required is the

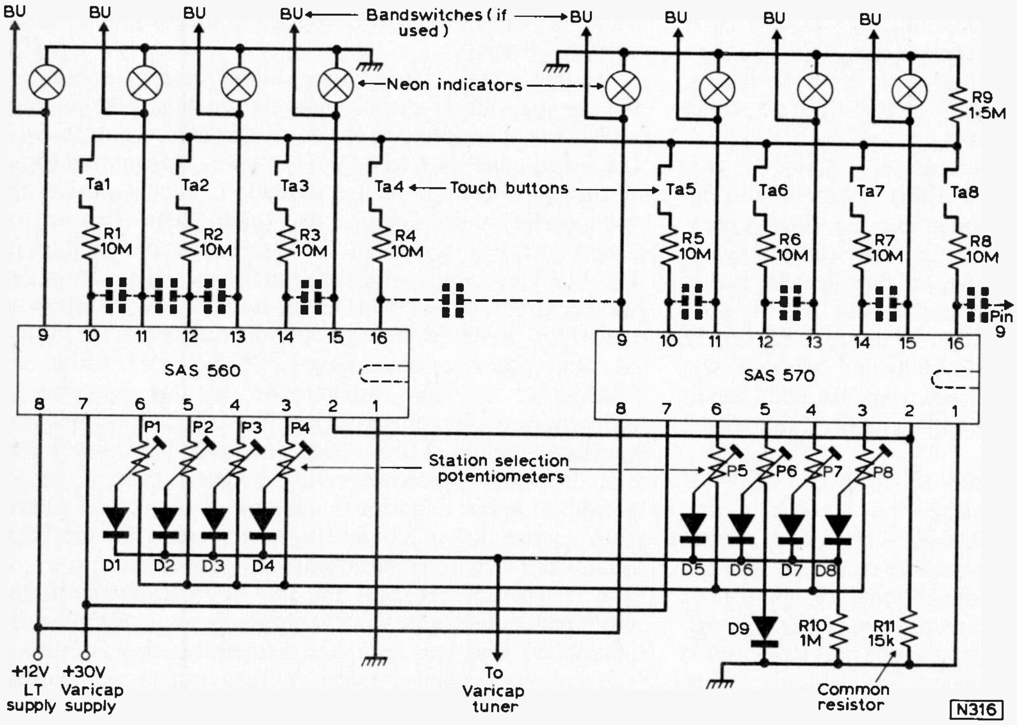


Fig. 7: Arrangement of an 8-channel touch-tune i.c. pair from Siemens.

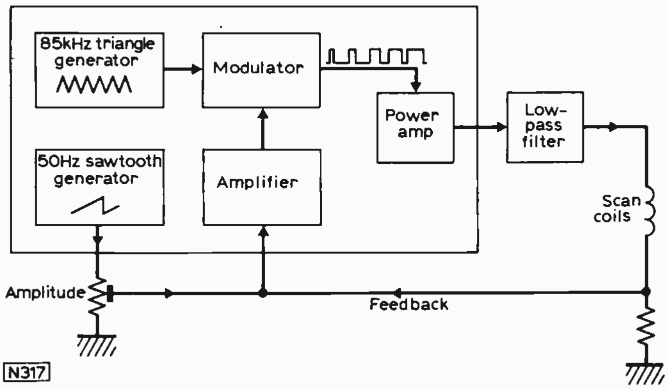


Fig. 8: Principle of operation of the TDA2600 switched-mode field timebase i.c. from Mullard.

tuner/i.f. bandpass filter with its conventional array of traps. The a.g.c. circuit permits the i.f. to resume control after the tuner a.g.c. range has run out. This may need qualification for those of you who do not handle a.g.c. circuits regularly, so a brief recap may help.

AGC action summary

Because the tuner mixer is the biggest noise generator in the set it is necessary to get as much r.f. amplification as possible before mixing. So for weak signals all the a.g.c. is applied to the i.f. stages, after the mixer. As the signal at the aerial increases, the i.f. gain is reduced to maintain a constant output from the detector. This is fine until the input signal reaches about 10mV, when the incoming sound and vision signals mix prematurely inside the r.f. amplifier causing sound-on-vision and vision-on-sound. Modern tuners cease to be noisy at around 1mV, so at some point between these two levels the a.g.c. is switched from the i.f. to the r.f. stage: 3mV is a representative level, the point being set by the crossover or takeover control (simply by applying 3mV and adjusting the crossover to where the voltage on the tuner a.g.c. line just begins to move positively). At the top of the u.h.f. band the tuner has little a.g.c. range and soon runs out to give lockout, i.e. negative picture and buzz. At this point our TDA2540 flips the a.g.c. control back to the i.f. section, extending the a.g.c range before lockout occurs.

Sound

The TBA120, TBA120S, TBA470 and TBA750 series of intercarrier sound amplifier/demodulator i.c.s is now so well established that no comment is needed here. Their outputs are sufficient to drive an output stage directly, but the trend is to follow them with an output i.c. such as the SN76013 or the TBA800 – not to be confused with the decoder TCA800. The latest from Mullard is a 4W package, the TDA2610, while the aforementioned Texas SN76013 has been uprated on voltage and noise and is now the SN76003.

Mono

The majority of recent TV i.c.s have been designed for use with colour sets. There has been increased production of monochrome sets in recent times however, and a few new i.c.s are found in this field. An interesting Texas i.c., the SN76544N, is used by Thorn in their 1612 and 1613 portable chassis to provide sync separation along with the line and field oscillator functions. It was used in earlier Pye 110° colour sets, but was later replaced by a separate discrete component field oscillator and TBA920 sync separator/line generator because this device is compatible with VCR operation. The Thorn portables just mentioned use a TAA611 audio amplifier/output chip and a TBA641 to provide the field deflection power. Pye's first solid-state monochrome chassis, the 176, introduces a new jungle (sync/a.g.c./video preamplifier plus blanking) i.c. previously seen only on the continent – type TBA890. It also joins the earlier Philips 320 monochrome chassis in using the TBA720 line oscillator i.c. which also contains a phase regulator and voltage stabiliser. Consistent with our theme, none of these interchange with their predecessors.

Colour timebases

There is a prolific number of newcomers for use in colour receiver timebases – a section previously monopolised by the TBA920 sync and line processor. Telefunken have a similar device, the TDA1180. The TBA920's successor, the TDA2590, generates the sandcastle pulse for the decoder directly from the transmitted signal so that adjustments to the timebase will not affect decoding. It also has provision for the mark/space ratio of the line drive to be changed, so as to set the output stage "on time" accurately.

The power supplies have attracted integration for the first time, with i.c.s such as the TDA1412, and the TDA2640 with over-voltage and over-current protection. Field timebases feature three contenders, the TDA1270 from Telefunken and SGS-Ates, and the TDA2650 and TDA2600 from Mullard. The latter is novel and merits description (see Fig. 8).

It is a switched-mode field timebase generator capable of driving the scanning circuits of a 110° 26 in. receiver. At first glance a field timebase that runs at 85kHz doesn't stand much chance against one that runs at 50Hz, but since switched-mode operation is used the output devices are either fully on or fully off thus reducing the dissipation. This permits a small i.c. to do the same job as a conventional 15W class A amplifier stage. There are two generators in the i.c. One produces an 85kHz triangle waveform while the other produces a 50Hz sawtooth. The sawtooth is mixed with a feedback signal from the deflection coils and is then fed via an amplifier to a modulator which is also fed with the triangle waveform. The modulator is really the heart of the arrangement, producing a pulse-width modulated squarewave train whose mark-space ratio varies from high to low at field rate. This is used to switch on and off the two high-power switching devices used in the output stage. The output from the i.c. is fed to the scan coils via a low-pass filter which removes the h.f. component from the signal. As a result a 4A, 50 Hz sawtooth is delivered to the scan coils.

There are many more new i.c.s that have not been mentioned here. The intention has been to select a few that typify the general trend, so we end with the TDA2600 because you cannot follow that.

I.C.s for Teletext haven't even been touched upon. Steve Money's mind-boggling series did that more than adequately, and with the current Oracle tests running at over 800 pages – including useful information for hikers in Wales – he is more than welcome to continue. For completeness however we ought to mention the vast amount of backroom work now going on to get the whole Teletext decoder package down to a handful of devices, with the leading labs playing "anything you can do I can do smaller". A lot depends on the system being accepted by Europe, and on the change of characters to be compatible with the Viewdata telephone system. ■

FAULT FINDING GUIDE

John Law

THORN 1500 CHASSIS

THE Thorn/BRC 1500 chassis is a single-standard, hybrid monochrome one used in many Ferguson, HMV, Ultra, Marconiphone and DER receivers. Valves are employed in the timebases and the audio circuit, and for sync separation, transistors being used elsewhere. The e.h.t. is obtained from a multiplier tray of which there are two types (*not* interchangeable!), a three-stick one which provides 15kV for the 17 and 20in. models and a five-stick one which provides 20kV for the 24in. models. The line output transformers also differ, those for the smaller-screen models being coded with a pink or green spot while those for the large-screen models are coded with a white spot.

There is a single, hinged panel which can be swung round to give access to the component side. The tuner used in most models has two transistors and four push-buttons for station selection. In the latest models a varicap tuner is used.

The circuit of the main chassis is shown in Fig. 4. Before going on to fault finding, we will provide a brief summary of circuit operation. There are quite a large number of stock faults, but this is perhaps not surprising when one considers that many tens of thousands of these sets have been produced since the original models appeared in 1969. The chassis is still in production.

Line Timebase

The sync separator is V1A, the line sync pulses appearing at its anode being integrated by R52-C43 and coupled by C44 to the flywheel sync discriminator diodes W3-W4. Reference pulses from tag E on the line output transformer are integrated by R51-C46, with shaping provided by C49, and applied to the flywheel sync circuit via C45. When the discriminator diodes conduct, a positive- or negative-going voltage dependent on the relative phase of the reference signal and the sync pulses is produced. The output is filtered and fed to the base of d.c. amplifier VT10 which controls the voltage applied to the line blocking oscillator time-constant network R61-C52. The line hold control R63 applies an additional d.c. voltage to the circuit to preset the oscillator frequency. The timing capacitor C52 controls the conduction of the oscillator circuit, the line drive waveform being generated by C53 which charges from the HT3 rail via R64. The drive is applied to the line output stage via C100.

The line output stage follows normal practice, with the boost reservoir capacitor C92 connected to the HT1 rail. C90 in series with the line scan coils provides scan correction. Stabilisation to maintain correct width despite variations in the mains supply is achieved by pulse feedback via C96 to the voltage-dependent resistor Z3. The negative potential thus produced across Z3 is offset by the positive voltage obtained from the width control R132.

Field Timebase

The field timebase consists of a cross-coupled PCL805 (PCL85 on earlier sets). C72 charges via R94, R93 and R123 to generate the field drive waveform. Z1 provides height stabilisation. The sync pulses are coupled to the triode cathode by C74. Field linearity correction is provided by the feedback loop C81-R104-R105-R106-R100-C76-R98. Z2 across the primary winding of the field output transformer T3 limits the peak value of the field flyback pulses while C80 across the secondary winding bypasses line frequency pulses fed back from the deflection coils. R92 in the triode grid circuit adjusts the field hold while R103-C79 bias the output pentode.

Power Supplies

There are separate rectifiers for the heater and h.t. supplies – W7 and W8 respectively. The heater chain is returned to chassis via two resistors R79 and R136. A filter (C58-R78-C56) fed from this point provides a 26V supply (HT6) for the tuner, i.f. and a.g.c. circuits. The video output transistor VT9 is fed from the HT2 rail while the flywheel line sync d.c. amplifier VT10 is fed from the HT3 rail.

The dropper resistor, consisting of R111, R116, R125, R133 and R79, is mounted at the top of the printed panel. R111 is the heater dropper resistor, acting in conjunction with W7; R116 is the h.t. surge limiter; R125 supplies the HT1 rail; R133 supplies the field output stage (HT4); R79 as we have just seen is part of the low-voltage transistor supply.

The receiver has only one cartridge fuse, F1. This is a standard size fuse rated at 1·6A and is mounted just below the mains dropper. In addition there are fusible resistors in the h.t. lines. These open in the event of a short-circuit or overload in the circuits they feed. They can be resoldered after clearing the fault. Earlier sets have only one thermal fuse – R124.

Signal Circuits

The push-button u.h.f. tuner follows usual Thorn practice with two transistors and a three-section ganged tuning capacitor. It's trouble free apart from one or two mechanical problems which we will come to shortly. The i.f.

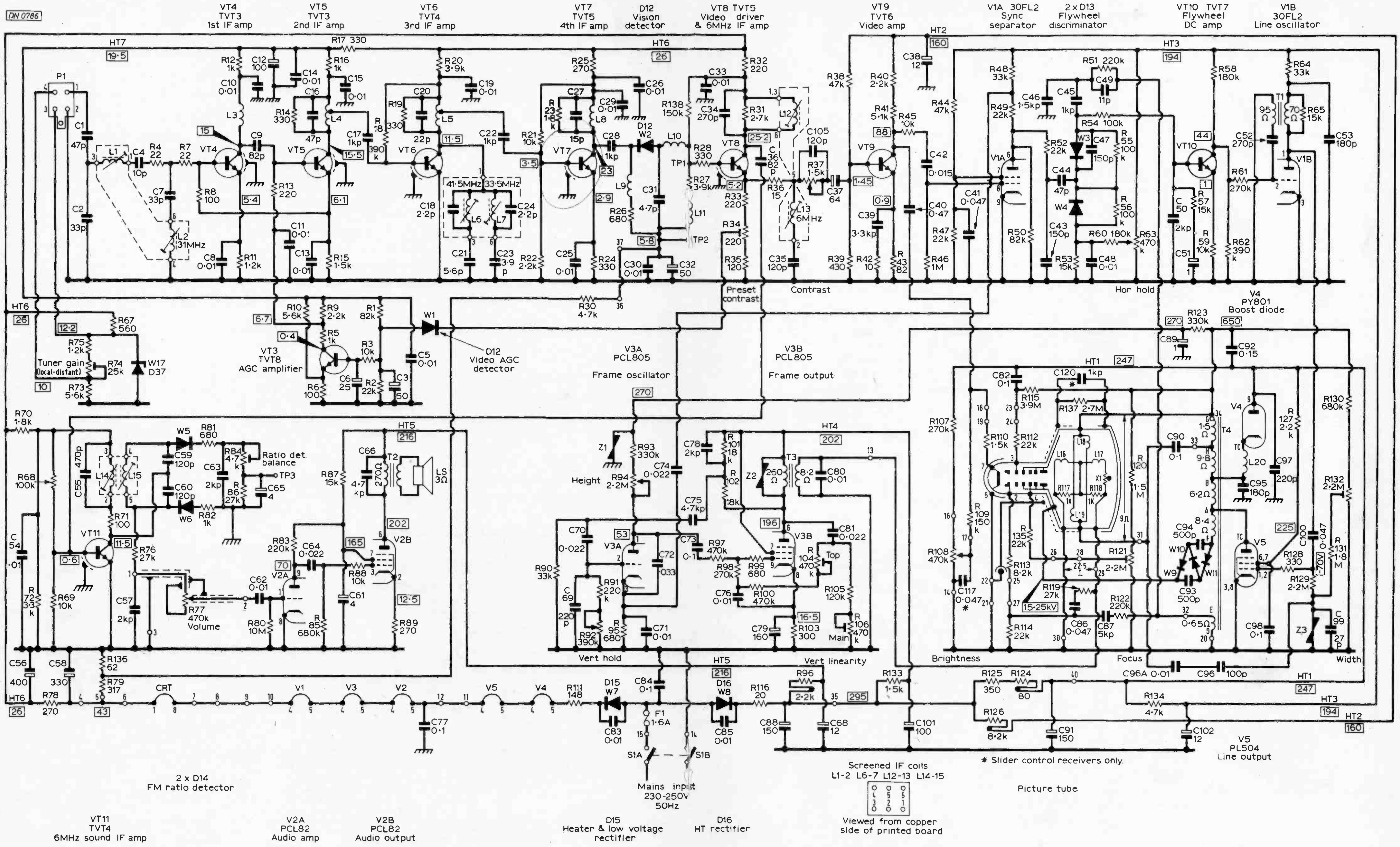
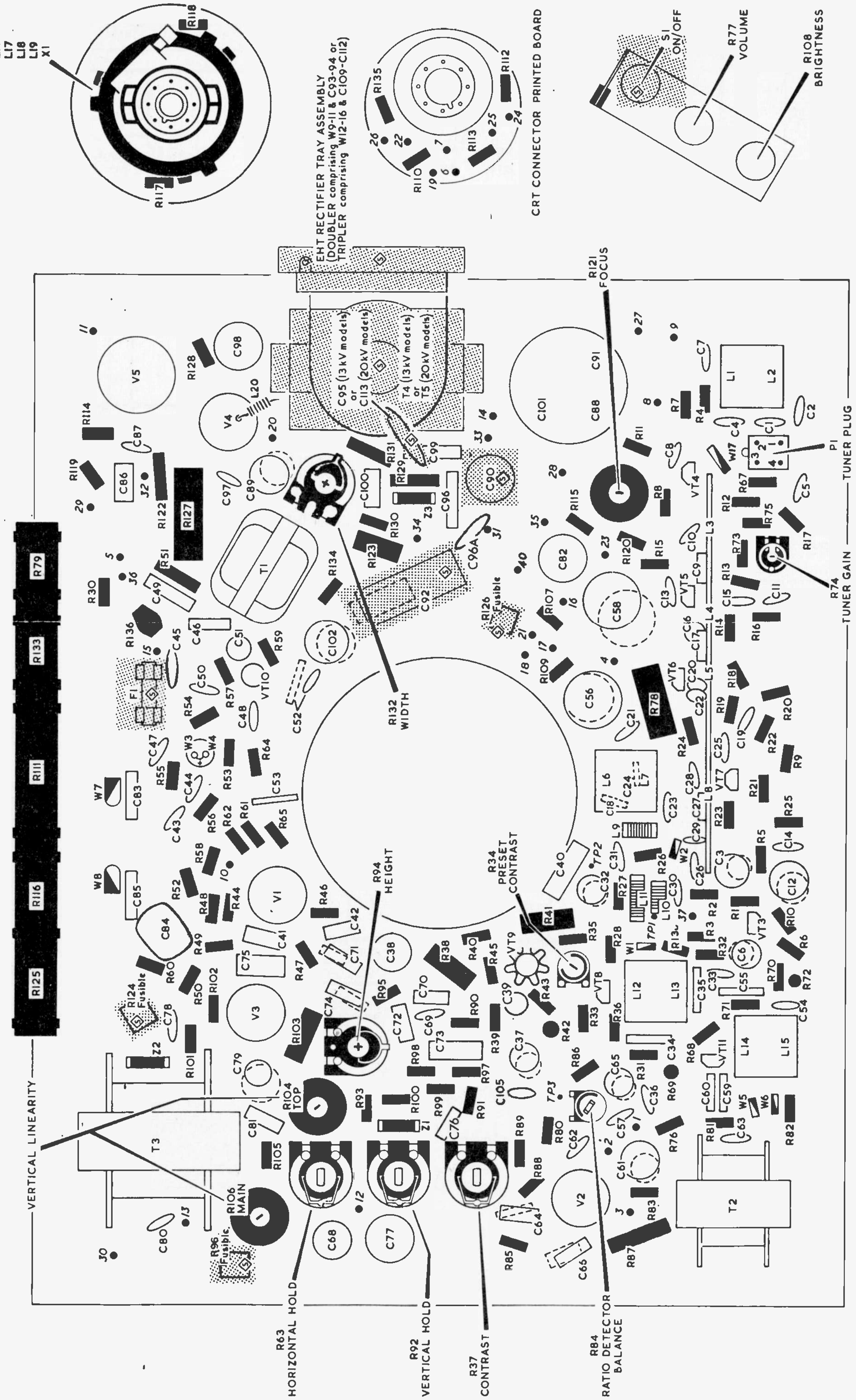


Fig. 4: Thorn 1500 chassis circuit diagram, incorporating modifications introduced during the production run.

strip is also relatively trouble free. There are four i.f. amplifier transistors (VT4-VT7), the first two being gain controlled. The output from the a.g.c. amplifier (VT3) is applied to the base of the second i.f. transistor VT5, which drives the base of the first i.f. transistor VT4 from its emitter – via R8. The base bias for the video driver stage VT8 comes from the junction R79-R136 at the end of the heater chain and is smoothed by C32. The 6MHz intercarrier sound signal is tapped from the collector of this stage and fed via C36 to the single intercarrier sound amplifier VT11. This drives a ratio detector circuit whose output is fed to a straightforward PCL82 audio amplifier/output stage. The sound output transformer T3 is mounted at the top of the panel.

Tuner Faults

One of the most common troubles with these sets is mechanical failure of the push-button tuner unit. The push-buttons appear to operate, but the channels don't change. The operating bar controlling the rotor of the tuning capacitor is soldered to two crank arms and operates against a spring. Station changing over the years results in the soldered joints fracturing so that the tuner is inoperative.



NOTE All components marked thus---- are alternative locations

Fig. 5: Layout of the printed panel.

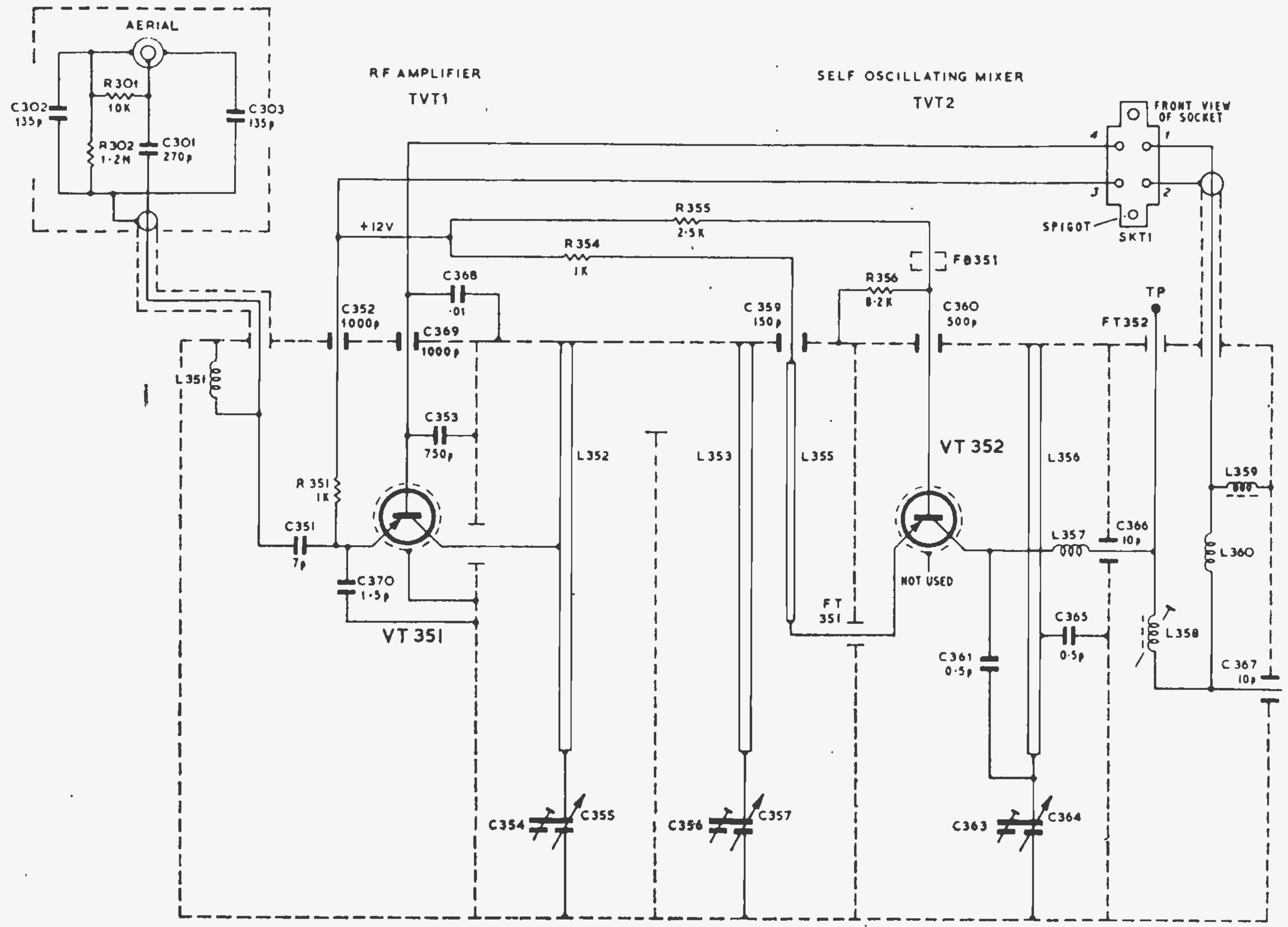
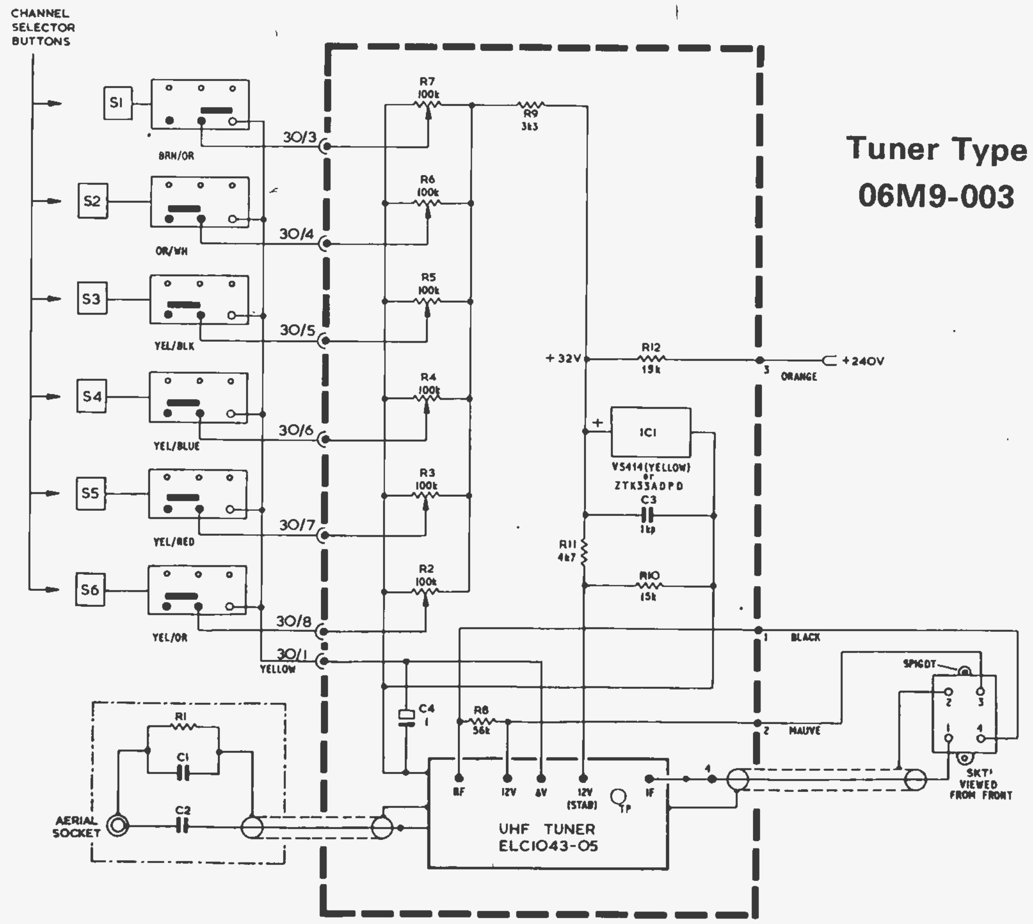


Fig. 1: Circuit of the mechanical u.h.f. tuner type T21.



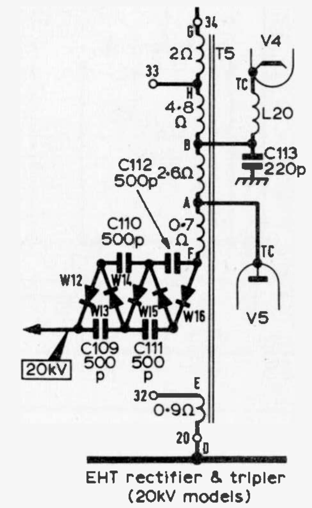


Fig. 2: E.H.T. tripler circuit used in the large-screen (20kV) models.

Fig. 3 (left): Tuning arrangements used in later models fitted with an ELC1043/05 varicap tuner. The 240V d.c. supply is obtained from the main panel – from a tag adjacent to C82.

The fault is easily recognised and the repair consists of resoldering the ends of the bar back into the crank ends. Stretching the tension spring lessens the chance of future failure of the joints. The bar return action must remain positive however, so be careful not to overdo the stretching.

Plug P1 connecting the tuner to the chassis panel sometimes develops intermittent connections. This trouble can be cleared with Servisol, as can dirty tuner spindle bearings. Be careful to use the minimum possible spray inside the tuner as excess oil or careless spraying can lead to alteration of the tuner constants. Drift often results from poor rotor shaft earthing. A fairly heavy soldering iron is required to remove the earthing springs for cleaning.

Complaints of weak, grainy pictures, or no picture at all following a local thunderstorm, can usually be traced to failure of the r.f. amplifier transistor VT351 in the tuner. If a Thorn TVT1 is not available an AF186 can be used.

Another cause of intermittent results is dirty contact at the slider of the tuner gain control R74.

When replacing transistors or components in the tuner be careful to copy the position and lead lengths so as not to disturb the alignment more than is necessary.

IF Strip

The transistor i.f. stages are not troublesome. Electrode voltage measurements will usually reveal a defective transistor or associated component. The most vulnerable component is VT7 and we shall have more to say on this subject shortly. Since all the i.f. and video transistors are npn types, a rough check on their condition can be obtained using an Avo meter switched to read ohms. Connect the black lead to the base and the red lead to the emitter and collector in turn. A reading of under 50Ω should be obtained in both cases. Reversing the leads should give a significantly higher reading if the transistor is in good condition.

Of the electrolytics in this area, C12 can occasionally give trouble but more often the a.g.c. reservoir capacitor C3 dries up causing such effects as flicker and buzz. Picture flicker has also been traced to C6 and the a.g.c. decoupling capacitor C11.

Power Supply Faults

Although not common, we have had cases of failure of one side of the mains on-off switch. The symptoms of course are no signs of life and no heater glow when the set is switched on. The only answer is switch replacement: avoid the temptation to short out the open section. The mains filter capacitor C84 can go short-circuit, blowing the mains fuse F1 and producing the same symptoms. The capacitor can reseal itself with the result that when tested using an ohmmeter the defect does not show up – it breaks down again however when the mains voltage is applied. The replacement should be rated at 1kV working.

Early chassis used miniature BRC diodes in the h.t. and heater rectifier positions (W8, W7). Mounted on the internal, hot side of the panel they tended to go short-circuit. The larger BY126 is a more reliable replacement, especially when mounted on the external, cool side of the panel.

A short-circuit h.t. rectifier will blow the mains fuse, while a short-circuit heater rectifier will remove the 26V HT6 supply since no d.c. will be developed across C58.

The circuitry at the end of the heater chain is the source of a lot of troubles on this set. The most common fault here is when R79 goes open-circuit. This removes the bias to VT8, with the result that the picture goes but the raster remains. The sound may go too. More serious however is that the HT6 voltage rises to 50V or more – which at least helps in giving a clue to the cause of the fault. If the set is left on however VT7 will go short-circuit and VT8 may suffer the same fate. The confusing thing is that the sound can still be present when this happens. If this situation is encountered it is worth taking a look at R78 which may have cooked, also the resistors associated with VT7 and VT8.

As you'd expect, the electrolytics here contribute their share of faults. The most common is C56 deteriorating to give field slip accompanied by a hum bar. The same symptoms can be caused by C58 deteriorating. There is a tendency to line pulling as well when these capacitors go open-circuit.

C32 which smooths the VT8 bias voltage from the junction of R79-R136 can be responsible for quite a few problems. When it goes short-circuit there is no bias of course and thus no vision or sound. More often however it dries up. The result again is poor sync and a hum bar and maybe ripple on vision.

When R136 goes open-circuit the symptoms produced are field roll and an over-contrasted picture.

Another electrolytic which gives trouble from time to time is C38, which smooths the HT2 rail. If it goes short-circuit the raster remains but the picture goes. The symptoms produced as it dries up are picture cogging, bent or wavy verticals, a slight hum bar and poor definition. We will deal with C37 and its habits later.

Visual Checks

As mentioned earlier, thermal fuses are fitted in the h.t. lines. Following a breakdown, inspection of these often speeds fault location. R124 goes open-circuit for example when there has been excessive current flowing in the line output stage, due for example to the harmonic tuning capacitor C95/C113 (C95 in small-screen models, C113 in large-screen sets) going short-circuit, or to lack of drive or a faulty line output transformer. A short-circuit video output transistor VT9 can open R126, while excessive current in the PCL82 audio valve will open R96 to give the no sound symptom. Obviously a visual check which reveals a spring contact parted from a resistor tag gives an immediate clue to the source of the breakdown. Once the defective valve or component has been replaced the spring can be resoldered to the tag.

The dropper section R111 feeding the heaters and the h.t. circuit surge limiter section R116 can both fail for no apparent reason, giving no results.

No EHT

Given that R124 is open as a result of excessive current in the line output stage it will often be found that on temporarily closing the contacts the PY801 efficiency diode runs red hot. In this case check C95/C113. You will find it wired across two tags on the line output transformer and if it's responsible for the condition there will be signs of burning. The capacitors originally used in this position were rated at 8kV: a replacement rated at 12kV working voltage will prevent further breakdown.

Still on visual indications, no e.h.t. with overheating and red hot operation of the PL504 line output valve or PY801 boost diode can be due to an internal fault in the valves or the boost capacitor C92 being short-circuit. Alternatively, there may be no drive – check for around –70V at the control grid of the PL504. If this is absent check the line oscillator valve V1B – triode section of the 30FL2. The valve may be faulty. The oscillator transformer T1 may have an open-circuit winding or be dry-jointed – the primary winding should give a d.c. resistance of 68-72Ω and the secondary 92-96Ω (the transformer is identical to the one used in the earlier 1400 chassis incidentally). Leakage in either the timing capacitor C52 or the charging capacitor C53 will reduce or stop oscillation (C52 can also be responsible for intermittent change in line frequency while C53 can cause intermittent picture tearing when leaky). R64 and R134 can go open-circuit – the latter sometimes does so intermittently. Once these possibilities have been checked overheating indicates shorted turns in the line output transformer.

Lack of e.h.t. with cool valves in the line output stage occurs when the PL504's screen grid voltage is removed. Check whether C98 is short-circuit. We haven't had R127 open-circuit yet but this would give the same result of course.

Lack of Width

Apart from low-emission valves the most common cause of lack of width is the width control itself – R132. There are frequently burn spots on the track. In earlier chassis the control was 1MΩ but in later production it was changed to 2·2MΩ while its series resistor R130 was changed from 330kΩ to 680kΩ. This has reduced the incidence of burn spots by lowering the dissipation in the potentiometer.

A narrow picture with the width potentiometer giving no control is usually due to R131 going high-resistance. A narrow picture with limited control action occurs when R130 goes high. The symptom when the grid leak resistor R129 is defective is a pulsing picture.

EHT Tray

Yet another common fault is breakdown of the selenium e.h.t. rectifier tray. The complaint is either that the picture expands and disappears when the brightness is turned up, or that the picture sizzles with increase in brightness – the latter fault is easily recognised once seen. Both are due to one or more of the selenium pencils overheating, turning the outer cover black where the heating has occurred. Separate pencils can be obtained but it is much safer to replace the complete tray.

Poor Focus

Poor focus was a common fault in early models, due to R120 going high-resistance or open-circuit. R121 can also be responsible.

Field Timebase Faults

The most common cause of field troubles is the PCL805. It should be changed before seeking further. Next come the output pentode cathode bias capacitor C79 and resistor R103. If C79 develops an internal break there will be a dramatic loss of height accompanied by some bottom compression. C101 can also cause this fault. If the original valve had been drawing excessive current a replacement may well improve the field when some adjustment of the height and linearity controls is made. The value of R103 should be checked however since if it has changed the life of the replacement valve could be considerably reduced.

The field charging circuit is fed from the boost line via R123 and the smoothing electrolytic C89. The capacitor can develop a leak, resulting in intermittent field collapse, varying height or gradual loss of height over several hours. A voltage check across the capacitor may show a reduction from the correct reading of 270V. Its size and position suggests that it is an 0·1μF capacitor, but in fact it is a 1μF unit. This high value is used to delay the collapse of the field scan long enough, in the event of the line timebase failing, to maintain a fading line instead of a brilliant spot which could burn the c.r.t. screen permanently. It's important therefore to use the correct 1μF, 350V replacement. The resistor can change value and become brittle, eventually crumbling at a touch – this is a fault that is appearing more frequently with the passage of time. The replacement should be rated at 1W.

The height and field linearity preset controls develop faulty tracks and dead spots, giving symptoms of intermittent field collapse, lack of height, cramping etc. Fortunately these little items are cheap. When in doubt replace a preset, don't clean it.

Faulty connections to the field output transformer are a fairly common cause of field collapse.

There are a couple of common defects in the cross-coupling network between the pentode anode and the triode grid. First, C75 becomes leaky, causing field bounce, loss of hold, etc. Secondly the resistors in the potential divider network R101-R102 change value. The main offender is R102 which can rise to 200kΩ or more. Loss of hold, lack of height and severe field flutter can occur as a result. Changed value resistors are common in the 1500 chassis in fact.

A recent case of intermittent loss of field hold was traced to both C69 and C70 being faulty.

Video Coupling Electrolytic

Poor field sync can be due to a number of causes as we have seen. One not mentioned so far is C37, the electrolytic coupling the output from the video driver transistor VT8 to the base of the video output transistor VT9. This capacitor can be the cause of quite a lot of troubles in fact. Poor sync and poor contrast with the contrast control having little effect, field hold varying when the contrast control is altered, intermittent loss of field sync with poor l.f. response, wavy verticals and intermittent vision or "blinking" are the sort of thing to expect when it dries up – also raster but no vision signal.

Weak Sync

A common complaint is weak line and field sync, with rolling when the slightest interference occurs. The most frequent cause of this trouble is the sync separator's screen grid feed resistor R44 changing value. Use a replacement rated at 1W to avoid recurrence of the fault. Leakage through the sync feed capacitor C42 can cause weak sync pulses – recently we traced a case of wavy verticals to this capacitor. The valve itself can also be faulty.

Line Sync Faults

Wavy verticals will be the result when C102 which smooths the HT3 supply dries up. Line pulling, a few lines at a time, occurs when C51 in the flywheel filter circuit goes open-circuit. This can even take the form of right and left movement of the lines from the centre, giving a zigzag effect. C51 can also leak to cause drifting line hold, hold at one end only of the control's range, or loss of sync. Complete loss of line sync can be due to VT10 being defective. It can also cause line drift – sometimes only when the back is in place.

Main Smoothing Can

The main smoothing can contains C88, C91 and C101. Failure in the can – which can be due to leakage between the capacitors inside the can – gives the picture an easily identifiable wavy, weavy effect. It is best to use the correct Thorn replacement can.

Sound Faults

Sound distortion can be due to the PCL82 valve or to leakage in the coupling capacitor C64. Hum on sound may be a defective valve or loss of capacitance in one of the smoothing electrolytics C88, C68 or C61. Vision-on-sound or sound buzz will be evident if the ratio detector diodes W5-W6 are unbalanced. Resetting the ratio detector balance potentiometer R84 may restore normal conditions: if not, check that the diodes have equal value forward resistance, and also check C65.

Modifications

During the eight year production run of this chassis over fifty modifications have been introduced. Our circuit shows the latest version. A selection of the modifications, with the reason for the changes, is given below. It is worthwhile making many of these modifications to earlier chassis in order to up-date them.

C39 changed from 3900pF to 3300pF and R42 from 22Ω to 10Ω to give improved transient response.

R48 changed from 22kΩ to 33kΩ and R49 from 33kΩ to 22kΩ to give improved field sync.

R58 changed from 180kΩ to 150kΩ and R64 from 39kΩ to 33kΩ to eliminate line oscillator crossover at the centre of the screen.

R96 repositioned and changed to a fusible type; R124 repositioned and the wattage rating increased to 4W; R126 changed to a fusible type; rating of R87 increased to 2W and R95 to $\frac{1}{4}$W. These changes made to give improved safety and reliability.

Rating of R103 increased to 2W for improved stability.

R134 changed from 5·6kΩ to 4·7kΩ for optimised HT3 voltage.

R130 increased from 330kΩ to 680kΩ and R132 from 1MΩ to 2·2MΩ to reduce the dissipation in the width control.

R137 increased from 2·2MΩ to 2·7MΩ to ensure that resistors at the low end of the tolerance range exceed 2MΩ in value.

R354 changed from 1kΩ to 470Ω and R355 from 2·5kΩ to 1kΩ to reduce patterning on the lower channels (push-button tuner modification).

C2 changed from 42pF to 33pF to give improved bandwidth, C18 being added and C21 changed from 8·2pF to 5·6pF to improve the shape of the i.f. response.

C66 changed from 0·015μF to 0·0047μF to give improved sound quality.

C83 and C85 increased from 0·001μF to 0·01μF to give added protection to rectifiers W7 and W8.

R138 added to give improved detector linearity.

Value of C95 160-180pF and C113 190pF-220pF to give e.h.t. correction. C95 should be 160pF on receivers fitted with Plessey scan coils to increase the e.h.t. and improve the focusing.

C96A, 0·01μF 1kV, added in series with C96 to give protection in the event of C96 going short-circuit.

C105 120pF added across the contrast control to give improved video compensation.

In later models fitted with slider user controls C117 is added to decouple the brightness control slider and C120 is added in parallel with R137.

R4 changed from 10Ω to 22Ω, R21 from 12kΩ to 10kΩ and R23 from 2·2kΩ to 1·8kΩ to give improved alignment.

R31 changed from 1·5kΩ to 2·7kΩ to give improved intercarrier sound performance.

R39 changed from 470Ω to 430Ω to improve the performance of the video output stage. This changes the base voltage of VT9 from about 1·7V to typically 1·45V.

To give improved tuner voltage supply regulation a 12V, 5% zener diode (W17) replaces the voltage-dependent resistor previously used for this purpose. With this modification R67 was changed from 1kΩ to 560Ω and R29 (3·9kΩ) which was previously connected between the HT6 rail and chassis was deleted.

QUERY SERVICE CHARGE NOW 50p

We regret that is has become essential for us to raise the charge made for replying to readers' servicing queries. The service, started many years ago, was originally free: it helped us to keep in touch with readers' problems and requirements. Those were the days of valve monochrome receivers however, when sets were relatively simple and most faults were straightforward. The present charge was introduced in September 1970, mainly to help with the rising costs of running the service. Because of our limited staff the queries have to be dealt with by external associates, and the cost of fees and handling far exceeds the present charge. We simply cannot continue to shoulder the substantial deficit that this represents, and for this reason we are raising the charge from the present issue to 50p (including VAT) per query. We will still be making a loss on each query dealt with but hope to be able to continue the service in the interests of keeping in touch with readers' day to day needs. We feel that readers will appreciate our difficult situation, with costs having risen substantially in recent years while the range and complexity of the problems presented by today's sets make heavy demands upon those who answer the queries.

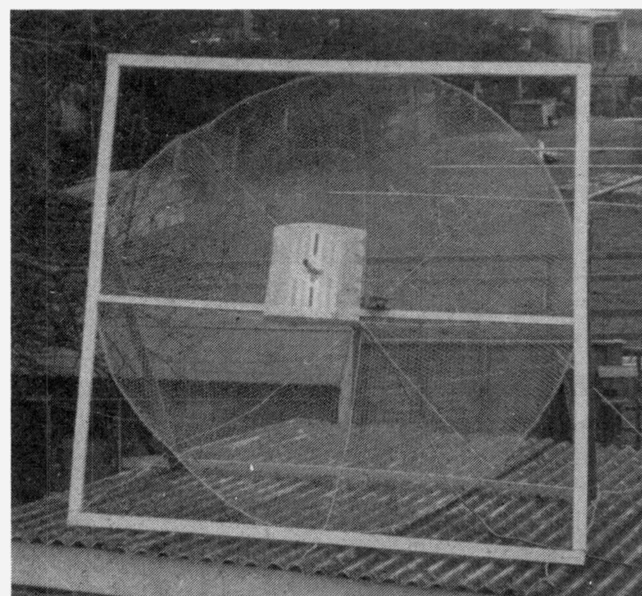
LONG-DISTANCE TELEVISION

ROGER BUNNEY

FOLLOWING an increase in Tropospheric reception towards the end of March (28th-29th), April has been a relatively quiet month, though there were further lifts in Tropospheric conditions on the 13th, 17th and 18th. The opening at the end of March produced mainly French v.h.f./u.h.f. signals with several West German stations and DFF (East Germany) on channel E6. The opening on the 13th produced an interesting variation, the old French test card – the one with the lady on a horse. This turned out to be Limoges, ch. E50. The openings on the 17th-18th brought me one new station, the Neufchatel ch. E65 TDF-1 819-line 7kW relay, and confirmation of a 350W ch. E52 relay at Vallee de Chevreusse. In addition there have been indications of the approach of the coming Sporadic E season – longer duration signals, and increasing activity in Band I. Hopefully by the time this column is being read things will be buzzing. The log this month consists mainly of meteor shower (MS) reception: if for nothing more than familiarisation with station and network initials I've decided to include it this time!

1/4/76 DFF (East Germany) ch. E4 – MS.
3/4/76 TSS (USSR) R1; RTVE (Spain) E2 – both SpE.
4/4/76 CST (Czechoslovakia) R1 – MS.
5/4/76 DFF E4; TVP (Poland) R1; RTVE E2 – all MS.
6/4/76 DFF E4; TVP R2; SR (Sweden) E2 – all MS.
7/4/76 CST R1; CST R1; WG (West Germany) E2 – all MS.
9/4/76 CST R1 – MS.
10/4/76 DFF E3, 4; TSS R1; DR (Denmark) E3; RAI (Italy) IB; JRT (Yugoslavia) E4 – all MS.
12/4/76 RTVE E2 – MS; CST R1 – SpE.
13/4/76 CST R1 – MS.
15/4/76 DFF E4 – MS.
16/4/76 TSS R1 – SpE; TVP R1; CST R1; MT (Hungary) R1; RTVE E2; ORF (Austria) E2a – all MS.
17/4/76 TSS R1 – SpE; DFF E4 – MS.
19/4/76 WG E4 – MS.
20/4/76 DFF E4; CST R1 – MS.
21/4/76 RTVE E2 – MS.
22/4/76 TSS R1 – SpE; DFF E4; CST R1 – both MS.
23/4/76 TSS R1; DFF E4 – both MS.
24/4/76 TVP R1; ORF E2a; SR E2 – all MS.
25/4/76 MT R1 – MS.
26/4/76 DFF E4; MT R1 – both MS.

Not an inspiring log, but hope for things to come!



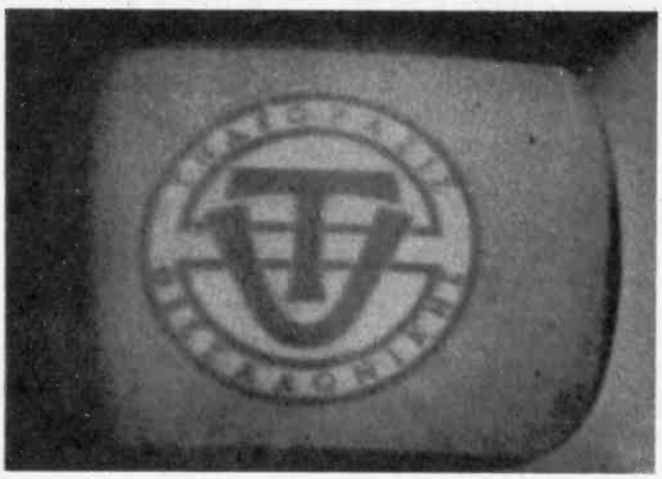
Ian Beckett's home-constructed dish for reception of signals from the ATS-6 satellite.

Satellite Reception

During April we visited Ian Beckett at Buckingham to see his reception of the ATS-6 Indian TV satellite transmissions. After lunch, and exactly on time, the ATS-6 transmissions appeared, starting with test cards and the PM5544 pattern followed by programmes. The signal wasn't strong of course, but there was no doubting the images displayed. To achieve reception Ian constructed a dish aerial system from $\frac{1}{4}$in. wire mesh, mounted in a wooden frame. The diameter is 63in., the depth of the dish $14\frac{3}{4}$in. and the dipole-dish spacing 26in. The dipole is one from a Jaybeam MBM array, cut down to 860MHz. There is a large reflector and a single director. Several amplifiers are in use – essential for reception of these signals – the most important being the 860MHz tuned head amplifier. The signal locks mainly with 625 lines and positive-going vision, but tends to go negative either side of the main carrier. Apparently this is a common feature when you try to resolve f.m. vision modulation on an a.m. vision receiver.

The following have now received the ATS-6 satellite transmissions: Steve Birkill (Sheffield) who started the whole thing off last December, Ian Beckett (Buckingham), Hugh Cocks (Devon), Reg Roper (Cornwall) and Charles Hopkinson (Yorkshire). Charles was successful using an Antiference XG21C/D array; everyone else has employed homemade dish systems. My own efforts met with little

The pictures above show the greatly improved quality of reception from the ATS-6 satellite now being achieved by Steve Birkill.



Caption used by the ch. E3 transmitter at Thessaloniki, Greece.

The Italian 1st chain news caption.

success to start with. Initially I tried with a modified short backfire aerial, then with a 6ft. dish feeding a stacked bowtie aerial. The latter has now been replaced with a cut to frequency dipole system which has at last brought success – but more of that next month. I've been using a 22dB gain, 3·5dB noise masthead amplifier with these aerials. A photograph of Ian's dish aerial system is included this month along with a couple more shots from Steve Birkill showing the quite fantastic improvement he has managed to achieve by modifying his gear.

News Items

India: The ATS-6 experiment is to end on August 1st, though there have been conflicting rumours.
Spain: A regional programme in the Basque language is being produced at the Bilbao studio centre. Programmes commenced last December and are radiated over the Gatooma transmitter and its relays.
Poland: The Rusinow transmitter has opened, carrying first chain programmes. U.H.F. aerials and transmitter facilities for the second chain are to be installed later.
Pakistan: Quetta TV will shortly be relayed over the Zhuzdarvin Baluchistan transmitter which is under construction.
Nigeria: The Rivers State Television service is in full operation, covering the whole state and the bordering areas of the South Eastern and East Central States.
Portugal: Kevin Jackson tells us that the old RTP test card which was used during the 1960s at v.h.f. is now being used on the u.h.f. network. He also mentions that the RSGB broadcast a propagation summary on 3·6MHz every Sunday morning.
France: James Burton Stewart tells us that Lille-1 will transmit on ch. E27 and not E29 as originally thought. It is possible that there may be problems – the Lille second service was changed many years ago from ch. E27 to ch. E21 due to cochannel interference with Lopik. Paris is still transmitting at quarter power on its second and third chain u.h.f. outlets. Further information from the ETFV journal indicates that the Paris first chain outlet will radiate on ch. E27 with 1000kW e.r.p. as from January 1977!
Greece: ETFV also lists a ch. E3 transmitter in operation at Thessaloniki. A photograph of the caption is included. I can otherwise find no information on this one.

LONG-DISTANCE TELEVISION

New EBU Listings

Spain: Ares ch. E22, 200kW (8W, 43N); Jaen/Sierra Almaden ch. E39, 372kW (3W, 37N); Camerena de la Sierra ch. E41, 200kW (1W, 40N); Villadiego ch. E41, 200kW (3W, 42N). All RTVE-2 outlets with horizontal polarisation.
France: Troyes ch. E21, 1000kW; Chamonix ch. E22, 50kW; Brest ch. E24, 1000kW; Ales Mont Bouquet ch. E24, 100kW; Besancon ch. E26, 250kW; Bourges ch. E29, 1000kW; Auxerre ch. E34, 300kW; Besancon ch. E44, 500kW; Orleans ch. E45, 100kW; Carcassonne ch. E61 1000kW; Aurillac ch. E62, 500kW. All third chain transmitters with horizontal polarisation.
Israel: Har Hacarmel ch. E46 (horizontal) increased to 200kW e.r.p.

Royal Television Society Award

Our congratulations to Graham Deaves of Norwich who has received the Royal Television Society East Anglia Centre's award for his work in the field of vertical interval data transmission and reception techniques. It will be recalled that Graham is an active DX enthusiast and has had extremely good results in receiving both PAL and SECAM colour transmissions from Europe.

Programme Times

For the record, Ian Beckett has sent programme times for Madeira: Sat 1600-2130; Sun 1500-2100; Mon-Fri 1900-2130/2240. And for the Azores: Sat 1530-2130; Sun 1530-2130; Mon-Fri 1930-2130. All these times show the commencement of the last programme.

From our Correspondents . . .

Some points from letters. David and Christopher Wright of Huntingdon have reported good signal reception at both v.h.f. and u.h.f. – with many u.h.f. stations – despite the fact that they live only some five miles from the 1,000kW Sandy Heath transmitter, with the obvious problems of overloading in Band III (ch. B6) and Band IV. Ryn Muntjewerff (Holland) tells us that CST-1 and CST-2 (Czechoslovakia) are transmitting the Fubk card with identification from all stations for half an hour before programmes start. Bill Holt (Leeds) suggests using sets in the Bush TV161 series for DX-TV use. They give high gain over the whole v.h.f.-u.h.f. range, and from the results he reports would seem to work most efficiently.

Graham Harrison (St. Leonards) has come up with a new notch filter that should help the Wright family and others living close to a high-power transmitter. This uses a ferrite toroid (type T-50 10MIX) which gives an inherently higher *Q* than can be obtained using the more traditional $\frac{1}{4}$in. coil former. The details are shown in Fig. 1 and the toroid can be obtained from TMP Electronic Supplies, 3 Bryn Clyd, Leeswood, Mold, Clwyd CH7 4RU (send s.a.e. with enquiries). Adjust the trimmer to null out the offending Band I transmitter.

DX-TV Book

Regular readers will have noted that a new edition of my *Long-Distance Television* book has been planned for some time. The arrangements have recently been changed and it will now be published by Weston Publishing (33 Cherville Street, Romsey, Hants SO5 8FB), hopefully in mid-July. The anticipated price is £1·11 including postage, both UK and overseas. The book will contain the information in earlier editions but has been considerably expanded to include the latest developments, methods of operation, etc. It should in fact be about twice the size of the previous editions. More information shortly!

Photographic Offer

We recently mentioned that Graham Harrison is able to offer a film processing and printing service at approximately half the cost of current retail charges (see details in the November 1975 column). We have now heard from another reader, Alan Damper of Carshalton, an experienced DX enthusiast and photographer, that he is able to supply film at reduced prices – Ilford FP4 36-shot cassettes at 58p each including postage, or two for £1·10 inclusive. He is able to make this offer having purchased a bulk film loader – he can consequently buy the film in bulk rolls. The only problem that sometimes arises is that being cut from a large roll the film is sometimes packed the "wrong way up", the frame numbers being along the upper edge and therefore upside down. The quality is unaffected of course. The address for orders is 144 Shaftesbury Road, Carshalton, Surrey SM5 1HL.

Photography Aids Signal Identification

Alan has also given us useful advice on the identification of very weak test cards and captions by employing time-lapse photography – the prolonged exposure cancels out the instantaneous picture noise. Since noise occurs in a random manner, the noise content of each TV field will be different. If the picture itself is stationary, say a test card or caption, it will be displayed for many fields. Consequently by using an exposure of one second at f22 instead of 1/30th at f5.6 we obtain a much cleaner picture which enables the details to be read – the accompanying shots bear this out. The reason for using a small aperture for a prolonged exposure is to avoid too much light reaching the film and over exposing the shot. For quick shutter speeds, such as 1/15th etc., a much larger aperture is required since the exposure time is so much less. Alan has written an article on off-screen photography and this will be appearing elsewhere in the magazine.

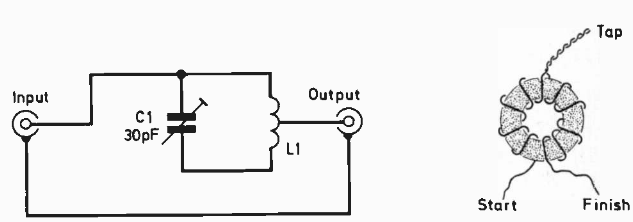
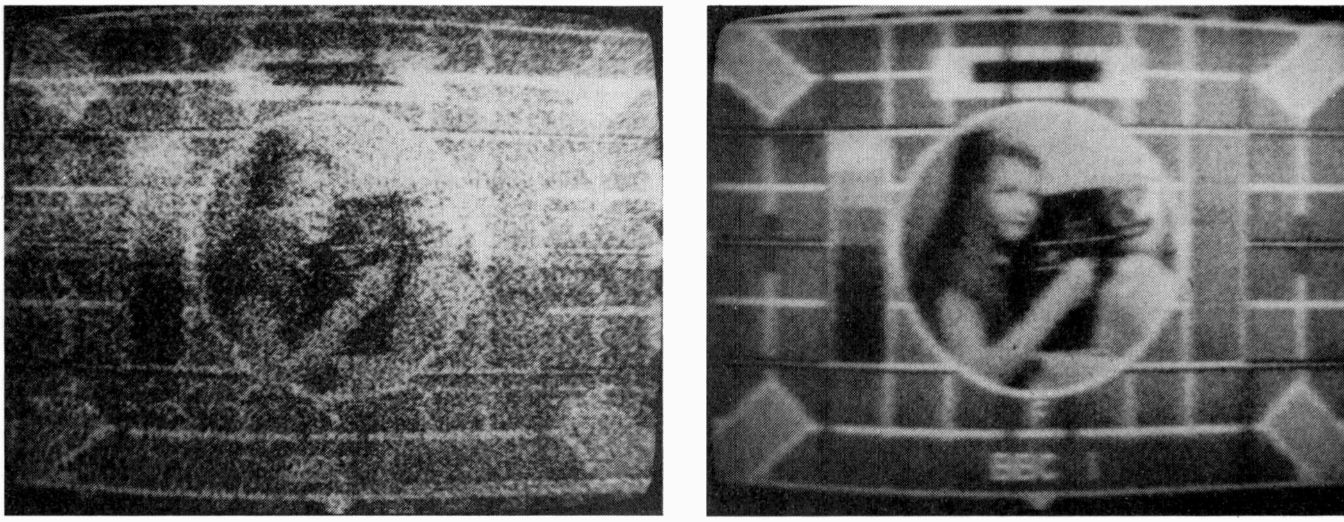


Fig. 1: Circuit and coil-winding details for a simple Band I notch filter. L1 is 10 turns of 20 s.w.g. enamelled copper wire, centre-tapped. The trimmer capacitor C1 must be an air-spaced type.



Alan Damper's two photographs of Test Card F. The left-hand shot was given an exposure of 1/30th second at an aperture of f5·6, and is almost entirely obscured by noise. The right-hand shot received an exposure of 1 second at f22, allowing the identification to be clearly read. A camera with a focal-plane shutter was used for this experiment, hence the shading visible on the shorter exposure.

Effect of Polarisation on Signal Propagation

There was an interesting discussion on the subject of planning Band II services in the February 1976 issue of the *EBU Review*. The points made relating to signal propagation v. polarisation are worth reporting. There are several components in the signals arriving at a receiving aerial. The strongest are direct and diffracted waves. The strength of these components is normally independent of the signal polarisation, but in certain circumstances variations can occur. In the case of a signal which has been diffracted over a smooth, round hill, i.e. one with no trees, high vegetation, etc., the attenuation of a vertically polarised signal will be less than that of a horizontally polarised one. If the hill is wooded with coniferous trees however a vertically polarised signal suffers greater scattering and is thus attenuated more than a horizontally polarised one.

In addition there will be reflected signals due to (a) ground reflection in front of the aerial, (b) reflections from the sides of the direct signal path, and (c) reflections from behind the aerial.

The reflected component arriving at the front is usually quite small and may cause only a slight signal reduction due to partial phase cancellation. Should the transmission path lie across a valley however (i.e. high transmitter and receiver sites) a delayed signal will become very significant. Horizontal polarisation produces a reflected signal of greater strength.

In the case of objects in the vertical plane, i.e. hilltops, trees, etc., the reflected signals will be stronger with vertically than with horizontally polarised transmissions. The effect is more significant with side reflections, especially where the direct and reflected signal paths differ by more than two and a half miles.

With reflections from objects behind the aerial the type of polarisation is unimportant when the object is large in both the horizontal and vertical planes. Again, a hill with coniferous trees tends to have a different effect on vertically than horizontally polarised signals. Problems commence with path differences of two and a half miles.

The EBU concludes that whilst vertically polarised signals with vertically mounted aerials give higher signal strengths at low heights, but with the possibility of increased multipath reception in certain types of countryside, in mountainous regions, especially where there is coniferous vegetation, horizontal signal polarisation is to be preferred. In flat or rolling countryside better reception is obtained with vertical polarisation. The EBU intend these notes to assist normal coverage planning rather than enhanced long-distance reception!

SERVICING THE DECCA 'BRADFORD' CHASSIS SERIES 10 & 30

PART 2. by R.W. THOMSON

THE main difference between the earlier 10 and the later 30 chassis lies in the decoder. The earlier decoder is all-transistor while the later one features an MC1327 i.c. which carries out chrominance demodulation and matrixing to provide RGB outputs and also contains the PAL switch.

RGB Channels

Both decoders are highly reliable. The most common colour faults occur in the RGB output stages. A bright red, green or blue picture usually indicates a short-circuit BF337 (BF179 in the 10 chassis) while a cyan, magenta or yellow picture is normally due to an open-circuit BF337/BF179. A less common cause of a bright blue/red/green picture is an open-circuit output stage collector load resistor. In all these cases diagnosis is easily confirmed by checking the voltage to chassis from each collector heatsink in turn – the odd voltage is the wrong 'un!

Care should be exercised when replacing these transistors, particularly on the older type of decoder. On both panels it is very easy to break the print around the soldered joints. The earlier panel is worse however because the more complex output stages run with a bit more heat, with the result that the panel becomes very brittle and easily broken. Replacing a BF179 with the later BF337 creates no problems – the Texas BF258 or ITT BD115 can also be used.

The RGB output transistors in the 30 chassis are d.c. coupled to the preceding MC1327 i.c. – which can also be responsible for the predominance of one colour. In the earlier 10 chassis the signals are a.c. coupled to the RGB channels and the electrolytic coupling capacitors used can be responsible for colour tinting and a smeary picture, particularly C214 in the blue channel since it's mounted rather close to R325 which tends to run hot – position a replacement capacitor well clear. As the electrolytic(s) dry up, so there is loss of the appropriate primary colour(s).

Clamp Circuits

The a.c. coupling used in the 10 chassis means that the RGB channels must be clamped in order to maintain the correct drive conditions. Clamping faults are not common but when they do occur can give rise to weird colour effects. Erratic brightness variations can usually be attributed to C265 which to a very large extent plays a part in picture brightness level (there are other causes of brightness faults however – we will come to them when we deal with the appropriate sections of the chassis). The bias on the RGB stages produced by the clamp action consists of the voltages established across C215, C244 and C267: leakage in these capacitors results in background colour faults in the blue, green and red drives respectively. If the pulse clipper diode D215 is faulty there will be complete loss of control over all three drive circuits. The circuit may look a bit complicated but isn't as bad as it seems All three clamps act in the same way so a description of one will suffice.

Consider the red channel. A 660V pulse from the line output stage is fed via R253 to the pulse shaper transistor TR211 and via R325 (that's why it gets hot) to the anode of D215 and then via R335/R295/R240 to the RGB clamps. Since the cathode of D215 is tied to a voltage dependent upon the setting of the brightness control, the 660V pulse is clipped to a voltage just above this. Sticking to the red channel, the clipped pulse passes via R335 and C268 to the clamp diode D217 which promptly switches on, producing a negative-going voltage on C267. This voltage counters and partly cancels the positive bias applied to the base of TR225 via R330 from the 20V line – this bias would otherwise turn both TR225 and TR226 hard on. The two voltages result in a steady "correct" bias however, D217 conducting just sufficiently during the line flyback blanking period to maintain this steady state. This ensures that during the blanking interval the voltage difference between the output stage collector and the base of the driver stage is more or less equal to the difference between the mean and the peak levels of the line clamping pulse as clipped by the action of D215/C265 and the brightness control. As all three channels are identical and controlled by the same clamp pulse input the three output stage collectors are brought back sharply to approximately the same voltage at the end of each line, thus maintaining a reasonably constant grey-scale performance. As mentioned earlier, clamp faults don't occur often and when they do the trouble is usually due to a leaky or open-circuit capacitor – diode failures are almost unknown in these chassis.

In earlier versions of the 30 chassis uncontrollable blue can occur after the set has been on for some time – the picture background becoming predominantly blue. The cause of this is that the metal ends of R214 and R293 touch as a result of expansion. Careful separation cures the fault – in later versions the type of resistor used in the R293 position was changed to overcome the problem.

Decoder Faults

In the case of no colour, with no 'scope, no colour-bar generator, no nothing in fact except a good meter and a stout heart, the writer freely admits that his biggest task is to drag his aforementioned stout heart up out of his boots. Such situations do arise however, and as in all decoders the first step to take is to defeat the colour-killer stage – by shorting the collector and emitter of TR214. In the 30 decoder, pins marked TP205 and TP206 are provided for this purpose (while the colour-killer transistor in this case is TR208) but there are no such shorting pins in the earlier version. This would be a good point to add to the general difficulties by mentioning that all the 10 series decoders serviced by the writer have had two test points marked TP205! The pin nearest R273 on the right-hand side of the panel is the one that should be marked TP205: the other should be marked TP203. But to get back to the task in hand, should shorting out TR214/TR208 restore colour it's a fair bet that the transistor is open-circuit.

Should the colour-killer transistor prove to be o.k. even though shorting it out restores colour, check the following components in its base circuit, C236/D208 (10 chassis) or C232/D203 (30 chassis) – both are essential to the switch-on of the colour-killer transistor in the presence of the colour bursts.

No PAL Switching

If over-riding the colour-killer produces a colour picture containing very low or no red, i.e. a cyan picture, this indicates loss of PAL switching and in the 10 chassis points to failure of TR215/D206/D207/TR216 or an associated component, or in the 30 chassis TR209, an associated component or the MC1327 i.c.

Unlocked Colour

Another symptom which may appear when the killer is shorted out is unlocked colour, i.e. colour bands running through the picture, it being possible to lock or nearly lock the colour by adjusting the set oscillator frequency control VR305(10)/VR269(30). Should this effect appear the fault must lie in the phase detector or d.c. amplifier circuits which control the oscillator frequency. Components to check are D212/D213/TR222/C254/R308 in the 10 chassis, D205/D206/TR212/C246/C247/R272 in the 30 chassis. Less likely causes of these symptoms are D214/C248/C250/R304/R306/R312/R313 on the 10 chassis, D207/C241/C243/C248/R267/R268/R277/R280 on the 30 chassis.

Dead Chroma Circuits

Failure to obtain colour at all when the colour-killer transistor is shorted out is the worst headache of all when test instruments are denied to us. The writer adopts the following approach.

(1) Do not touch any of the presets.

(2) Detune the receiver slightly to see whether the colour subcarrier can be seen as patterning in what are definitely known to be coloured parts of the picture. If so proceed to (3). In the less likely event of no patterning, misalignment or lack of bandwidth in the i.f. strip or tuner must be suspected.

(3) Check that the decoder 25V l.t. supply is present.

(4) At this point we must differentiate between the 10 and 30 decoders. Taking the 10 decoder first, check the voltages on the oscillator transistor TR223 and the following emitter-follower buffer stage TR224. Check TR223 by substitution since slight leakage can stop oscillation (slight leakage in TR224 – TR214 in the 30 decoder – can cause weak, incorrect colours due to the reference signal being attenuated).

(5) Check all transistors in the chroma and burst paths – TR210, TR212, TR213, TR220 and TR221, the d.c. amplifier TR222 in the oscillator control loop, and the pulse shaper TR211. Check the varicap diode D214. Check for dry-joints around the crystal, which itself could be faulty.

(6) Check all the components mentioned earlier when we were discussing the symptom of unlocked colour on over-riding the colour killer.

(7) Check all the small electrolytics and polystyrene capacitors in the circuits around the transistors listed above.

(8) Check the continuity of all inductors in the same circuits.

On the 30 decoder the procedure is similar, the transistors in step (4) being TR213 and TR214. Before proceeding to (5) however check all voltages around the MC1327 i.c. Great care must be taken when doing this not to short any pins together – the i.c. can be destroyed instantly by inadvertent connection of pins. A very sharply pointed meter probe should be used therefore. If these voltages are correct or very nearly correct, proceed to (5).

(5) Check TR205, TR206, TR207, TR210, TR211 and TR212.

(6)—(8) As above.

If the voltages on the i.c. are incorrect at any point it is fair to assume that the i.c. is faulty and that replacement will cure the no colour symptom.

Performance Peaking

Once colour has been restored it remains only to peak the performance of the defective circuit *if* it contains a tuneable inductor or variable preset. If the oscillator was at fault for example – as is usually the case with no colour failures in these sets – it may be necessary to adjust the set oscillator frequency preset (VR305 or VR269) to obtain satisfactory colour lock while adjustment of the oscillator coil (L208 or L207) may be necessary to compensate for slight variation in transistor characteristics. Tune the coil with a small tool for maximum colour consistent with good colour lock.

If the trouble was in the ident circuit, readjustment of the coil (L207 or L205) may be necessary.

Incorrect PAL Switching

The PAL switch on the 10 decoder is driven directly by the ident signal. A low-amplitude ident signal can cause incorrect switch timing, i.e. a vertical band of incorrect colour down one side of the screen or the other. Check the tuning of L207, TR215 for leakage and the switching diodes D206/D207. The alternative possibility is a fault in the colour-killer stage, i.e. C236 dried out leaving a ripple on the base of TR214, D208 leaking or high-resistance, or possibly even C230 dried out to give a similar effect to C236.

In some 30 decoders, where the PAL switch is in the MC1327 i.c., the switching time can be incorrect resulting in wrong colour at both sides of the screen. The cause is a leaky disc ceramic capacitor. Check that the voltage at pin 11 of the i.c. is between 2·2V nd 2·7V. If the voltage is low, check C230 and C231: if it's high, check C235 and C228. If C228 is defective there are likely to be Hanover bars as well. If C244 is of the same type and is defective there will be complete colour reversal. Only a limited number of 30 series decoders were fitted with the type of capacitor that causes these faults however.

Line Flyback Blanking

Another operation carried out in the MC1327 i.c. is line flyback blanking. R286 can go high-resistance or open-circuit with the result that the blanking is not carried out.

Sync

In addition to the chrominance circuitry there are two luminance stages and the first sync separator on the decoder panel.The input to the sync separator transistor (TR206/TR202) is coupled via an electrolytic (C213/C207) which can be responsible for complete loss of sync or for vertical ripple on the picture and possibly bent verticals. The latter symptoms or signal loss can be caused by the

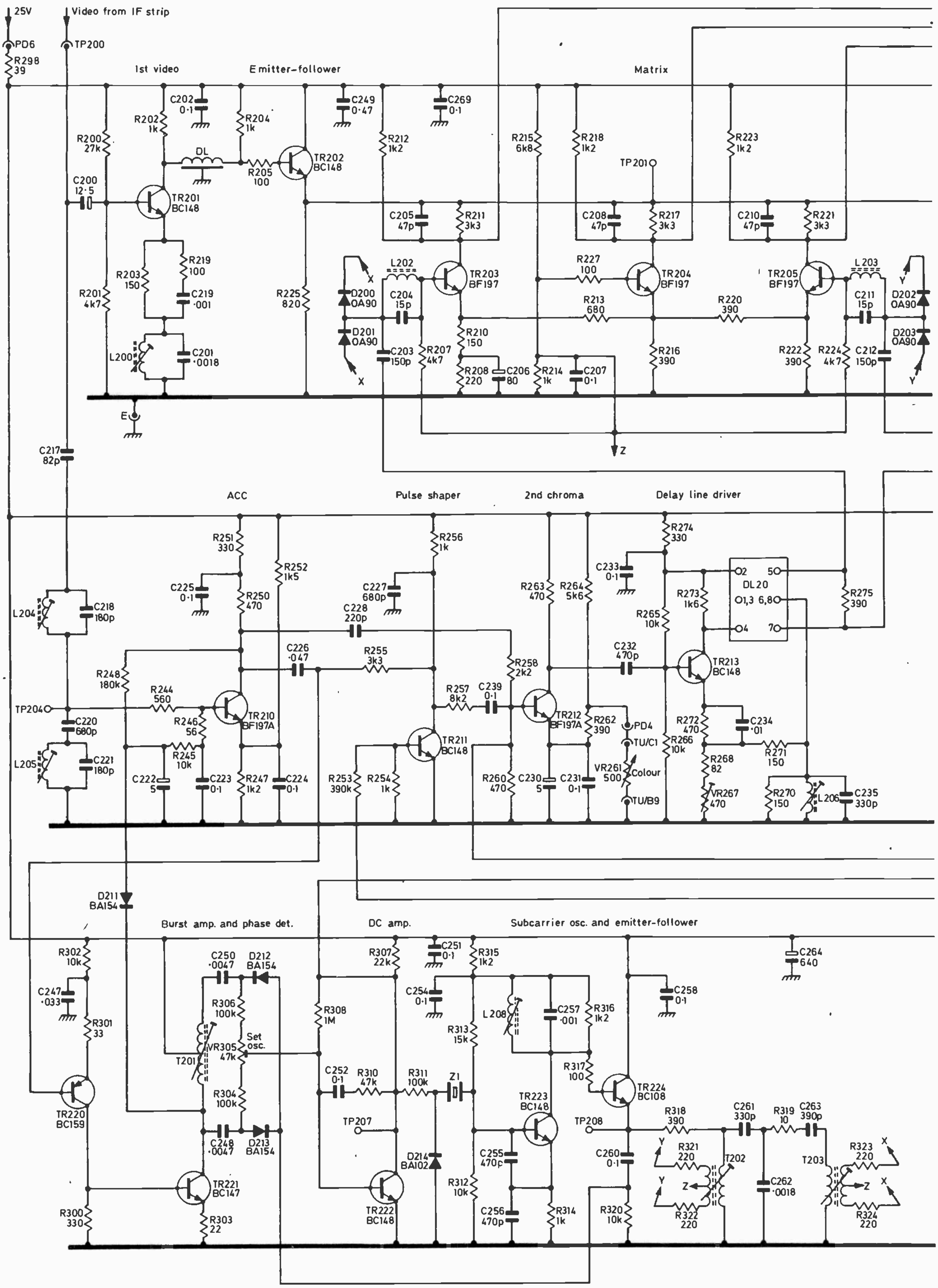
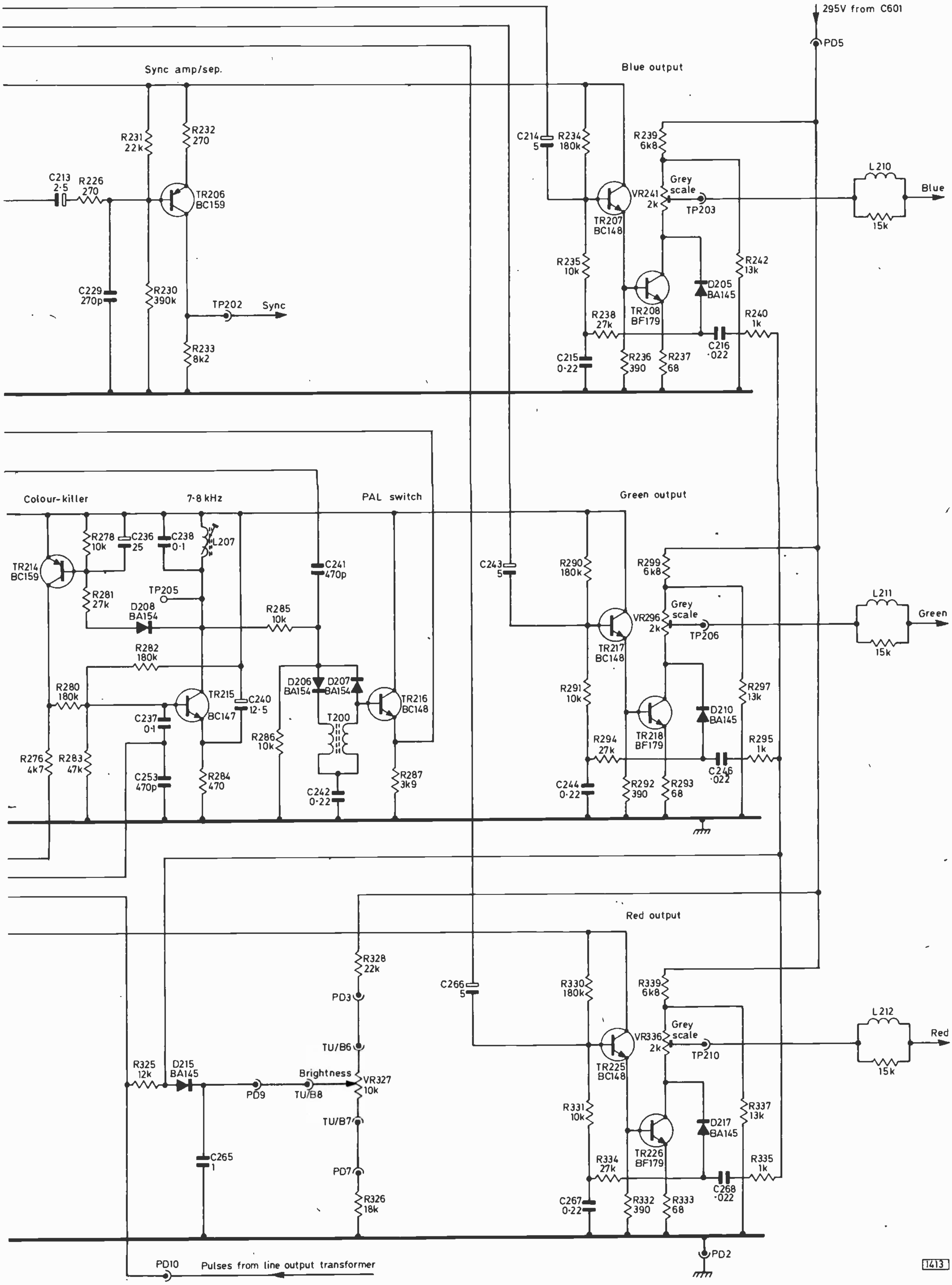


Fig. 8: Decoder circuit used in the 10 version. The circuit used in the later



30 version is almost entirely different and will be included next month.

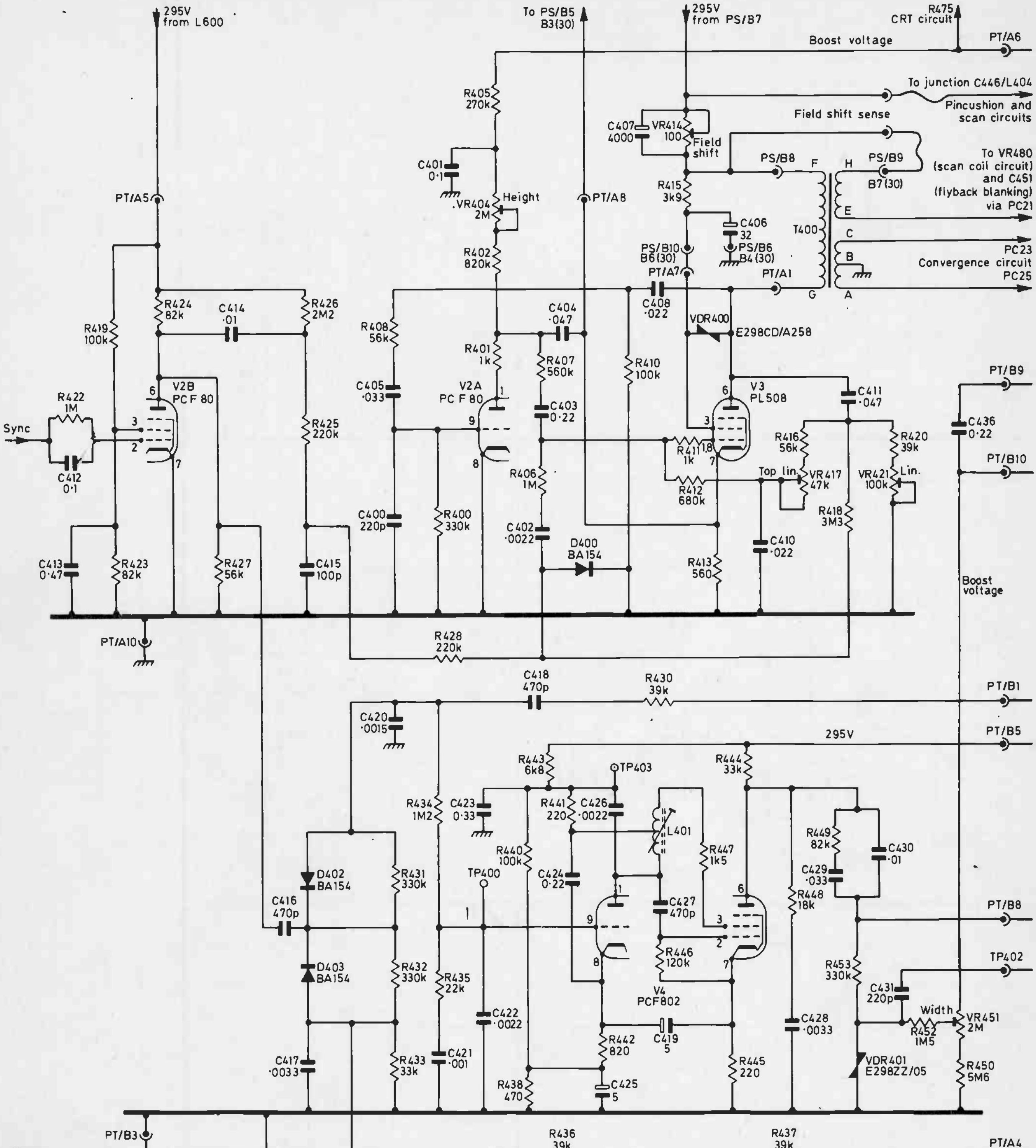


Fig. 9: Circuit diagram of the field and line timebases, 10 chassis. Small-screen (20kV) models differ in using an e.h.t. doubler instead of a tripler, with no e.h.t. adjustment (R458 not present). There are several modifications which should be noted in the later 30 chassis. These are as follows. The 500mA h.t. fuse is coded F1 and supplies V2, V3, V4 and V1 plus PC6 (c.r.t. first anode circuit) in addition to the line output stage, the 100mA fuse on the line output transformer being replaced by a link. C449 (0·001μF) is added to link the earth sections of the field and line parts of the printed panel. In the line generator circuit D402 and D403 are type 1N914, C423 is 8μF and R452 consists of two 820kΩ resistors in series. TP403 is marked TP402 on some

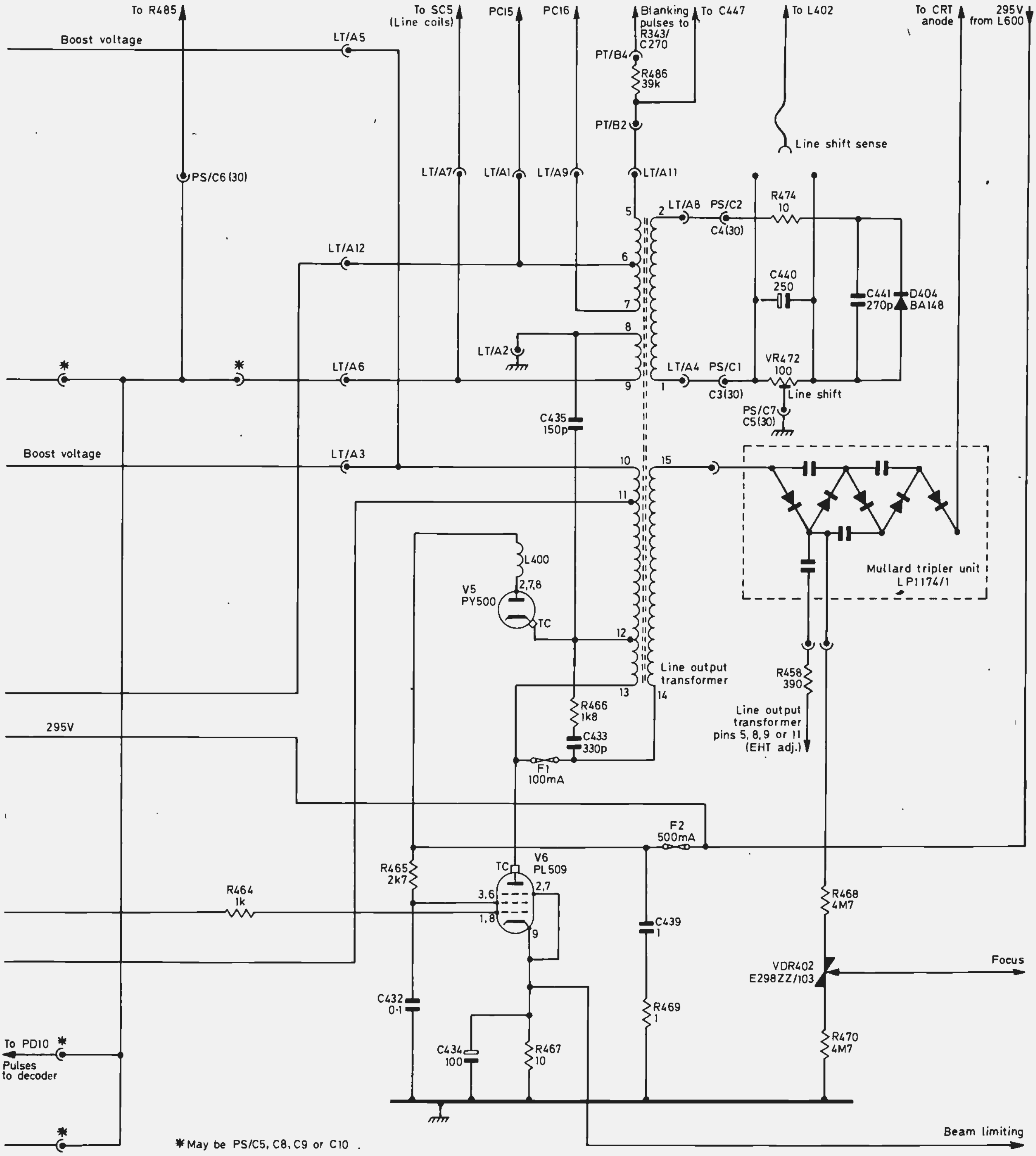
electrolytic C200 which couples the signal to the base of the luminance amplifier TR201. In later 30 decoders a 6·8pF capacitor is added between the base and collector of the sync separator transistor TR202 to reduce a tendency to line pulling under difficult reception conditions.

The Timebases

The timebases are reliable and don't give a lot of trouble, though as you'd expect the line output stage is the cause of most calls to attend to faults. We'll take the field timebase first. Two valves are involved, the triode section of a PCF80 and the PL508 output pentode. The pentode section of the PCF80 is the second sync separator.

Second Sync Separator

The reason for using two sync separators is that there is always a small amount of video present at the collector of the first, transistor sync separator on the decoder panel.



panels, while the TP402 marking (next to C431) may be omitted. Great care should be taken not to confuse these points: the white lead from the line output transformer must be connected to the pin adjacent to C431. In the line output stage R467 may be 6·8Ω, C435 maybe 220pF, C440 is 220μF and C439 is 0·22μF with R469 omitted. There is no "LT" plug and socket. R486 is omitted, the line flyback blanking pulses for pin 6 of the MC1327 i.c. being taken from pin 9 of the line output transformer via PD10. In the field timebase D400 is type 1N914 and C407 is 4,700μF. The field linearity circuit is modified as follows: C411 is 0·1μF, R420 22kΩ, R416 33kΩ and R412 820kΩ.

Under good signal conditions this video is removed by the pentode sync separator. Under weak signal conditions the transistor is unable to carry out any separation and the whole duty falls upon the valve.

Field Timebase

The triode section of the PCF80 acts as a multivibrator with the PL508, the field sync pulses being fed to the grid of the PL508. As there is no field hold control in the circuit it is essential that the multivibrator's natural free-running frequency can be easily locked by the field sync pulses over a much wider range than in more conventional circuits. This need for a wide lock-in range presents the problem of random triggering by spurious pulses. This is overcome by diode D400, which is turned on during the forward scan by the waveform fed back to it from the anode of the pentode and effectively removes any odd pulses which might otherwise appear at the pentode's grid and upset the locking. The diode is protected from the high-voltage flyback pulses by VDR400 which bypasses the peaks via the screen grid decoupling capacitor C406.

The circuit gives very little trouble. The main faults are no scan and intermittent height fluctuations.

If scan failure is not due to the PL508 it is likely to be due to C401 being short-circuit. This capacitor smooths the boost feed to the triode's anode circuit, i.e. the field charging circuit. No other damage is caused when this capacitor shorts, due to the high impedance of its associated resistor R405.

Height Fluctuations

Intermittent and sometimes very rapid fluctuation in height can be caused by partial failure of VR414 or VR480, both of which run fairly hot under normal circumstances. VR414 is the field shift control – controlling the flow of d.c. through the field scan coils – and VR480 the field deflection coil balance control. Alternatively R491 can be intermittent, causing intermittent height variations plus random convergence shifts.

Height/Linearity Faults

The PL508's cathode electrolytic C448 feeds the waveform developed at the cathode to the vertical convergence circuits. When it dries up the result is lack of height – the scan can collapse to say a third of full amplitude, with cramping at the top and bottom when the height control is advanced. The only other fault encountered is a band of cramping between the top and centre of the screen. If this is experienced check the screen grid feed resistor R415.

Line Timebase

The line timebase follows normal practice in hybrid colour receivers, with a flywheel sync circuit, a PCF802 reactance/sinewave line oscillator valve, conventional PL509/PY500 line output stage and e.h.t. tripler.

Oscillator

There is no line hold control, the frequency being roughly set by the oscillator coil L401, the reactance stage then ensuring precise lock. Initial setting of the line speed is done by shorting the two pins provided, marked TP400 and TP401. This removes the control voltage from the grid of the reactance triode. The core of the coil is then adjusted until the picture is seen to be complete and just running through. Remove the short and the line should lock. Failure to lock is almost always due to an aged or otherwise faulty PCF802, but the flywheel sync discriminator diodes D402/D403 can occasionally cause weak or no lock if one of them develops a low reverse resistance. In difficult cases check C427, C424, C419, C425 and C423. Vertical ripple was mentioned when we dealt with the decoder.

Line Output Stage

The line output stage is the weakest point in the receiver, though this does not detract from our previous statements that the set is highly reliable. The fact that the line output valve, boost diode and line output transformer are all crammed very tightly into a comparatively small space means that there is a great deal of heat concentration. Thus faults that give rise to increased current consumption very often result in otherwise trouble free components being damaged.

Early sets had a 100mA fuse on the line output transformer itself. This prevented a lot of damage but since it was prone to frequent failure due to internal flashing in the PL509 line output valve it was deleted from later sets.

Overheating plus Lack of Width

A common fault is overheating with lack of width. This is usually due to R453 changing value. Resistors R450, R452, R467 and the width control itself are not above suspicion however, while C430 and C434 are occasionally the culprits – C434 will cause uncontrollable contrast as we saw last month because of its effect on the beam limiter circuit.

EHT Multiplier

Loss of picture with the line output stage obviously running o.k. though the PL509 is hot probably means that the tripler (doubler in the smaller-screen models) is defective. R458 may be damaged as well. After replacing the tripler it is advisable before switching on to remove the c.r.t. cathode leads from the decoder and check the voltage on the c.r.t. grids (should be between –40V and +25V) and the cathode drive voltages (should be about 140V). This will ensure that the new tripler is not over-run.

Non-Linear Scan

A non-linear picture with cramping at the right-hand side of the screen, the amount of cramp varying with the brightness, can be due to R487 falling in value. If it goes high or open-circuit the result is striations on the left-hand side of course.

Burnt out Wiring

Burnt out wiring to the line output valve and boost diode top caps, accompanied by low receiver gain, lack of width and possible damage to the line output transformer, with the PL509 cathode reading well in excess of the 2·2V normally considered as the maximum, takes us back to the beginning of the story when the writer warned about the link between the a.g.c. and beam limiter arrangements. Check R453 when these circumstances are discovered – it's nearly always the cause. Replace it with a 2W type to avoid repetition of the same often extensive damage. It is quite on the cards that renewing the wiring to the top caps of the valves along with valve replacement will restore the receiver temporarily to working order, particularly in good reception areas, and if the slight overheating of the PL509 is not noticed the receiver may work satisfactorily for a few days until the damage once again occurs. So check R453 whenever there are line drive or receiver gain faults.

No EHT

No e.h.t. can be due to the PL509 or PY500 of course. If the PL509 is cool it probably means that the screen grid feed resistor R465 is open-circuit.

No e.h.t. with the line output valve excessively hot means no line drive and probably the fuse open-circuit. Check the PCF802 and if necessary C427. This capacitor can be responsible for intermittent failure. The fuse may be found blown because the oscillator is slow to start as a result of C427 playing up. A leaky C427 can also be responsible for a symptom akin to e.h.t. brushing when the set is first switched on.

No e.h.t. with the PY500 possibly damaged and the fuse blown point to a short-circuit boost capacitor, C436, since it's returned to chassis via windings on the line output transformer. Alternatively it could be that the harmonic tuning capacitor C435 has gone short-circuit. This capacitor can be damaged if the red/yellow lead from pin 9 of the PL509 is too close to it. Before C435 breaks down under these conditions the trouble will be corona, which will also occur if the glass envelope of the PL509 is too close to the metal shield.

Though we've not come across it ourselves we've seen reports of no e.h.t. due to the oscillator's anode load resistor R444 going low in value. This removes the drive to the PL509 which gets hot, the excess current probably blowing the fuse.

Line Output Transformers

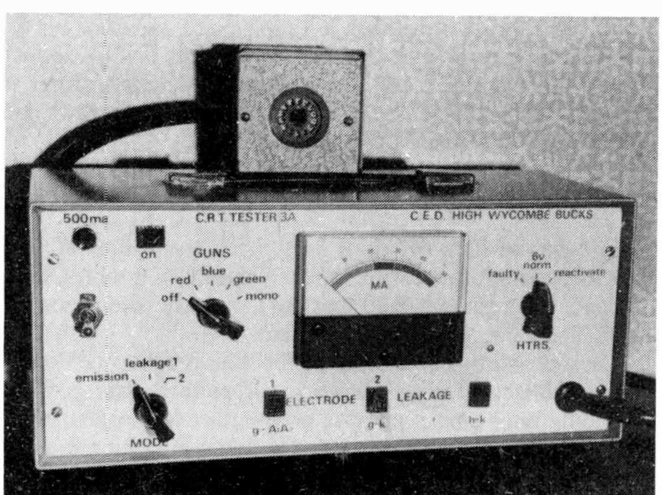
There are several different types of line output transformer in use in these sets. The well-known Mullard transformer is suitable for use in both the larger screen (25kV) and smaller screen (20kV) models. The Weyrad transformers used can be easily recognised by the translucent gold-coloured shrunk-on sleeves around the windings. There are different types for the 25kV and 20kV models. The 25kV transformer has a label marked Weyrad-057 and a blue spot adjacent to the solder tags on the top cheek of the main winding. It can be interchanged with the Mullard transformer. The 20kV Weyrad unit has a label marked Weyrad-093 and a red spot on the top cheek. It is suitable for use only in the 20kV, i.e. 17 and 18in. models. In addition a different transformer is used in 18in. sets carrying the Model number CS1830/A. These sets are fitted with different scan coils – a combined scan-convergence coil assembly bearing the part number 822165/18. The correct transformer is part number 85-0313-3 – early versions carry an identification label marked 093A. Neither the coil assemblies nor the transformers are interchangeable. Model CS1830/A also has the following component value alterations: C435 100pF, R448 27kΩ, R450 2·2MΩ.

Review: The CED CRT Tester-Reactivator

Ian C. Beckett

THE Model 3A cathode-ray tube tester is another addition to the range of test equipment manufactured by CED Instruments of High Wycombe, Bucks. It measures 14in. wide by 5in. high and 5in. deep. The strong metal case is finished in grey, with a carrying handle and a white fascia. The weight, including the c.r.t. base box and leads, is 10lb.

The meter is calibrated from 0 to 50 and measures $3\frac{7}{8}$ by $3\frac{1}{8}$in. It is situated at the top centre of the front control panel. To the left of the meter are the on/off control, a five-position gun selector switch (off, red, blue, green and monochrome), and a three-position mode switch which selects the emission and two electrode leakage tests. There are three indicators along the bottom of the fascia panel for the indication of grid-anode 1 or 2, grid-cathode, and heater-cathode short-circuits and leakage. To the right of the meter is the 6·3V heater supply and reactivate control which is also fitted with an off position.



The CED Model 3A c.r.t. tester.

The instrument operates on 220-240V a.c mains supplies and is fitted with a 500mA fuse. A fourth indicator shows whether the mains supply is "on".

The instrument will test 6·3V monochrome and colour tubes with B8H or B12A bases without the tube having to be removed from the set – just remove the base and connect the tester's base box instead. The red, green and blue guns of colour tubes can be tested individually. Interelectrode shorts or leakage, and emission, can be measured. The reactivate facility enables the life of tubes that are not completely exhausted to be extended.

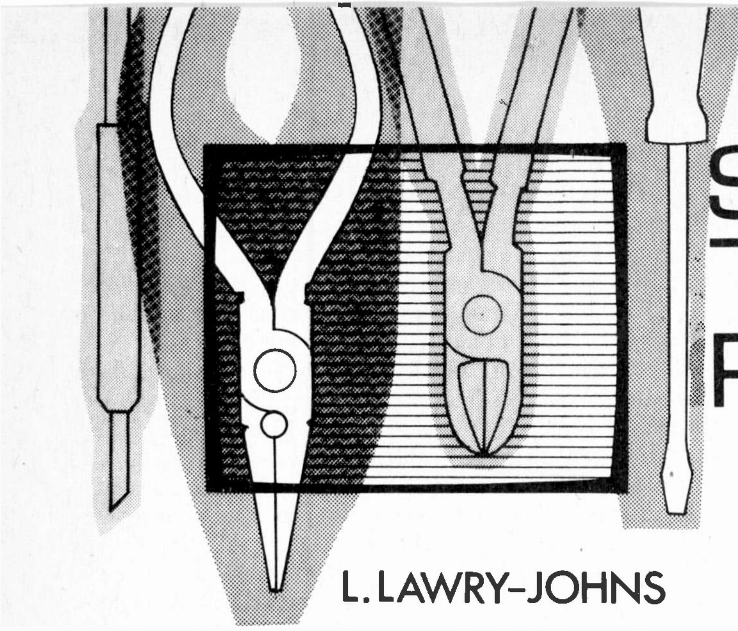
With colour tubes we have found that the red gun very often appears to lose emission first. Reactivating a colour tube for the first time generally brings all three guns up to the same level. When a tube loses emission for the second time however it is sometimes difficult to balance the three guns evenly – careful adjustments of the first anode controls have to be made.

On testing the emission of a good monochrome c.r.t. a reading of 45 can be expected. On reactivating some nearly exhausted c.r.t.s giving readings of only 15-20 we obtained emission readings of 40-45. Most of the tubes we reactivated a few months ago are still holding up well.

The 3A tester/reactivator performed well on test over a period of several months. It has proved a good companion in the workshop and for field servicing.

A base (B14G) is now available for use with the Sony triniton tube. We understand that an adaptor base for the Thorn PIL tube will soon be available. On the latest version the heater supply voltage has been lowered and the current increased: this improves the reactivation process. The meter is now screen printed, and it is planned to introduce a smaller case.

Including leads and base box the CED Model 3A c.r.t. tester carries the price of £53 plus VAT (8%). It can be supplied by Willow Vale Electronics Ltd., Old Hall Works, Aberfield Road, Shinfield, Reading, Berks; Charles Hyde and Sons Ltd., Canal Head, Pocklington, Yorks; and Eastern Electrical Wholesale Ltd., Demesne Road, Dundalk, Eire. Further details are available from the above suppliers or from CED Instruments, 54 Barons Mead Road, High Wycombe, Bucks HP12 3PG.



SERVICING TELEVISION RECEIVERS

PYE 173 AND 573 CHASSIS

L. LAWRY-JOHNS

– continued –

The Line Timebase

The line timebase is where a goodly percentage of the troubles will be found.

Line sync problems where the picture hovers but cannot be locked are usually due to the PCF802, not to a defect in the IC2 chip (which carries out the flywheel line sync discrimination). In fact most line hold troubles centre around the PCF802 (having said that we'll probably have an avalanche of line hold troubles which will be due to everything but the PCF802), though C66 can cause line drift with time. C49 going open-circuit will result in complete loss of line sync.

Line Output Stage Faults

But most of the defects occur in the line output stage, and some of these can be tedious. R84 is the screen grid feed resistor of the PL504 line output valve. If the PL504 passes too much current R84 heats up and its spring contact opens, leaving you to solder it back and then find that everything works fine for a time. To cut a long story short, this is usually due to an intermittently defective PL504. Last time however it turned out to be an intermittent PY800, and before that we have known it to be due to the PCF802 and to a faulty line output transformer. We stress that these cases were when resoldering the link restored normal conditions and the fault did not reappear for some time.

There is no problem when reconnecting the resistor immediately produces overheating in the PL504: this is usually caused by the PCF802 not oscillating or not being supplied from HT3 (for example R56 could be open or there could be a crack in the track from the supply point to the line oscillator stage).

Although most troubles can be cleared by valve replacement (this includes the DY802, which seems to short at the drop of a hat), there are other causes. Not the least frequent of these is a poor connection at one of the line output transformer tags – where they are supposed to be soldered to the panel. There is usually not much doubt about this, as a certain amount of sparking may have been taking place as a result of which the area in the vicinity is blackened. This condition can also account for the complaint that there is a white line down the centre of the screen, tending to suggest that the line scan coils are open-circuit. Isn't it nice to find that all that's needed is a clean up and a dob of solder (perhaps a piece of wire to boot)? There are times when fortune may not smile however.

No Picture

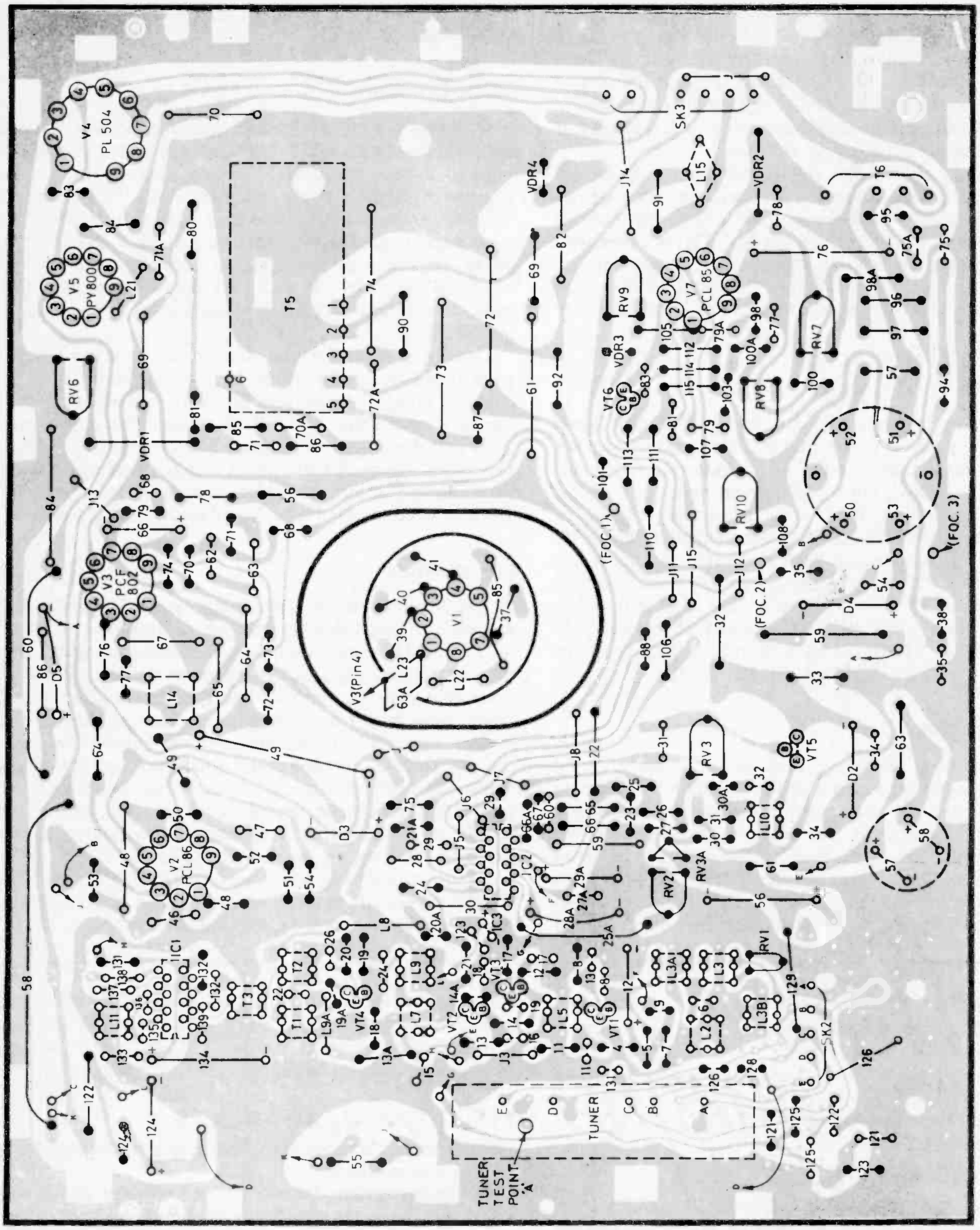
A "no picture" condition may lead you to the line output stage because your magic neon does not light up when waved over the line output transformer. A look may reveal that the DY802 is not lighting up, that the screen feed resistor is intact, and that the PL504 is not overheating excessively but is not exactly cool either. It may look a little dull red, but not so that the line drive could be suspected of being absent. Now this condition cannot mean (in this chassis) that the boost capacitor (C73) has shorted, since it is not returned to the h.t. line.

The drill here is to check the easy things first. Take off the DY802's top cap. If there is a sudden surge of energy you can smile and replace the offending DY802. If there is no difference, keep your head and try a new PY800. If this is to no avail, try another PL504 but don't be too hopeful. Next take off the DY802's top cap (to prevent e.h.t. being applied to the tube if it should be restored), remove the scan coils plug and link the remote pair of tags to maintain the screen grid feed to the PL504. If this restores vibrant life it is probable that the line coils are at fault. It is likely that there will be little response however, and the possibility of line output transformer trouble then looms large. But first check the condition of R87 (this could be charred due to C72 shorting, and may thus be presenting an overload), and R87A which is in series with a 120pF pulse capacitor on the line output transformer bracket (disconnect it if in doubt). Finally accept the fact that a new output transformer is needed. Replacement presents no problems: two screws and the removal of solder from the panel tags.

Lack of Width

In cases of lack of width first check the values of R85 and R86. Shunt them with similar values if in doubt. Check V4 and V5, resistors R80 and R81, and the width control itself. The v.d.r. is very rarely at fault.

Lack of width due to any of the above components will often also cause large variations of picture size, perhaps providing only a brief glimpse of a picture (or raster) as the brightness control is advanced. The latter condition may be the complaint in the first place, the initial lack of width having been ignored or not commented upon by the customer. It is essential therefore to reduce the brightness control setting so that the raster is only just visible



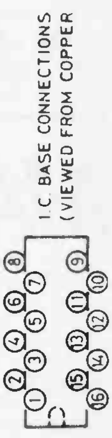


Fig. 3: Layout of the printed circuit board.

(assuming that this can be done) and then see whether there is indeed lack of width, thus helping to establish the real cause of the trouble.

There are times when there is plenty of drive and evidence of ample e.h.t. at the glass of the DY802 but this valve may not visibly light up. The obvious remedy of replacing the DY802 may well be unproductive. In this case it is necessary to prise up the valve holder from its housing and check the little coil of wire which forms R89. It is often the case that this wire is not making contact (electrical contact that is, not mechanical) with the base tags. This coil must not be shorted out or the DY802 will light up too brightly and will have a short life, albeit a gay one. Scrape the ends and resolder properly (be a good boy and have patience) and make sure that the heater lead-ins are also properly connected.

Striations on the left-hand side should direct attention to R91 which may be high-resistance or dry-jointed.

Power Supplies

We have left the power supplies until last not because they give little trouble (quite the reverse) but because we felt like doing so. If you don't like it done that way you can always read the article backwards (bit of an Arab this boy, even his name is written backwards on his old tool box, but don't worry about it if none of this makes sense).

The mains input is taken first to a fuse holder which is in the live side (fuse rating 1·25A, delay type), then to the on-off switch. There is a filter capacitor (C55) on the rear of the on-off switch, and this should be viewed with suspicion if the fuse presents a blackened appearance. A replacement should be rated at 300V a.c. or 1kV d.c.

The heaters and the low voltage transistor lines are fed via a BY126 (D5). If there are no sound or vision signals and the valves light up too brightly it is probable that this diode has shorted. The thermal cut out (TH) in series with R60 should then cut out, but this does not always happen. There will be no low voltage lines (19V and 11V) as C58 will present a short-circuit to the a.c. The input fuse may not survive.

HT Supply

Usually however it's the h.t. supply line that gives trouble. R59 pops off at the drop of a hat, and this does not necessarily mean that an overload has occurred. The value of 7Ω is not critical, but a replacement must have fusible properties. The failure of this resistor is usually responsible for the symptom of the set being dead although the valves continue to glow. Despite what we have said about the resistor failing with no contributory cause, a check on the h.t. supply should always be made when R59 is found to have gone open-circuit. The same applies when the supply fuse has failed. Check the back-to-front resistance of the BY127 h.t. rectifier diode D4 which can short.

Mains Dropper

The smoothing resistor is R58, which is the left-hand section of the top left mains dropper. The right-hand section is R60 which is the heater circuit dropper. Either section can become open-circuit, but being in the position where they are checking is only a matter of seconds. The failure of either causes no sound, no picture. If R58 fails there may still be a hum from the loudspeaker as HT4 remains live. If R60 goes open-circuit there will still be plenty of h.t. around to give the unwary a nasty jolt, but of course the set will appear dead.

Other Droppers . . .

Droppers are not confined to those inside a TV set. The term can also be applied to humans, who seem to be able to drop anything – including TV sets. It also applies to those who permit sets to topple over backwards thus denting in the rear cover, damaging the tube base and cracking the main panel if not the tube neck or nipple. A cracked tube doesn't require much comment but it is likely that if this has happened the panel will also have been damaged together with other things and repair may then be the subject of discussion.

Usually however the tube escapes and the repairer is left pondering how far the cracks have gone (and are likely to continue going . . . bear that in mind), and where exactly they are since some are difficult to see. The reader may think that this sort of repair is most unlikely to be necessary very often. We don't know about that but it seems to be our lot to have this sort of disaster brought in to us with the morning paper. Lots of wire, lots of solder, lots of patience.

Electrolytics

Readers may have noticed that we have made little reference to faults due to defective electrolytic capacitors. This is simply because we have had little trouble so far with the electrolytics used in this series of models. However, when the sides start curving and the bottom goes up and down, hum bars travel up or down, the field unlocks at regular intervals and other funny things happen, do check the electrolytics but don't just shunt another across the existing suspect. It's often the case that a crack in the printed track between the capacitor and the part of the circuit it decouples is responsible, so shunt the test capacitor at a supply point as close to the circuit under suspicion as possible – say pin 7 of the PCL805 if the HT2 electrolytic C51 is suspect, or the junction of R72-R78 in the line oscillator circuit if C49 is suspect.

MATTERS ARISING

MITSUBISHI MODEL CT-200B

Since our servicing notes on this set in the March issue (page 254) we have received comments from Mitsubishi Electric Service (UK) Ltd. The following points should be noted:

(1) The front slider controls tend to cause intermittent fault conditions when defective due to dirt on the tracks. There is loss of saturation in the case of the colour control and incorrect tinting in the case of the tint control.

(2) If the luminance emitter-follower Q204 goes short-circuit from base to emitter there is lack of brightness, if it goes short-circuit from collector to emitter there is excessive brightness.

(3) Sound faults. Distortion can be due to the collector of the sound output transistor not making a good connection to the printed board. Intermittent loss of sound can be due to a dry-jointed sound output transistor base connection.

(4) The comment about edge connectors applies to the 14in. Model CP-140B, not the 20in. Model CT-200B which uses soldered connections. Faults can occur due to poor edge connector contact on the CP-140B, and can be corrected by cleaning and spraying with contact grease.

FIELD TIMEBASE FAULTS

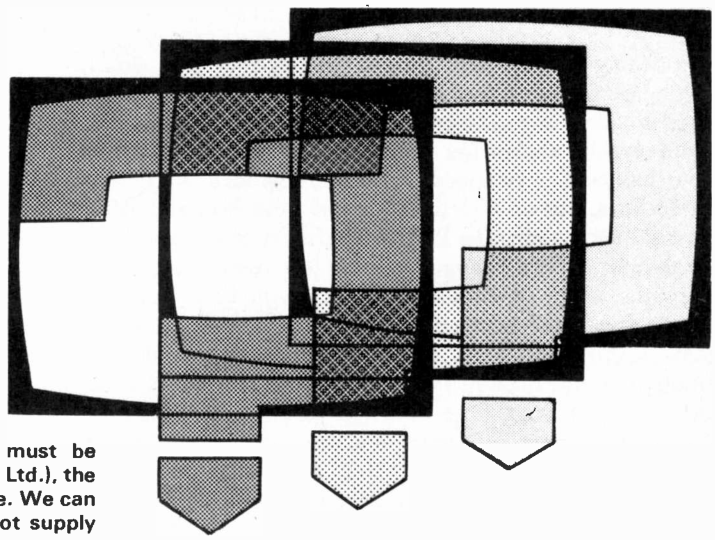
An amendment is necessary to our article in the May issue on field timebase faults.

Under the heading "no field scan" on page 348 it was stated that the anode voltages of a stopped oscillator will be high. Generally however a lower voltage will be found. This is because a working oscillator generates its own self-bias. If it is not oscillating the self-bias will not be present and the anode voltage will be lower than scheduled. One cause of a stopped oscillator is a leaky coupling capacitor. If this puts a positive voltage on the grid the anode voltage will be lower than it should be to an extent proportional to the severity of the leak.

GEC JUNIOR FINELINE

In the circuit diagram for this model on pages 364-5 of the May issue the emitter arrowhead of Tr208 in the field output stage was omitted. This is an npn transistor with its emitter connected to chassis.

Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 499 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.

BUSH CTV1122

The trouble with this set was a small picture – it shrunk still further after the set had been on for a time. Slight adjustment of the "set e.h.t." control on the power supply panel brought the picture back to normal size, but the picture still shrinks when the set has thoroughly warmed up. The shrinkage is most noticeable, about ¾in., at the bottom.

First set up the geometry and picture size carefully, on the test card. Take note of the voltage at the h.t. fuse 8F3. If the picture then shrinks, measure the h.t. voltage again. If it has fallen, check the components in the power supply regulator circuit with freezer, particularly the reference zener diode 8D2, the triggering diac 8D3 and the control transistor 8VT1. If the h.t. remains the same however, suspect an increase in the e.h.t. and check components in the line output stage. If the shrinkage is confined to the bottom of the raster, concentrate on the field timebase, particularly the driver transistor 5VT7 (AC128) and the field charging capacitors 5C24 and 5C25. (Rank A823AV chassis.)

HMV 2802

There is an annoying hum from the loudspeaker on this set. It seems to be at field frequency and falls considerably when the set is opened up for servicing. The field timebase and audio circuit h.t. smoothing components have been renewed without improving matters, whilst adjusting the ratio detector balance potentiometer does not affect the hum.

Check the PCL82 audio valve by substitution. If the fault persists, link pins 1 and 8 (triode grid and cathode) of this valve. If the hum continues, check the h.t. smoothing again. If the hum stops, check the earth bonding of the screened leads to the volume control – these should be earthed only at tag 3 on the main printed panel. If the buzz disappears on disconnecting the aerial, check the ratio detector diodes W5 and W6 and the 4μF electrolytic (C65) in this circuit. (Thorn 1500 chassis.)

FERGUSON 3717

There is no sound or raster though the fuses are intact. The 30V line is way down at only 12·5V though the series stabiliser transistor VT601 appears to be o.k. I have checked all the components in its base circuit and there are no faults here. Disconnecting C609 in its base circuit increases the base voltage and produces a noisy raster.

The collector of VT601 is fed from a full-wave rectifier with a 1,000μF reservoir capacitor (C607). The fault is generally due to this capacitor losing capacitance. We suggest you replace it: the voltage rating must be at least 60V. (Thorn 3500 chassis.)

KB KV003

One evening the height slowly decreased, leaving a gap of about 2in. at the top and bottom of the screen. Adjusting the height control makes very little difference. Also, even with the width control at maximum the raster barely fills the screen at the sides. This had been the case some time before the lack of height developed.

Most problems in this chassis are due to resistors increasing in value. For the height fault check R96 and R97 which are in series with the height control – we assume you have tried a new PCL805. Also check C91 which decouples the feed to the height control. The width problem could be due to the PL81A line output valve or to the various resistors associated with the width control circuit. There are quite a number of possibles: R159 (820kΩ), R158 (470kΩ), R160 (120kΩ), R153 (1MΩ) and R154 (820kΩ). If necessary check the resistors in series with the separate 405/625 line width controls. (STC VC11 chassis.)

BUSH TV135R

When switched to u.h.f. there is ample contrast on BBC-1 and ITV but poor contrast on BBC-2. The picture is also subject to severe aircraft flutter on all channels.

Assuming that there is not an aerial problem, poor signals on only one of the u.h.f. channels means that there is a fault in the u.h.f. tuner. For the flutter problem we suggest you check the a.g.c. circuit. Mean-level a.g.c. derived from the control grid of the sync separator is used. Check the filter components here, 2C37 (0·47μF) and 2R30 (820kΩ). Also check 2C58 (0·47μF) which is in parallel with the anti-lockout diode. Some experimenting with the a.g.c. line time-constant, i.e. the values of 2C37 and 2R30, may be necessary to obtain optimum results.

BUSH TV135R

After fitting a new line output transformer this set is working perfectly on 405 lines. When switched to 625 lines however there are vertical white lines about 1in. wide spread evenly across the screen – they are also present when the aerial is removed. Field and line lock are perfect on 405 lines, but on 625 lines the line hold is good but the field hold very poor. The PFL200 video/sync valve and the i.f. valves have been changed without improving matters.

For the white striations we suggest you first check the line output transformer third harmonic tuning capacitor 3C25 (150pF) and 3C27 (100pF) in the primary winding damping circuit, then suspect that the transformer is either faulty, of the wrong type or wired incorrectly. Poor field sync on 625 lines, assuming that the contrast is not set excessively high, is usually due to faulty decoupling electrolytics in the video/sync circuits. Check 2C22 (1μF) which decouples the screen grid of the video section of the PFL200, and 2C43 (4μF) which decouples the screen grid of the sync section. Less likely suspects are 2R6 (22kΩ) which on 625 lines forms the upper section of a potential divider feeding the screen grid of the first i.f. amplifier valve 2V1, 2R20 (10kΩ) which feeds the video section screen grid of the PFL200, and 2R36 (56kΩ) which is the sync section's anode load resistor.

DECCA CTV25

Unless the focus control is set at one end of its travel it starts to burn out. All the associated resistors and capacitors have been changed. Is there any way of setting the e.h.t. with an Avo Model 8?

It is likely that the focus rectifier D401 (type TV6·5) has failed. This commonly results in the focus control burning. The e.h.t. current can be set by adjusting VR810 for 1·2V across R416 in the PD500's cathode circuit, using your Avo Model 8. Measurement of the e.h.t. voltage requires a proper e.h.t. meter or 30kV multiplier probe.

GUS C501

There is a bright white line at the top of the raster. Associated with this are flat heads and line cramping. I have replaced the PCL85 field timebase valve and all electrolytics without success.

Replace the 0·003μF capacitor (C529) in the cross-coupling network between the pentode anode and triode grid of the PCL85. Then check the value of the pentode cathode bias resistor (R509, 330Ω). (First Plessey dual-standard chassis.)

ITT CK602

This set has developed Hanover bar trouble. Can you suggest what adjustments need to be made?

It is normally unwise to tackle this type of fault without the aid of a colour-bar generator and an oscilloscope. If the trouble is purely alignment drift however careful adjustment of R214 and L68 which set the amplitude and phase of the direct signal feed to the delay line/matrix circuit while observing a highly saturated test card transmission might suffice. Failing this the correct test gear must be obtained and the manufacturer's alignment instructions followed through. (ITT CVC5 chassis.)

MURPHY V2015S

There is a vertical blink whenever the picture changes from a bright to a dark scene and vice versa. The blink is accompanied by loss of vertical linearity, especially at the bottom.

First try a new PCL805 field timebase valve, then check its pentode cathode decoupling electrolytic 3C35, the interlace diode 3MR3 and its associated components. The PFL200 video/sync valve or the electrolytics associated with it could be responsible – check especially the sync screen grid decoupler 2C48. Finally, the field sync pulse coupling capacitor 3C29 (390pF) could be leaky: the only check in this case is by substitution. (RRI A793 chassis.)

SONY KV1810UB

The colour reproduction is good, but any bright linear patterns in the background are clearly visible through darker objects in the foreground. For example, the white railing around a racetrack is visible through the horses when they are between the camera and the railing. In addition, bright objects such as station caption cards have light streaks extending horizontally from them.

The symptom, called streaking, can be caused by a faulty aerial or by poor reception conditions. Check the aerial on another set. All sets show this effect to some extent, but this Sony set is no worse than others. If the effect is severe, the cause is likely to be poor l.f. response in the luminance channel. The main suspect in this case would be the electrolytic capacitor C157 (4·7μF) in the coupling circuit between the luminance amplifier (Q151) and the luminance driver (Q153) transistor.

FERGUSON 3802

The focus and picture quality are poor, the focusing being uneven with no mid-setting available. The c.r.t. gives the visual effects of low emission, the peak whites looking silver. We've checked the tube by substitution and also with several commercial c.r.t. testers. The e.h.t. doubler has been replaced and the focus control and its feed resistor checked.

A soft tube, i.e. one with impaired vacuum, can give these effects but still read o.k. on a c.r.t. tester. If a known good tube still gives the same results from the set check the e.h.t., ensure that the correct line output transformer and e.h.t. tray are fitted, then see that there is at least 600V at pin 3 (first anode) of the c.r.t. The 3·9MΩ first anode feed resistor R115 can increase in value to cause these effects. (Thorn 1500 chassis.)

PYE CT78

The problem with this set is that the brightness level falls after it has been on for about half an hour. I have replaced the luminance and colour-difference output valves and checked all relevant resistors on this panel. The set is perfectly o.k. when first switched on, but slowly darkens after about half an hour.

It is our experience that these sets do drift by about two squares of the grey scale after they have thoroughly warmed up. This is the sum of all the drifts and does not appear to be curable by replacement of any particular component. The colour content drifts the other way, tending to exaggerate the effect. (Pye 691 chassis.)

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

A Pye colour receiver fitted with the 713 chassis arrived in the workshop with the complaint of vague colours only in the display, sound normal. On feeding the set from the workshop aerial system this proved to be the case. The receiver was then fed with a standard colour-bar signal from a pattern generator – the signal being applied direct to the aerial input. It was found that the white bar was virtually black (there was only a very slight trace of brightness), the yellow bar was just a little brighter while the other bars increased progressively in brightness from the left- to the right-hand side of the screen. The display from an off-air picture signal showed only patches of red and blue at the normal brightness control setting.

The set has a liberal complement of integrated circuits. Separate red, green and blue primary-colour output transistors drive the three cathodes of the picture tube, these transistors themselves being driven by a TBA530 matrixing i.c. The colour-difference signals are demodulated by a TBA990 i.c. and are fed to the TBA530 matrix i.c. along with the luminance signal from a TBA560 i.c. A fourth i.c. (TBA540) in this area provides the reference signal and incorporates the burst channel, also providing the ident signal for the flip-flop in the TBA990.

An oscilloscope was not at hand and measurements of the various voltages around the i.c.s and the associated components failed to provide any conclusive clues as to the whereabouts of the trouble. The voltages around the primary-colour output transistors were also correct, while the intensity of the colour in the display could be adjusted by the colour control.

As the receiver was required urgently by the customer a second technician's opinion was sought. Having had some previous experience of this chassis he studied the screen display provided by both the off-air and pattern generator signals, made one or two adjustments to the controls, and then went almost immediately to the fault area, soon clearing the trouble.

What did the symptoms tell the technician, and what was the most likely trouble spot? See next month's Television *for the solution and for a further item in the* Test Case *series.*

SOLUTION TO TEST CASE 162 (Page 443 last month)

It will be recalled that the problem was absence of colour, and that it had initially appeared as an intermittent fault occurring after the set had been on for some time. The tests carried out and described last month revealed that there was lack of turn-on bias voltage at the base of the second chrominance amplifier. This bias is obtained from the colour-killer circuit, but the colour-killer rectifier, its reservoir capacitor, and the colour-killer threshold preset control were all in order. Clearly there was inadequate input to the rectifier. This comes from the 7·8kHz ident amplifier stage, and the usual cause is simply mistuning of the 7·8kHz tuned circuit coil. Adjusting this produced no difference however, while the d.c. conditions in the stage were correct and the emitter decoupling electrolytic capacitor proved to be o.k. The ident amplifier receives its input from the burst detector circuit, so there were still several possible causes of the fault. In addition to the bursts, the detector is fed with an input from the reference oscillator, and after extensive tests it was discovered that the reference oscillator was operating at the wrong frequency.

The technician had checked that the oscillator was working, discovering in the process that its output was on the low side. In these sets – the GEC group's hybrid single-standard chassis – the amplitude of the output from the reference oscillator circuit is rather critical. Under normal operating conditions the output in the emitter circuit of the following buffer stage should be 5-6V peak-to-peak.

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TELEVISION JULY 1976

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