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5CG8	0·55	6C17	1·00	6Q7GT	0·50	12BH7	0·27	30L15	0·75	AC2/PEN		E88CC	0·80
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5V4G	0·54	6CG8A	0·75	6SA7	0·44	12J7GT	·55		1·00	AC2/PEN/		E182CC	1·00
5Y3GT	0·38	6CH6	0·60	6SC7GT	·33	12K5	0·95	30P12	0·80	DD	0·98	E1148	0·53
5Z3	0·53	6CL6	0·55	6SG7	0·44	12K7GT	·38	30P16	0·37	AC/PEN(7)		EA50	0·27
5Z4G	0·35	6CL8A	0·80	6SH7	0·44	12Q7GT	·45	30P19/			0·98	EA76	1·00
5Z4GT	0·35	6CM7	0·75	6SK7GT	·44	12SA7GT	·55	30P4	0·75	AC/TH1	1·00	EABC80	·30
6/30L2	0·60	6CU5	0·75	6SQ7GT	·38	12SC7	0·50	30PL1	0·66	AL60	1·00	EAC91	0·75
6A8G	1·25	6CW4	0·70	6U4GT	0·70	12SG7	0·38	30PL12	·32	ARP3	0·35	EAF42	0·50
6AC7	0·49	6D3	0·60	6U7G	0·75	12SH7	0·35	30PL13	·75	ATP4	0·40	EAF801	·55
6AG5	0·27	6DE7	0·75	6V6G	0·17	12SJ7	0·44	30PL14	·80	AZ1	0·60		
6AH6	0·50	6DT6A	0·75	6V6GT	0·38	12SN7	0·60	30PL15	·95	AZ31	0·60		
6AJ5	0·75	6EW6	0·75	6X4	0·30	12SQ7GT	·65	35A3	0·65	AZ41	0·65		
6AK5	0·34	6E5	1·00	6X5GT	0·28	14H7	0·55	35A5	0·80	B36	0·60		
6AK6	0·60	6F1	0·70	6Y6G	0·65	14S7	0·75	35D5	0·75	BL63	2·00		
6AM6	0·30	6F6G	0·50	6Y7G	1·00	19AQ5	0·42	35L6GT	·55	CL33	1·50		
6AM8A	0·55	6F13	0·55	7B6	0·75	19G6	1·40	35W4	0·33	CV6	0·53		

ECF804	2·10	EM84	0·40	P61	1·00	PL83	0·39	UCF80	0·65	U4020	0·55
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ECH35	0·65	EM87	0·68	PC86	0·60	PL504/500		UCH42	0·65	VP23	0·75
ECH42	0·70	EMM803		PC88	0·60		0·67	UCH81	0·38	VP41	0·75
ECH81	0·30		2·00	PC95	0·75	PL505	1·15	UCL82	0·38	VT61A	0·35
ECH83	0·44	EY51	0·40	PC97	0·45	PL508	0·90	UCL83	0·60	VU111	0·44
ECH84	0·44	EY81	0·40	PC900	0·45	PL509	1·15	UF41	0·70	VU120	0·60
ECL80	0·40	EY83	0·54	PCC84	0·40	PL802	0·95	UF42	0·70	VU120A	·60
ECL82	0·34	EY84	0·70	PCC85	0·44	PM84	0·60	UF80	0·35	VU133	0·35
ECL83	0·57	EY87/6	·33	PCC88	0·60	PY33/2	·50	UF85	0·44	W76	0·38
ECL84	0·60	EY88	0·40	PCC89	0·50	PY80	0·38	UF86	1·00	W107	0·65
ECL85	0·60	EY91	0·58	PCC189	0·53	PY81	0·31	UF89	0·38	W729	0·75
ECL86	0·40	EZ40	0·55	PCC805	0·75	PY82	0·25	UL41	0·65	X41	1·00
EF22	1·50	EZ41	0·50	PCC806	0·70	PY83	0·33	UL84	0·38	X63	1·25
EF40	0·60	EZ80	0·24	PCF80	0·28	PY88	0·33	UM80	0·44	X66	0·65
EF41	0·70	EZ81	0·25	PCF82	0·33	PY301	0·70	UR1C	1·00	XH/1·5	·48
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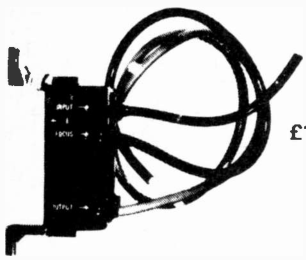

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TELEVISION
SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS
VOL 24 No 6
ISSUE 282
APRIL 1974

COMPONENTS SURVEY

It does not seem to make sense at times. On the one hand we hear of component shortages and hard times falling on suppliers. On the other hand some are proudly boasting new extended ranges in their latest catalogues. We also hear of suppliers who stock product lines "in depth" and others who quote delivery times of a year or more. What is the service engineer, television designer or constructor expected to believe? It really all depends on what you want.

In the past two years development has been rapid and customers have been tempted by manufacturers' new or extended ranges. This in turn has resulted in promises to distributors to encourage them to expand their catalogues and in some cases to find more space to stock new lines. But when it comes to the point an order, especially of considerable size, may result in a very long delivery time. If a small order is put in, very likely the manufacturer will not want to be bothered. What he is really looking for is a promise, contractual or otherwise, that will assure him of a factory work load over a long period. If he gets this he can plan ahead, offer forecasts and have some idea of what sort of growth to expect. This in turn enables him to maximise the company's effort and dispose the labour force in the areas of greatest profitability.

This procedure is the accepted current management practice in many large companies. When it reflects on the service offered in supplying goods on demand however things start to go wrong: at least that is the way the customer often sees it.

What can be done to iron out this sort of problem? There are several suggestions that could be made. The first that comes to mind is standardisation on components and their characteristics (hence BS9000). The second is rationalisation of type and performance categories—easier said than done when classification is usually carried out after manufacture within known limits—hence for example 5%, 10%, 20% resistors and BC107/8/9 transistors.

One suggestion which can help the customer and supplier is through improved communication. There are several journals that publish details of products as they become available but for obvious reasons it is not possible for them to deal exhaustively with all available components. Customers must rely to a great degree therefore on having a wide selection of catalogues from which to select components. This is probably the case with most of our active readers.

Over the next few months *Television* will be looking into some of the problems of component supplies and will publish (commencing in the August issue) its findings. We have already received the co-operation of several distributors and wholesalers and would like as many more as possible to help—by sending us their catalogues, prices and details of their trading terms. For more details see "Teletopics" over page.

M. A. COLWELL—*Editor*

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DUE TO THE CONTINUATION OF THREE-DAY WORKING IN THE PRINTING INDUSTRY PUBLICATION OF THE MAY ISSUE MAY BE DELAYED

Cover: The CCTV camera featured on our cover this month is the Ikegami viewfinder Model VF-302. It was kindly lent to us by M. J. Hughes, M.A.

TELETOPICS

YOU CAN HELP US TO HELP YOU!

We are planning to publish later this year a survey of component suppliers' and distributors' catalogues and terms. The main aim is to be able to inform television engineers in industry and in the trade and retail shops about component manufacturers' main outlets so that the engineer and retail trade can take full advantage of the distributor network. Readers who would like to suggest particular items and information they would like to see included in this survey, and *component* manufacturers, distributors or wholesalers who would like us to consider including details of their trading terms and/or catalogues, are invited to write to the Editor, "Television" Components Survey, Fleetway House, Farringdon Street, London EC4A 4AD.

We regret that the survey cannot be extended to include details of retail outlets, either shops or mail order, on this occasion because of space limitation. The final date for receiving information for this feature will be 1st May 1974. We cannot guarantee the inclusion of any particular item nor can we guarantee to reply to all contributors, though we appreciate any assistance offered.

This survey is likely to appear in the August issue of TELEVISION. Any company requiring details of favourable advertisement rates for this issue is invited to contact Roy Smith on 01-634 4293.

INSTANT-ON CRT

Instant-on TV sets have long been popular in the US. They use the simple technique illustrated in Keith Cummins's feature on *Converting Foreign TV Sets* in our February issue: in this arrangement current is passed through the c.r.t. and any other valve heaters even when the set is switched off, so that on switching on the heaters are warm and a picture appears almost immediately. This is wasteful however, and we all know by now about the importance of conserving energy! From Sylvania (USA) comes news of a development which gives instantaneous—well almost—pictures without the previous power-consuming instant-on technique. This is a new form of c.r.t. heater which warms up so that the c.r.t. produces a picture within five seconds. This compares with the 30-60 seconds required by the conventional c.r.t. cathode.

BBC ANNUAL REPORT

In its annual report for 1973 the BBC has again expressed concern over the use in the UK of imported non-PAL specification colour receivers that have been adapted in one way or another so as to be able to receive PAL transmissions, for example by converting the incoming PAL signal to an NTSC one. The BBC states that although it may have been necessary to import such sets to meet the sudden rapid increase in the demand for colour some of these sets are not adequately equipped to correct colour distortion resulting from spurious changes in the transmitted signals. UK setmakers have consistently designed and manufactured receivers to the PAL specification which enables such changes to be corrected. The transmissions of both the BBC and the IBA are held within certain tolerances that assume the use of a receiver whose specification is in accordance with the PAL system.

The report summarises the growth of the 625-line system and mentions that much thought is being given to the future use of the v.h.f. bands at present used for the 405-line services. Investigations into techniques for recording television signals in digital form are reported to be well advanced and digital timing correctors have been developed to deal with mechanical problems in the recording equipment.

Further details on all aspects of the BBC both past and present are given in the *BBC Handbook 1974* which is priced at 75p.

NEW ICs FOR COLOUR TV

A new range of i.c.s for use in PAL colour receivers has been developed by SGS-Ates. We were informed prior to their presentation at the Seminex seminars in London that the range is already in part production and is being evaluated by setmakers. It is claimed that the new range will simplify the design and setting up of colour sets. Further details will be given next month.

MORE ON SATELLITE TV

A discussion at the Royal Television Society's 1973 Cambridge Convention brought out some further aspects of satellite TV broadcasting as it might be introduced to serve the UK. It was pointed out that tall buildings which cause reception problems at u.h.f. will be even more troublesome at 12GHz, while it is possible that in hilly areas the signals will have to be distributed by cable TV networks due to the angle of elevation of the transmissions. Because of the height of a synchronous satellite's orbit—22,300 miles above the equator—the cost of launching is considerable and the only servicing possible is by duplicating circuits and switching over in the event of a fault.

The use of digital (p.c.m.) transmission is being studied and while it seems that this could have advantages over f.m. for the up link there does not seem to be any significant improvement in using it for the down link. Using p.c.m. for the up link and f.m. for the down link would necessitate incorporating a digital to analogue converter in the satellite however so the balance at present seems to be in favour of using f.m. for both.

On the question of whether the commencement of satellite TV transmissions should coincide with a change in the basic TV standards it was suggested that this could put the start of satellite TV farther into the future while little advantage is likely to be gained from any such change until a new domestic TV display device has been evolved.

TRANSMITTER OPENINGS

The IBA's **Brecon** (Wales) relay transmitter is now in operation, on channel 61 (group C/D receiving aerials) with vertical polarisation. The station transmits HTV Wales programmes.

The BBC and IBA **Gartly Moor** (Aberdeenshire) transmitters are now in operation, BBC-1 on channel 58, IBA on channel 61 (Grampian programmes) and BBC-2 on channel 64. Use vertically polarised group C/D receiving aerials.

TRADE SCENE

The latest BREMA figures for TV set deliveries to the trade, for November 1973, record the highest monthly total ever of colour TV set deliveries in the UK—283,000. This is well over twice the number of monochrome sets (127,000) delivered during the month. The trade scene has of course changed radically since then. It is estimated that in recent weeks TV set sales and rentals have been running at between 40 and 60% below the equivalent 1973 figures. Whilst prior to the recent economic upsets it was estimated that colour set sales during 1974 would reach 3 to 3·2 million the latest estimate is that the figure will be in the region of 2·2 million. It increasingly looks as if, with one in four homes in the UK now equipped with colour TV, 1973 will prove to have been the peak year for colour set sales and rentals. The fall in expected 1974 deliveries should mean that home setmakers will be able to cope with the demand. If importers intend to try to hold on to their share of the market there could be price cuts, though with component prices soaring there can be little scope for this.

REVISED VALVE TYPE NUMBERS

Mullard type DY86/87 and EY86/87 e.h.t. rectifiers and PY81/800 boost diodes will in future have the following single markings: DY87; EY87; PY800.

IBA's 1974 HANDBOOK

The IBA's *Guide to Independent Television 1974* is an attractive, colourful and well prepared volume which records all TV activities within the IBA but lays most emphasis on the programme material side.

Undoubtedly the IBA's pride and joy is DICE (digital intercontinental conversion equipment) which is now in operation to increase the scope of the material that can be made immediately available for news programmes. The equipment consists of a digital field-rate standards converter that changes US NTSC signals into the European standard and in doing so can even improve the quality of the signal. The team that developed it is now working on a two-way version that will also convert European standard TV signals to the US standards. The other major IBA technical development, Oracle, was started in April 1973. As previously mentioned in this column Oracle is a system in which news information in digitally coded form is transmitted on certain lines during the field blanking period. If a suitable decoder is used at the receiver the information can be displayed on the screen.

The Guide contains considerable information on receiver installation and how to obtain best results. Guidance on aerials, u.h.f. reception, colour and local conditions is provided and the coloured transmitter coverage maps should be a considerable help to dealers and aerial installers.

ITV 74 is published by the Independent Broadcasting Authority and distributed by Independent Television Publications Ltd., 247 Tottenham Court Road, London W1P 0AU.

NEW TYPE COLOUR CRTs FROM TOSHIBA

The Japanese electronics firm Toshiba have announced their intention to introduce in the UK a range of new 90° and 110° colour tubes. Full details have not yet been released but it is understood that they feature three in-line guns, slotted masks and vertical striped screens. The 90° versions will be in the smaller sizes, intended for use in portable models, while the 110° tubes will be in sizes up to 22in. The 110° tubes appear to be of the RIS type first mentioned in this column in January 1973, with a rectangular instead of conical flare. These require a rectangular toroidal scanning yoke.

EEV's LIGHT-BIASED LEDDICONS

The English Electric Valve Co. Ltd. has introduced a new series of Leddicon TV camera tubes designated P8005. These tubes incorporate an integral light-biasing system to reduce the smearing of moving information at low operational light levels.

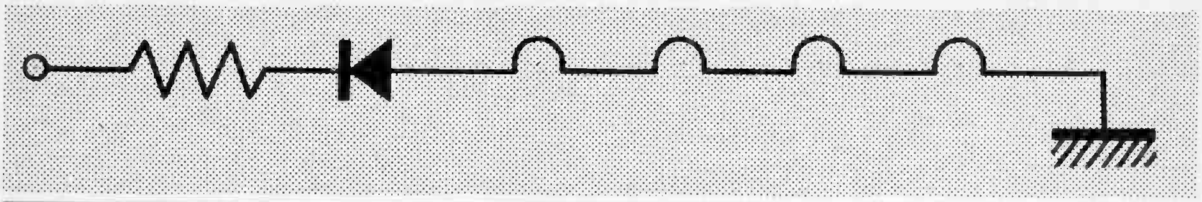
The P8005 series of Leddicons are lead-oxide target tubes and operate on the principle of improving the beam discharge efficiency of the target by raising its general potential level in conditions of low illumination. This is achieved by including a small light source within the tube envelope to provide background illumination. The resultant picture lift is then corrected electronically.

P8005 series tubes can be fitted into most existing television cameras which use 30mm. lead-oxide tubes. No optical or mechanical problems are involved and the light bias supply can be provided by a simple potentiometer feed from the heater supply.

BLOWING OUR OWN TRUMPET!

There has been a steady increase in the sale of TELEVISION over the past couple of years. The latest official ABC circulation figures, for the period July-December 1973, show yet another increase, this time of just over 7%. This brings the circulation to the highest point for ten years.

THE DIODE DROPPER



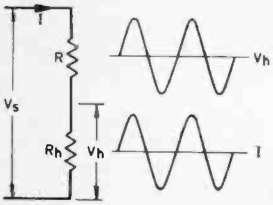
S.A.MONEY T.Eng.(CEI)

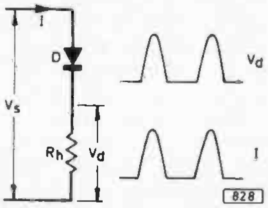
ALTHOUGH most of the latest TV models use solid-state circuits the majority of receivers in use today still employ valves in some of their circuits. In these receivers it is usual to find the valve heaters connected in a series chain fed from the mains supply. The total voltage needed by the series heaters will be less than the supply voltage so that some means of dropping the excess voltage is required. The traditional method of doing this is to connect a resistor in series with the heater chain. This resistor has often to dissipate some 50W or more however and apart from being large will get quite hot.

An alternative technique which has been in use for some years now is to employ a silicon rectifier diode in series with the heater chain. By removing alternate half cycles of the supply the diode reduces the effective voltage applied to the valve heaters. The diode itself dissipates little power and in consequence the arrangement is sometimes referred to as a "wattless" dropper.

A diode dropper is an attractive proposition since the heat generated in the receiver will be reduced whilst the diode itself is both small and inexpensive. The diode produces a fixed voltage drop however so that it is still necessary to use a resistor dropper—though of lower power of course—to reduce the diode's output voltage to the correct value required by the heater chain.

Older television receivers fitted with a conventional resistor fed heater chain can be fairly easily converted to the series diode technique. The operation of the diode circuit is not quite as simple as it at first appears however. The usual trap into which one can fall is to assume that the output voltage from the diode is equivalent to half the supply voltage. This is far from being true and any circuit designed on this assumption is a sure fire way of rapidly destroying the valves in the chain. In this article the operation of the diode as a voltage dropper will be explained and the correct method of designing this type of circuit given.





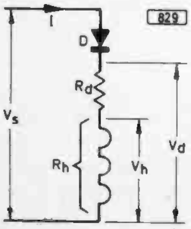


Fig. 1 (above left): Resistive dropper circuit.

Fig. 2 (above right): Diode dropper circuit.

Fig. 3 (left): Practical diode dropper circuit.

Resistive Dropper

Before dealing with the diode type voltage dropper let us look first at the operating conditions in the conventional resistor type circuit. The basic circuit of this type of heater chain is shown in Fig. 1, together with the voltage and current waveforms. For the moment let us assume that the resistance of the dropper R is the same as the operating resistance of the heaters Rh. This makes the arithmetic easier and shows more clearly the comparison with the diode chain.

Since R and Rh are in series the current flowing through each will be the same, and because the two resistances are assumed to be equal the voltages across each will also be the same. The total heater voltage Vh is therefore half the supply voltage Vs.

The heat generated in a valve heater is directly proportional to the electrical *power* applied. When a simple resistor voltage dropper is used the power fed to the heater chain will be $V\text{h}^2/R\text{h}$ watts. In the case where $R = R\text{h}$ the value of Vh is $\frac{1}{2}V\text{s}$ where Vs is the supply voltage. The power in the heaters, in terms of Vs, will therefore be $\frac{1}{4}V\text{s}^2/R\text{h}$ watts.

Using a Diode

Suppose that the dropper resistor R is replaced by a diode D: the circuit and its associated waveforms will now be as shown in Fig. 2. The diode will conduct only during the positive half cycles of the supply, but when the diode conducts the full supply voltage will be applied across the heater resistance Rh.

If this resistance Rh was connected directly across the supply the power developed in it and hence in the heaters would be $V\text{s}^2/R\text{h}$ watts. Since the diode conducts for only half a cycle however the power is only delivered to the heaters for half the time. So with a diode in circuit the mean power applied to the heaters will be $\frac{1}{2}\,V\text{s}^2/R\text{h}$ watts.

If the diode was simply substituted for the resistor R in Fig. 1 the power supplied to the heaters would be doubled from $\frac{1}{4}Vs^2/Rh$ to $\frac{1}{2}Vs^2/Rh$ watts and the valve heaters would run excessively hot.

Equivalent Voltage

The output voltage from a diode dropper consists of a series of half-sinewave pulses with a peak amplitude equal to that of the supply voltage Vs. For convenience in making calculations we need to know the equivalent r.m.s. voltage which would produce the same power in the heaters. Let us call this effective voltage Vd. The power produced by Vd across the resistance Rh will be Vd^2/Rh watts. If Vd is to be equivalent to the pulses from the diode then

$$Vd^2/Rh = \tfrac{1}{2}Vs^2/Rh$$

so that $Vd^2 = \frac{1}{2}Vs^2$

and $Vd = 0{\cdot}707\ Vs$.

For a 240V supply the equivalent r.m.s. voltage across the heaters will therefore be approximately 170V.

Design Method

In practical circuits the total heater chain voltage is less than 170V. Thus to produce correct operating conditions the circuit shown in Fig. 3 is required. The value of the resistor Rd can be calculated from

$$Rd = (Vd - Vh)/I\ \Omega$$

where $Vd = 0{\cdot}707\ Vs$, Vh is the total heater voltage and I the heater current in amperes. The power rating of Rd will be

$$W = (Vd - Vh) \times I \text{ watts.}$$

As an example let us take the heater chain in the Television Colour Receiver project.

The valves have heater voltages of 42V, 40V and 9V giving a total of 91V at a current of 0.3A. The value of the resistor Rd needs to be

$$Rd = (170 - 91)/0{\cdot}3 = 263{\cdot}3\Omega$$

and its power dissipation will be

$$W = (170 - 91) \times 0{\cdot}3 = 23{\cdot}7\text{W}.$$

A practical value for this resistor is 250Ω ohms at 25W.

In this receiver a similar diode feed system was initially used for the c.r.t. heaters. In this case the supply was at 24V and the heaters need 6·3V at 0·9A. Here the voltage drop of about 0·6V across the diode must be taken into account and the effective voltage Vd becomes 17−0·6 which is 16·4V. The resistor Rd now needs to be

$$Rd = (16{\cdot}4 - 6{\cdot}3)/0{\cdot}9 = 11{\cdot}2\Omega$$

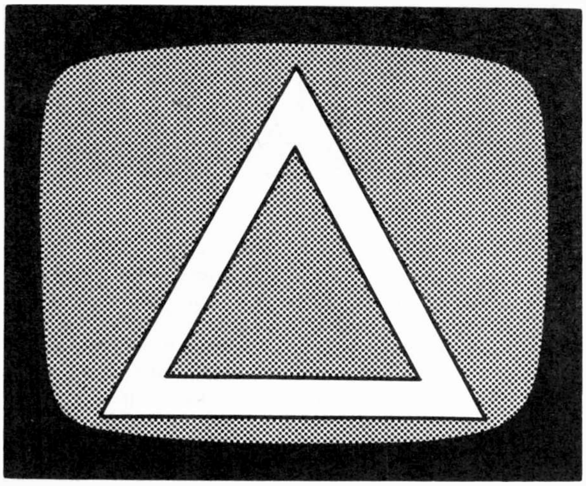
and its power rating will be

$$W = (16{\cdot}4 - 6{\cdot}3) \times 0{\cdot}9 = 9\text{W}.$$

In the original circuit a thermistor with an 0·8Ω operating resistance was included in series with the tube heaters, so a practical value for Rd would be 10Ω at 10W.

Any series heater chain can be converted to use a diode "wattless" dropper along with the correct value resistor Rd calculated as above. The diode must be able to carry the heater current and should have a peak inverse voltage rating of at least twice the supply voltage. The diode type dropper will not work with a d.c. supply of course since the diode will then conduct all the time. ■

TV SET SAFETY



The BEAB System

PART 2

E. J. HOARE

C R T Protective Band

In some sets the safety metal P band (or "Rimguard") around the rim of the c.r.t. is accessible through the edge of the opening in the front of the cabinet. There must be no danger of component failure resulting in the chassis being directly connected to this metal band and thus accessible from the outside. The parallel *CR* combination commonly used to leak away any charge on the c.r.t. P band must be made up from components of special quality. These have to pass a series of special tests similar to those used for aerial isolator components. It is very difficult for home constructors to be sure of getting the special quality resistor and capacitor combination for leaking away the P band charge. It is better to avoid this problem by making absolutely sure that the metal band is completely inaccessible from outside the cabinet.

Set Testing under Fault Conditions

So much then for safety testing under normal operating conditions. The tests for accessibility of live parts and overheating under these conditions have next to be repeated with certain modifications under fault conditions. The term "fault conditions" is largely self-explanatory: it is intended to mean the kind of failure situations that occur in normal conditions of use.

The first part of the test procedure consists of short-circuiting in turn all insulation, including air gaps, that does not comply with the creepages and clearances listed in Table 2. Any heating that results from this test must be checked against the relevant temperature given under the fault condition heading in Table 1. The extra heat produced in the cabinet will in some cases result in softening of the structural materials, so the accessibility tests described earlier must be repeated.

This test sounds fairly innocuous but in practice many clearances between copper conductors on printed panels do not meet the specifications given in Table 2. These must be short-circuited in turn to establish whether overheating can occur. Where trouble arises the obvious cure is to move the conductors farther apart.

In carrying out these tests care has to be taken to see that higher voltages do not occur under fault conditions, as sometimes happens with line timebases and stabilised power supplies. If so, these higher voltages have to be taken into account.

Effects of Component Faults

The next part of the test procedure is frankly beyond the scope of most home constructors—it is too expensive. The clearance and creepage problems we have discussed can be checked by measuring voltages and clearances without actually doing any damage; this can be done by the home constructor. What has to be done now is to short-circuit and open-circuit in turn every resistor, capacitor and inductor, also each valve, c.r.t., lamp or semiconductor electrode to each other electrode of the same device. It does not need much imagination to foresee the damage that can be caused in the process of discovering each potential source of overheating or excessive voltage. How would you like to blow up a pair of perfectly good field output transistors to see if the l.t. decoupling resistor overheats? And how about interconnecting all the permutations of pairs of pins of a sixteen pin integrated circuit?

Practical Example

All this has to be carried out in conscientious detail and some of the problems that arise can be quite tricky. To take a simple case, consider what happens if you apply a short-circuit to a capacitor which decouples a resistor of a few tens of ohms feeding l.t. to a transistorised sound output stage (see Fig. 7). When the capacitor is short-circuited the resistor is connected between l.t. and chassis and instead of dissipating about a quarter of a watt the power increases to say twenty watts.

If you use a half watt resistor it glows white hot and bursts into flames before finally going open-circuit. This contravenes the requirements of BS415:1972 and probably overheats the printed panel as well. If you use a larger resistor, say a wirewound one, it still glows red hot but does not burst into flames: in this case the resistor takes quite a long time to fail, and the panel will certainly overheat and will probably be scorched.

Solutions

There are two possible answers to this one. The first is to use a fusible wirewound resistor spaced well clear of the panel. The trick is to find a component whose soldered spring will release before enough heat has been conducted down the leads, and radiated off the body, to overheat the panel underneath: in this case a temperature rise of 110°C is permitted. The alternative is to use a small special quality fusible carbon resistor which will go open-circuit quickly, without emitting flames or overheating the panel. They are not always easy to get.

In other situations quite large wirewound resistors overheat. A fusible component is almost the only answer here and it may even be necessary to use metal heat baffles to prevent the cabinet or other items of insulation being overheated by thermal radiation. Note that in all these examples where the structure of the receiver gets hotter it is necessary to repeat the accessibility tests in case some of the cabinet materials become more flexible.

There is one important alternative allowed by the Standard. If short-circuiting a certain component results in a shock hazard the Standard's requirements can be met by using a component that passes the special humidity and voltage breakdown tests. The difficulty is that these components tend to be too expensive for the setmaker, and unobtainable by the home constructor. In a few cases however they are the only means of complying with the Standard.

Another fault condition that often requires special measures concerns leads carrying more than 0·5A and more than 15VA. Any insulating material supporting junctions or within 10mm. of junctions must comply with certain temperature and pressure tests. This means in practice that some chokes and transformers with moulded plastic bobbins holding interconnecting solder tags do not comply with the Standard unless the tags concerned are more than 10mm. long. This is not usually the case and there must be on the market many examples of iron-cored components which do not meet this requirement.

High-voltage Assemblies

Any components or wiring in circuits handling voltages greater than 5kV peak, or any material within certain specified distances of a high-voltage point, has to pass detailed flammability tests. These involve applying a flame from a specified hypodermic needle jet to the various materials: any flames that arise as a result of this action have to be self-extinguishing within a certain period of time. In cases where there is any doubt tests are carried out on the complete receiver to establish whether there is any fire hazard.

The practical implications of this part of the Standard are as follows. Any e.h.t. leads or insulating pieceparts for holding or insulating e.h.t thermionic diodes or stick rectifiers must be of flame retardant material. This also applies to the focus assemblies used in colour receivers since these normally have an input of about 6kV. All line output transformers involve voltages in excess of 5kV so all material used in their construction must be flame retardant. A rough and ready test which is quite effective although it does not comply with the Standard is to use a lighted match on a sample of the material in question: hold the sample in the flame until the match has burnt out. If the material burns but the flame extinguishes itself within about ten seconds it is probable that the material has reasonable flame retardant properties.

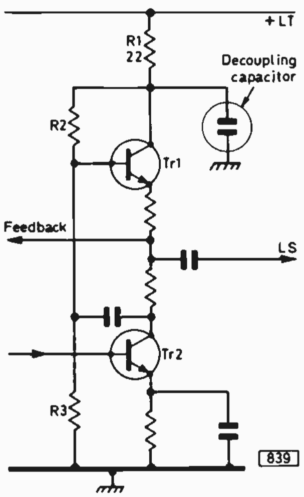


Fig. 7: If the decoupling capacitor in the supply to this sound output stage becomes short-circuit R1 will be connected between the l.t. rail and chassis. This will produce overheating. Incidentally this particular circuit, a class A push-pull circuit with Tr1 base driven from the collector of Tr2, is not too common. A similar circuit is used in the Philips 320 chassis however. R2 and R3 set the mid-point voltage.

Fuses

All fuses must be of the fully enclosed type and must conform to BS2950 or BS4265. The rating of the fuse must be clearly marked on the holder or nearby so that anyone who fits a replacement knows the value required.

Mains Switches

Mains switches must be of the double-pole type so that both sides of the mains are disconnected when the receiver is switched off. All apparatus with a rating of more than 5VA must be fitted with a switch which complies with certain specified quality standards. Although it is permissible to fit fuses on the mains side of the switch it is suggested that it is better practice to fit the fuse as close as possible on the receiver side. The fuse is then never in the dangerous state of being live when the receiver is switched off.

Plugs and Sockets

With plugs and sockets there is the obvious point that it must be impossible for any plug used for earth or signal inputs and outputs to be inserted into any mains supply socket outlet—or contact made even to one pin. It does not need much imagination to foresee the possible consequences of feeding raw mains into the wrong part of any equipment.

Mains Lead

Mains leads must comply with BS6500 and for currents of less than 3A the cross-sectional area must be not less than 0.4 square millimetres while for 3-6A it must be not less than 0.75 square millimetres. Any screw connections in the receiver must be securely made and there must be a clearance of at least 8mm. between the end of the lead and any accessible part: this clearance is to avoid the risk of loose strands of the mains lead sticking out and touching any accessible conducting material.

Securing the Mains Lead

The mains lead must be properly secured inside the cabinet by some form of insulated clamp, and protected from abrasion caused either by the clamp or by the inlet hole in the cabinet. Makeshift methods such as tying a knot in the lead are not permitted.

It must not be possible to push the lead into the cabinet to such an extent as to cause damage to either the lead or the internal parts of the receiver.

Mechanical Fixing

Care is needed when fixing screws into or through a cabinet for the purpose of retaining a backplate or stand. Ideally the screws should be captive, or the holes blind. Blind holes must be tested for strength. If this cannot be done a test should be carried out with a screw 40mm. long to establish whether the creepages and clearances listed in Table 2 are complied with. Do not replace a screw with a larger one unless you have first checked the clearance inside the receiver.

The C R T

Most picture tubes nowadays are of the intrinsically implosion safe type (with protective rim band) and home constructors would be unwise to use any other. Handling a tube which has no built in protection needs care and it is difficult to know how safe it will be when installed in the cabinet. The forces liberated when a c.r.t. implodes are so great that no chances should be taken. It is almost like a small bomb exploding.

Receiver Stability

The complete receiver must have adequate mechanical stability for use in a normal domestic household. In the case of table models it must be possible to tilt the receiver by at least ten degrees in all directions without it overbalancing.

Floor standing models are tested with a force of 100N applied vertically downwards on any horizontal surface in such a way as to cause the largest overturning effect.

Care in Servicing

From the foregoing it will be seen that a great deal of care, expense, time and testing goes into the design of any television receiver that finally secures BEAB approval. The description given here has necessarily been only a summary of some of the more important aspects of the safety requirements, and many of the details and issues difficult to describe have had to be glossed over or omitted.

Enough has probably been said, however, to show how important it is for all engineers engaged in service work to have an understanding of the issues involved, so that when repairs are carried out there is less chance of anything being done inadvertently to nullify the safety precautions that have so carefully been built into the equipment. There are so many different ways in which safety can be impaired.

In any individual receiver design there are always particular components which have been chosen for their special performance, fusing or non-inflammability characteristics. The more important examples of these are now being clearly marked on manufacturers' service data. They include such items as glass fuses, fusible resistors, thermal spring-off devices, c.r.t. P band isolating components and so on. It is essential that all service engineers become familiar with these items and that when necessary they are *always* replaced with manufacturers' approved replacement parts. Failure to do so may make the receiver unsafe, and then the question of responsibility for any subsequent mishap could have unpleasant consequences for the individual.

Home Constructed Sets

It is difficult to see how the average home constructor can be expected to meet all the requirements of BS415:1972. It involves a great deal of skill, experience, time and resources. It is fair, however, to ask all concerned to exercise as much care as possible and at least to comply with those parts of the Standard that depend more upon common sense and care than upon the destructive testing of numerous expensive components.

There is no reason for example why all home built receivers should not be safe to handle with no danger of touching live parts. Fire risks should be kept to a minimum by incorporating the smallest possible quantity of flammable material inside the cabinet. For example always specify flame retardant grades of copper clad laminate material when ordering, and choose components with an eye to their non-flammable properties. A few simple tests will soon show which types of components and insulating materials will burn readily and those which will not.

Precautions to Take

All resistors that generate heat, whether under normal working conditions or fault conditions, should be mounted well clear of printed panels—preferably by at least half an inch. Fuses should be chosen so that they just stand up to the switching-on surge but fail at the smallest practicable overload. Capacitors connected across h.t. lines should be generously rated and any capacitor connected across the mains supply *must* be of a type specifically designed for the purpose. Ordinary 400V or 600V foil capacitors will not in general stand up reliably to the 240V a.c. mains supply.

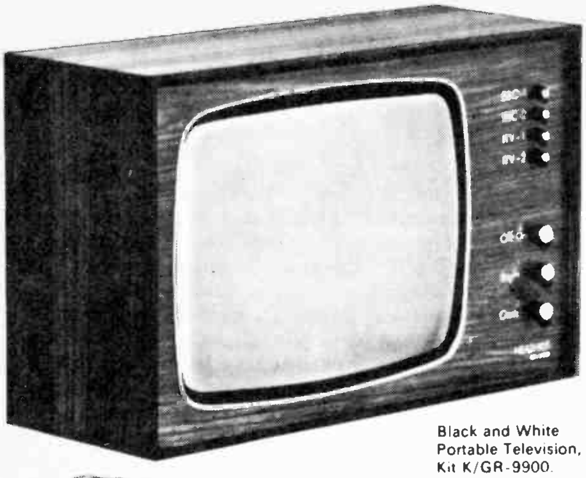
High-voltage electrolytic capacitors usually withstand their rated voltage reasonably well but are liable to fail surprisingly quickly with an appreciable over voltage. They should always be mounted in a cool part of the cabinet.

High temperatures are the enemy of good reliability and long component life. They are also likely to promote burning in the event of a component failure which under cooler conditions might fizzle out harmlessly. Good design is based on low air temperatures throughout the cabinet, without any localised hot spots.

In the absence of proof to the contrary any component failure must be regarded as constituting some degree of hazard. In building in better reliability you are not just saving yourself trouble at some later date but also adopting a responsible attitude to matters of safety.

Acknowledgement

This article could not have been written without frequent reference to the safety Standard. The extracts from BS415:1972 Safety Requirements for Mains Operated Household Sound and Vision Equipment are reproduced by kind permission of the British Standards Institution, 2 Park Street, London W1A 2BS ■



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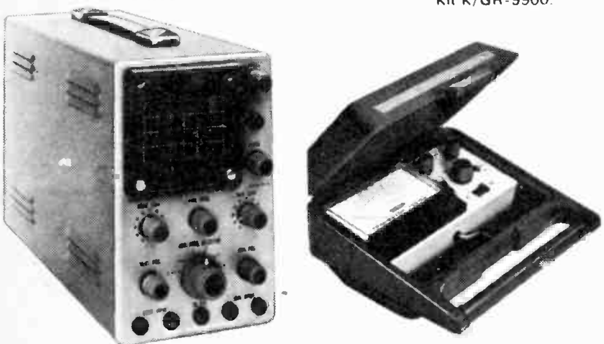

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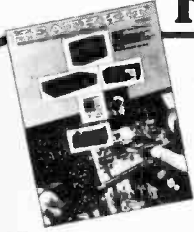

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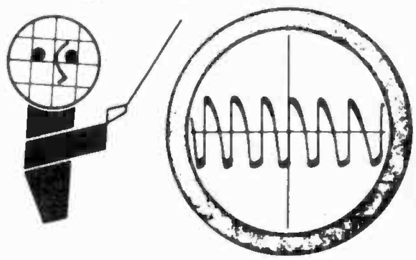

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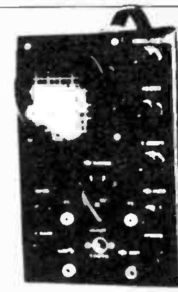

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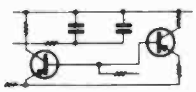

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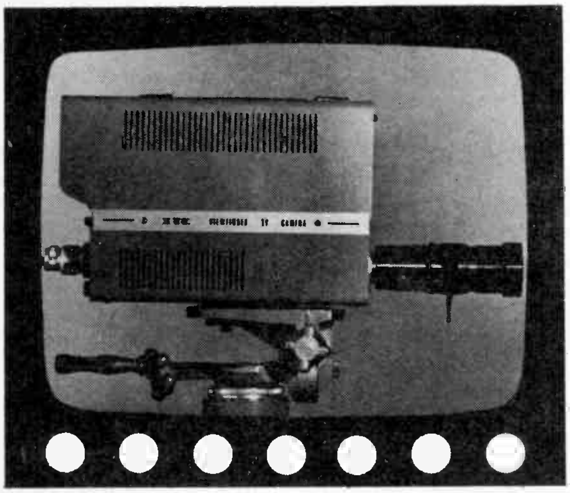


PART 1

Peter Graves

IT is hard to summarise briefly this versatile and rapidly expanding branch of television. Broadly speaking a closed circuit television (CCTV) system is a private television service. It can range from a simple camera and monitor connected by a single coaxial cable, to a full scale colour television studio capable of providing pictures of broadcast standard. This series of articles will deal with the operation, setting up and servicing of the most common type of CCTV camera in the hands of the amateur experimenter—the transistorised, monochrome camera using a vidicon pick-up tube (the "vidicon camera"). Much of the information also applies to cameras using the Plumbicon (lead oxide) tube. We shall also deal with some of the associated equipment and methods of signal distribution (cables, switching, mixing etc.).

Camera Block Diagram

As an introduction to camera operation let us look at the typical vidicon camera block diagram shown in Fig. 1.

Vidicon Tube

The vidicon tube converts the scene focused on its front face into an electrical output. It does this by means of an electron beam which scans the rear of a photosensitive layer inside the tube. The tube provides a current output, the level of the output current at any instant being proportional to the level of illumination at the particular spot the beam has reached. After amplification and processing this output is fed to a monitor where it is reassembled to give a viewable picture.

Monitor

Basically a monitor can be a domestic receiver without its r.f., i.f. and detector stages, the signal from the camera being fed directly into the video amplifier. The synchronising and blanking signals are separated from the video signal and used to drive the appropriate circuits. Some monitors use a domestic TV receiver chassis with a slightly modified video amplifier (to ensure ample gain and correct input matching) and a mains isolating transformer to prevent shock hazards (since one side of the camera output is usually at earth potential). Alternatively the camera output can be used to modulate an r.f. oscillator and the resulting modulated carrier fed directly into the aerial socket of an unmodified domestic set. Some cameras have built in oscillator/modulator circuits to enable this to be done.

Vidicon Scanning and Focusing

The scanning beam is deflected and focused magnetically by means of external coils wound on a rigid former called the "yoke". The tube fits snugly inside the yoke, plugging into a socket at the rear. Focusing (that is optical focusing) may be done by moving the entire tube and yoke assembly backwards and forwards, or the lens may be screwed in and out as in an ordinary film camera. Vidicons are approximately 1in. in diameter and about 6in. long, a tube of this type being referred to as "a one inch vidicon". There are other sizes, a half inch tube for miniature cameras and a one and a half inch tube which is used in some colour cameras. The scanning circuits are very similar to those used in domestic sets except there is no e.h.t. circuit and the voltages and currents involved are less.

Sync Signals

Sync signals for the line and field timebases are derived from processing circuits which are driven from external pulses, internal oscillators, or a combination of the two. Switching between the various modes of operation (often by soldered links) makes these circuits complicated. Another output from this circuit provides correctly timed synchronising and blanking pulses which are mixed with the outgoing video signal in the final stages of the video amplifier.

Output Signal

The output signal obtained from the tube is at a very low level (a *peak* current of $0{\cdot}3\mu A$ is typical from a vidicon) and is fed to a high-gain, low-noise amplifier called the head amplifier. The output signal from the head amplifier is further processed and amplified by the main video amplifier.

Auto Target Signal

This in addition provides the auto target signal, a d.c. voltage proportional to the mean level of the video signal, which is fed back to the tube and

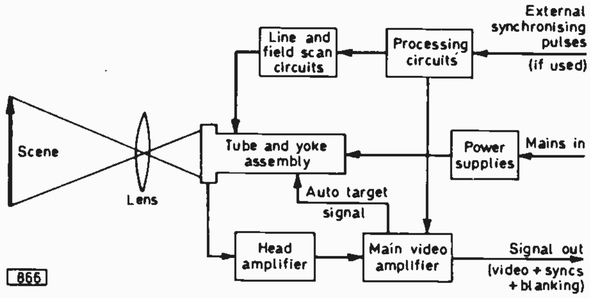


Fig. 1: Block diagram of a typical vidicon camera.

adjusts its sensitivity to compensate for changes in scene brightness (roughly akin to the use of a.g.c. in receiver circuits).

Power Supplies

Power supplies are straightforward in most types of equipment. Electronic stabilisation is very common and some of the supply rails may be floating, that is neither side of the power supply is connected to earth. The advantages of this will become apparent in a later article.

Servicing Equipment

An oscilloscope is an essential tool for servicing and setting up vidicon cameras. Ideally it should have a bandwidth of at least 5MHz. For more serious work a double-beam 'scope is useful—for comparing the relative timing of waveforms. A delayed timebase facility can be used to look at a single line of information but this is not necessary for most servicing jobs.

Useful Tools

No special tools are necessary (unless supplied with the camera, e.g. a vidicon tool). Miniature cutters and pliers and a 10W instrument soldering iron are useful. It may be necessary to add a set of small hexagonal Allen keys.

If it is at all possible the servicing manual for the equipment in hand should be obtained before starting work.

Vidicon Operation

Fig. 2 shows a cross section through a typical vidicon. The electrodes at the rear of the tube form an electron gun which shoots a narrow beam of electrons along the highly evacuated tube. The heater is usually fed from a d.c. supply to minimise stray a.c. pickup in the signal circuits. The heater current requirements vary with the type of tube (common values are 600mA, 300mA, 150mA, and for low consumption circuits 90mA) and some means of catering for this fact must be provided unless the camera is designed round one specific type of tube.

Heater Adjustment

Methods of adjustment include wire wound resistors (soldered in as needed), a wirewound rheostat or a combination of these. Under- or over-running a tube heater will shorten the tube's life besides giving substandard pictures. Correct adjustment of the heater current is essential therefore, particularly if the tube is mounted at a distance from the power supplies (as in some designs). Always check the heater current if a new or different type of tube is fitted or, where appropriate, the interconnecting cable length is changed.

Beam Control

In front of the indirectly heated cathode is the grid or modulator, a disc with a small hole in its centre through which electrons from the cathode must pass. It is fed from a variable negative supply (with respect to the cathode) and controls the number of electrons in the beam. The variable resistor that adjusts this bias is known as the *beam* control and is one of the main tube setting up controls.

Electrode Connections

In different designs the electrode connections and voltages may differ from the description here (for instance the electrode voltages may all be kept constant and the beam focusing carried out by varying the current through the external focusing coil). If in doubt consult the circuit. The accelerating anode is held at a constant positive voltage (with respect to the cathode) of a few hundred volts (typically 200V).

Electrical Focusing

The other electrode, the wall anode, has an adjustable voltage (typically between 200V and 300V) applied to it. The action of varying this voltage, in conjunction with the constant magnetic field from the external focus coil, brings the electron beam to a sharp focus at the rear of the target layer. The variable control for this purpose is known as the *focus* or *electrical focus* adjustment and should not be confused with *optical focus* adjustments which are concerned with focusing the reflected light image from the scene on to the front of the target layer. Magnetic discs (such as are used to shift the picture on a domestic receiver c.r.t.) or external coils with a variable current flowing in them (the alignment coils) are set so that the undeflected beam falls exactly in the centre of the target layer. Setting up ("alignment") is not carried out by removing the scan voltages but by an indirect method of observing the image on the monitor—exactly how this is done will be covered in a later article.

The Mesh

Over the face of the wall anode (which is shaped like a wide necked bottle without any bottom) is a very fine metal mesh (referred to as "the mesh") which most of the electrons in the scanning beam pass straight through. The mesh may be electrically connected to the wall anode inside the tube (an "integral mesh" tube) or may be insulated from it and a connection to the mesh brought out to a base pin (a "separate mesh" tube). In this case it is connected to a slightly higher positive voltage than the wall anode, from a potential divider fed from the focus control. If a different type of tube is fitted it is necessary to modify the camera wiring to suit.

In either case the mesh has two main functions. First it provides a uniform electrostatic field between the target layer (whose far side is at a potential of between 10V and 60V positive with respect to the cathode) and itself. This decelerates the electrons in the beam so that they strike the target layer at a low velocity. The uniform electrostatic field together with the magnetic field from the focusing coil also ensure that the beam hits the target at right angles to the surface of the target wherever the beam lands. This is known as orthogonal scanning and is compared with the scanning of a normal cathode-ray tube in a monitor or domestic receiver in Fig. 3. The target is scanned in this manner to ensure maximum resolution (ability to discern fine detail) since this depends on the size of the scanning beam where it falls on the target—the smaller the spot the better. If the beam strikes the target at an angle the resulting ellipsoidal spot is of course bigger than the circular spot obtained from the same beam striking the target at right angles. There are other reasons for using simple scanning with a c.r.t.: for instance an orthogonally scanned c.r.t. would be unacceptably large and heavy. The second function of the positively charged mesh is to attract any secondary electrons emitted by the target under the bombardment of the scanning beam.

Target

The target consists of a layer of photoconductive material (e.g. antimony trisulphide) whose resistance decreases when light falls on it. We are talking about relative changes: even when brightly illuminated the very thin layer (typically 10 microns—millionths of a metre) has a resistance of the order of tens of megohms. Deposited on the target layer on the opposite side to the gun assembly is a thin, transparent, conducting layer of tin oxide. This is electrically connected to a metal ring sealed into the glass envelope (the "target ring") and forms the signal output electrode, providing a short signal path to the input of the head amplifier—the first stage of the video amplifier.

Signal Circuit

Light from the external scene is focused by the lens system through the optically flat and polished glass faceplate, through the tin oxide layer and on to the target layer. The signal circuit (shown simplified in Fig. 2) is completed by the load resistor and the variable target supply back to the cathode and the beam (which, being a stream of electrons, acts as a conductor). In Fig. 2 the load resistor is shown earthed—in some circuits the cathode is earthed, but the basic circuit remains the same.

Synchronisation

A closed circuit television monitor tube is scanned in basically the same manner as a domestic receiver (we shall look at the variations when we discuss scanning in detail), that is line by line from top to bottom, flying back rapidly at the end of each line to the start of the next line and returning to the top at the end of each frame (field and frame are taken as synonymous at this stage). The vidicon target must be scanned in step with the monitor tube. If the monitor scan is say halfway along line 117 then the vidicon scan must also be halfway along line 117 and so on. The two scans are kept exactly in step by the sync pulses added to the video signal from the camera. Since the monitor scanned area is rectangular it follows that the scanned area of the circular vidicon target must also be rectangular.

Target Capacitance

The target layer can be thought of as the dielectric for thousands of tiny separate capacitors that cover it. Only those capacitors that the scanning beam actually falls upon are used. One plate of all these capacitors is the tin oxide layer which forms a common connection. A capacitor consists essentially of electrical charges separated by an insulator (the dielectric). In electronics we tend to take a simplified view and think of a capacitor as two metal plates separated by the dielectric. The target layer has only one plate—the tin oxide layer—the other "plate" being the charge of electrons actually deposited on the target layer by the scanning beam. For convenience we can think of these electrons as being deposited in separate, minute areas, thus forming corresponding minute capacitors. We shall see the significance of this in the following description of the operation of the vidicon.

Obtaining a Video Output

Suppose that an area of the target is in complete darkness. The "capacitors" in this area will have very high insulation resistance. When the beam falls on this area electrons will build up on the rear of the target until the electrostatic field due to these deposited electrons is sufficient to repel any further electrons from the beam.

These repelled electrons (still under the influence of the focusing and scanning fields although travelling in the opposite direction) form a return beam back along the tube. In a vidicon this return beam is not used: it returns to the positively charged accelerating anode and ends up as a small current in that circuit. Other types of pickup tubes—e.g. the image orthicon—utilise the return beam as an important part of the signal circuit.

Dark Current

When the beam leaves the high insulation resistance area of the target the "capacitors" will remain charged. Thus when the beam returns (on the next frame) no further electrons will be able to land because of the charge established during the previous scan. (This is not strictly true: no insulator is perfect. A small—very small—current flows, the *dark current*.)

Action of Light

Suppose now that some other area of the target has light falling on it. The "capacitors" in this area will have a lower insulation resistance due to the photoconductivity of the target (i.e. the "capacitors" are leaky). When the beam reaches this area the capacitors will charge in the manner just described

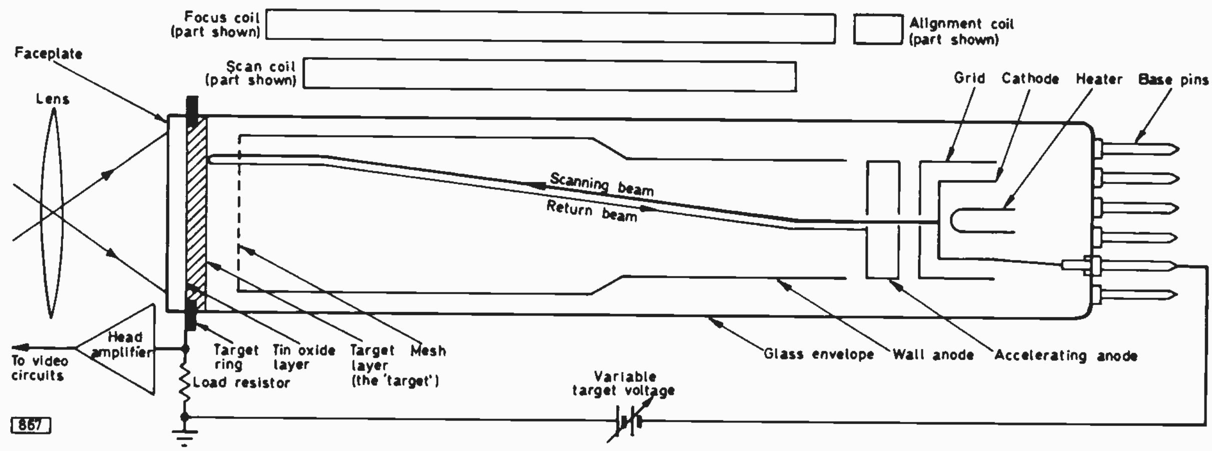


Fig. 2: Vidicon construction and basic external circuit.

but when the beam leaves the area they will discharge through the leaky target layer (note that no current will flow in the external circuit—there is no return path for it). When the beam returns to this area electrons flow from the beam to recharge the "capacitors" and there will be a current flow round the external circuit causing a voltage drop across the load resistor.

Thus no external current flows when the beam lands on a dark area. On the other hand the greater the illumination (within limits) the greater the fall in the target insulation resistance, the more the "capacitors" discharge and the greater the recharging current. In consequence the output current obtained is proportional to the illumination at any point on the target. The electron beam acts in effect as the moving contact of a sophisticated rotary switch, connecting each area in turn in a pattern determined by the currents flowing in the scan coils.

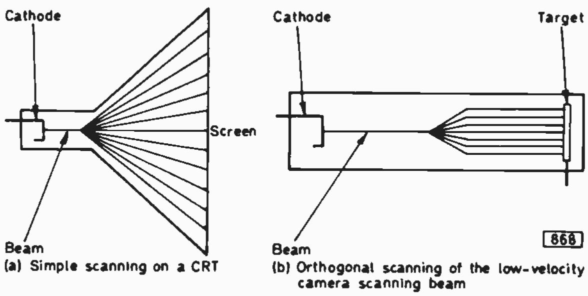


Fig. 3: Comparison between (a) normal c.r.t. scanning and (b) low-velocity beam orthogonal scanning as used with a vidicon tube.

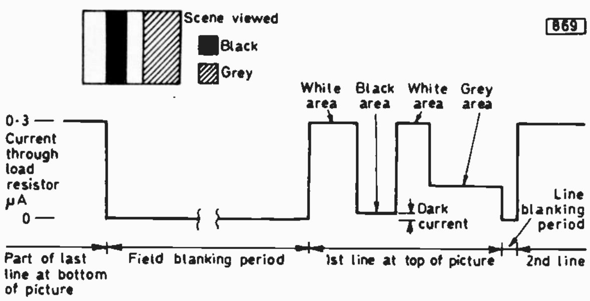


Fig. 4: Representation of the current output waveform obtained when the scene shown at the top is being viewed by a vidicon camera. The blanking periods are also shown. Note the low level of the output (peak 0.3µA).

Blanking

During the line and field flyback periods (when the scanning beam is returning to start a new line or field respectively) it is necessary to blank—cut off—the beam to prevent it interfering with the charges on the rear of the target. For this purpose a pulse is applied to the cathode or grid to bias off the tube (a positive pulse to the cathode or a negative pulse to the grid of course). These pulses are known as "camera blanking pulses" and are derived from the scan circuits. Since they contain both line and field components they are referred to as "mixed". Loss of blanking—due to a broken wire or faulty circuit—shows up on the monitor picture as diagonal lines across all or part of the picture.

Fault Finding

An oscilloscope is best for fault finding here: start from the grid or cathode pin itself (if it is accessible) and work backwards through the coupling capacitor to the processing circuits.

Output Current Waveform

Figure 4 shows the current waveform through the load resistor with the camera looking at some arbitary scene. The horizontal (time) scale has been exaggerated for clarity. The field blanking period is usually much longer than the line period. This sort of representation of waveforms (usually voltage is the vertical scale) is very common in closed circuit television work and we shall be using it a lot in future instalments.

In Part 2 we will look further into the technical side of the vidicon, its setting up and the prevention and cure of common faults.

CONTINUED NEXT MONTH

TRANSISTOR FIELD TIMEBASES

Harold Peters

ONE reward in looking back through recent issues of the magazine is a wealth of gen on valve field timebases. There has been very little on their transistor counterparts however. I have just found out why: there is so little in them to go wrong, and when they do the faults tend to defy description and, as I have discovered, correction. (Crystal sets fall in the same category!)

This article follows my attempt to service a transistor field timebase panel, starting from scratch, and deals mainly with the panel used in the current Pye group colour chassis. This particular circuit has been around now for some six years and still adheres closely to the original Mullard design. Other timebases using similar circuitry will have their differences outlined in the concluding paragraphs.

Oscillator

The circuit is shown in Fig. 1. Four transistors are used, with d.c. coupling throughout. VT24 is a blocking oscillator. Look upon it as a flyback switch, not a sawtooth generator. The timing circuit consists of RV21 (field hold), R252 and C251. When the negative charge established on C251 as VT24 briefly conducts (flyback) has leaked away sufficiently VT24 conducts again. Feedback via T18 drives it rapidly to saturation, base current then charging C251 negatively so that VT24 cuts off again. The oscillator is free-running but is synchronised by negative-going field sync pulses applied to VT24 collector via PL9C and C252. D43 protects VT24 during negative half cycles by conducting and placing a short-circuit across the secondary of the transformer.

The flyback switch proper is D45, which is "on" when the negative-going flyback pulse appears on the small overwind on T18 primary winding. D45 shorts out the sawtooth generator charging capacitors C253 and C254 more effectively than a screwdriver to chassis.

Driver

The driver stage VT25 (AC128) is an emitter-follower and is fitted below the panel to keep it cool and prevent height shrinkage. During flyback it conducts heavily (in fact it is saturated) thus clamping the base of the lower output transistor VT27 to the −20V rail throughout the flyback time. To prevent height variations the charging circuit is fed from a zener-stabilised 20V line.

Output Stage

The output stage may look like a push-pull pair as used in a high-fidelity audio amplifier but is not. VT27 is an amplifier, working in class A conditions, and VT26 a glorified collector load which does funny things during the flyback period.

A glance at the circuit shows that the scan coils are connected between a point halfway down the VT26, VT27 chain of components and a point midway between +20V and −20V at the shift control slider. Maximum scan is obtained by leaving one side of the coils at approximately chassis potential (i.e. as set by the shift control) and by pushing the other side up to +20V and down to −20V. This is done by alternately varying the conduction of VT26 and VT27 like a seesaw.

At the start of the scan the lower transistor VT27 is cut off because the flyback switch, being a dead short, has bottomed the driver transistor so that its emitter—and thus VT27 base—is at the lowest potential. With VT27 off VT26 is on, conducting heavily as a result of the choice of resistors used in its base and emitter circuits, and also using the charge in electrolytic C256 as a bias battery.

Following the flyback period the charging capacitors C253 and C254 slowly build up a potential which lifts the base of VT27 (via the emitter-follower driver) to make it conduct. The voltage produced across R265 in its collector circuit is then applied via R260 to VT26 base, and this transistor begins to turn itself off. The conduction of VT27 and VT26 gradually reverses until VT26 is cut off, VT27 is fully on and the voltage on their side of the scan coils has swung from +20V to −20V. Which leaves us with the tricky bit.

Flyback Period

The scars on our knuckles remind us of the stored energy in timebase output transformers, producing enormous back-e.m.f.s during the flyback period as the magnetic field collapses at the end of the scan. Our trouble with the present circuit is that there isn't a field output transformer—only the scan coils. We have to make the most of what little inductance they contain therefore. This is done in three ways: the low impedance of the power supply is unhooked; VT27 is turned off as rapidly as possible; and the scan coils are made to resonate at a frequency close to the flyback speed. Now that we have established what is being aimed at we can discuss what actually happens without the mind boggling too much!

When the scan stops and the flyback begins scan coil back-e.m.f. lifts VT27 collector from −20V to +40V, taking with it VT26 base and emitter. This means that D46 and D47 (both dead shorts during the scan) are turned off, cutting off the power supply line with its damping effect. VT27 turns off very fast

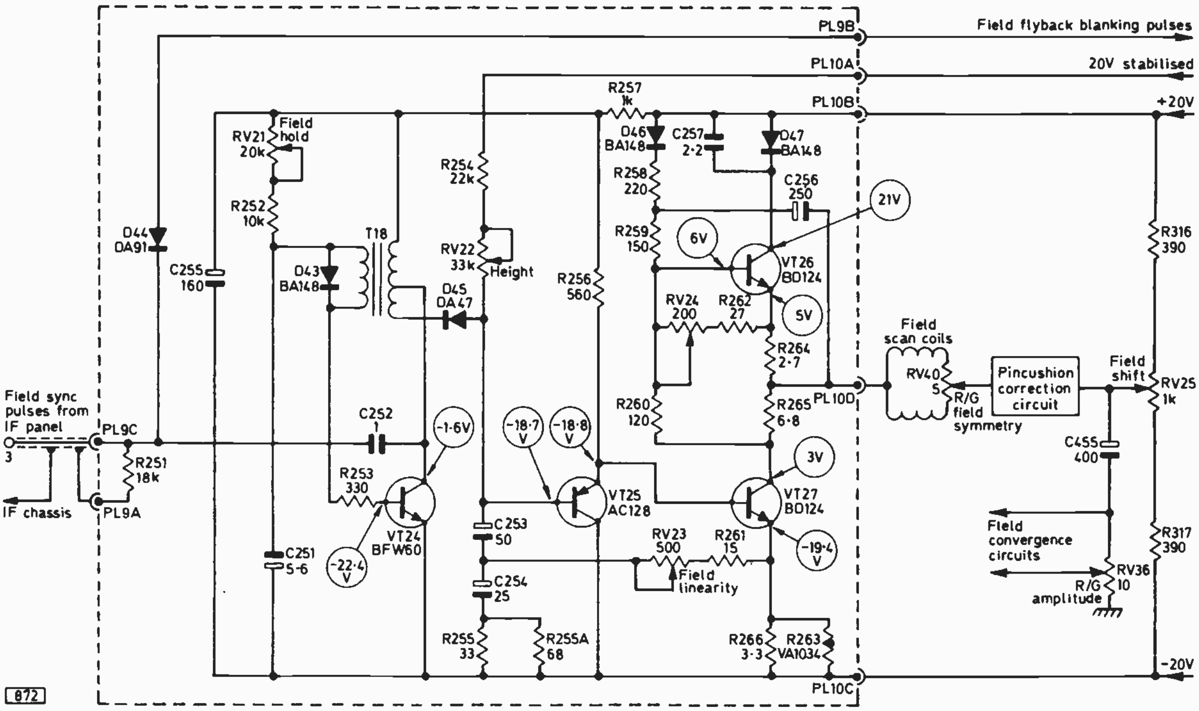


Fig. 1: Transistor field timebase circuit as used in the Pye 697 chassis.

because the small amount of voltage across R255, which is in series with the charging electrolytics C253 and C254, provides a voltage step on its base bias, giving it a push you might say.

Enter C257 (2·2μF) connected across D47 which is now an open-circuit. This capacitor is connected across the scan coils and provides the resonant circuit mentioned above via the reverse conduction of VT26 which turns itself inside out like an umbrella on a windy day. Because its base and emitter are at a higher potential than its collector the emitter and collector temporarily change places. If you find this reverse conduction mode hard to swallow, think of zener diodes—they do it all the time.

Waveforms

To put all these activities in perspective the waveform in Fig. 2 shows the conditions at VT27 collector, with the scan compressed and the flyback stretched for illustrative purposes. In the first period (a) you can see the voltage rising sinusoidally due to the resonant circuit consisting of the scan coils and C257. In the second period (b) the voltage falls off in the same manner and for the same reason. At the peak of the voltage sinewave the current is of course passing through zero. This brief pause enables VT26 to turn itself back into its normal conduction mode. When their cathodes fall to just below l.t.+ the two diodes D46 and D47 switch on again, shorting C257 and reconnecting the power supply.

A clamping period (c) then follows before the scan begins again. During this clamping period the voltages around VT26 settle to a point where it is just coming out of its bottomed condition—just the state it needs to be in when the scan starts again. RV24 enables this condition to be set to coincide with the

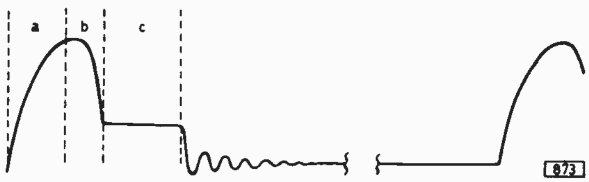
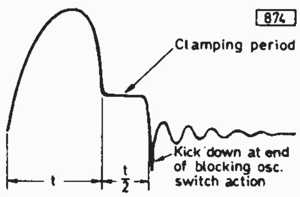


Fig. 2: Waveform (expanded) at VT27 collector.

Fig. 3: Setting RV24. With a 'scope at PL10D adjust RV24 so that the clamping period is half the flyback cycle time. This should coincide with the kick down.



duration of the blocking oscillator flyback switch action. This setting can be done in two ways: either connect a meter from the scan coil feed (plug PL10D) to chassis and set RV24 for the meter to read 2V higher than the mid-point between l.t.+ and l.t.−, or connect a 'scope across PL10D and chassis and adjust RV24 for the end of period (c) to coincide with the kick down of the trace (this denotes the end of the oscillator flyback switch pulse, see Fig. 3).

That is how the circuit works then, now on to mannerisms and modifications.

Modifications

When a circuit has been used for as long a time as this one a few changes are inevitable—if only to keep abreast of component supplies. The main modifications have been as follows:

R257 has gone up from 560Ω to 1kΩ to make the

Table 1: Desperation Chart—Try These Points When Conventional Servicing Fails

Symptom	*Possible Cause*
Foldover	T18 faulty; VT24 changed forward resistance; C256 open-circuit; D43 faulty.
Foldover with lack of hold	T18 faulty.
Foldover with insufficient height	D47 faulty—measure its forward resistance (900 Ω o.k., 3-5k Ω faulty); D46 faulty—measure forward resistance as given for D47; VT26 or VT27 low reverse resistance.
Foldover with too much height	D45 faulty—forward resistance over 100 Ω; C253 or C254 low capacitance.
No scan	Internal short in T18; VT24 short-circuit; D45 open-circuit.
Small, rolling scan	C255 open-circuit; D43 open-circuit; fault in stabilised 20V line.
Flyback lines at top of scan	R256 faulty.
Flyback lines seen overall	D44 short- or open-circuit; C252 short-circuit.

oscillator flyback time less dependent on transformer construction. If Ceefax or Oracle lines cut across the top of your picture this is a good modification to try.

RV21 and R252 have gone from 10kΩ and 15kΩ respectively to 20kΩ and 10kΩ, doubling the hold control range.

RV22 is now 33kΩ (was 22kΩ) to increase the height control range.

To accommodate more production spreads R259 is 150Ω (was 560Ω) and R262 27Ω (was 33Ω).

There is only one field linearity control, RV23. To make this more versatile a 68Ω resistor is wired across R255. This extra resistor is designated R255A and can be clipped out or reconnected as suits the particular VT27 in use.

VT27 works much harder than VT26. Production lines now select these for gain, fitting the "hotter" device in the lower (VT27) position. To change them in service to overcome inadequate height just transfer the leads.

The BD124 is an r.f. device, lovely for ham radio but rather wasted on a 50Hz timebase. The RCA LF16181 and LF16182 devices and the Texas R2382 have been used instead therefore. For a time the ITT BD107 was used for VT26 but it is not suitable for VT27 where it gives stretched middle scan and cramped top and bottom.

The problem of heat produced shrinkage has been tackled in three ways. As mentioned VT25 is mounted below deck. The heatsink carrying VT26 and VT27 is now clipped vertically to the main frame side instead of being bolted down to the printed circuit board. VT27 emitter resistor is bypassed by a VA1034 thermistor (R263) to correct height variations in use. If disturbed this thermistor should be suspended on its leads so that it hangs over R265 with about ¼in. of free air in between.

Eight-way Perm

Some of these panels give only just sufficient height before the bottom begins to curl up. Engineers have tried various replacements without success. Most of the trouble lies in the line timebase/power board. The supplies are unregulated except for the zener stabilised +20V line. The other +20V and −20V lines are subject to variable loading and circuit tolerances, particularly in single-standard sets which make less use of the −20V line than their dual-standard predecessors. The smoothing resistor values can vary within their specified tolerances and so can the output from the mains transformer. This means that you could encounter a comparatively high- or low-impedance supply, giving a comparatively high- or low-voltage output. It doesn't follow that the high-impedance supply will be high voltage, so there can be four possible combinations, the worst being high impedance, low voltage.

At the same time output transistors can be high impedance or low impedance, and also in an unrelated way either high or low gain (low gain, low impedance being worst). This gives eight possible combinations of power supply and output stage, and although transistors giving scant height are sorted out in manufacture it does mean that a replacement transistor may not prove adequate. Workshops that repair all their own panels on a common jig usually suffer the most and the writer vividly recalls an attempt to clear the "sticky ones" by getting in a gross carton of output transistors which were matched pairs. The box had a label saying "Any two of the devices in this pack constitute a matched pair". Nevertheless we tested them all and as a result feel that our protests were in some way instrumental in bringing about the Trades Descriptions Act.

Faults

The output transistors in this type of circuit can of course fail, resulting in field collapse. Before making a replacement it is worth checking that the drive waveform is correct. The driver transistor or oscillator semiconductor device (transistor or silicon controlled switch—see later) can also fail, giving the same results. Faulty output transistors can cause foldover at the bottom and cramping, while in some chassis faulty scan coils can be the cause of low field scan amplitude. In some sets employing this type of circuit the electrolytic capacitor used in the C455 position and providing the field scan current a.c. return path can give trouble. Typical symptoms are bottom cramping which gets worse as the set

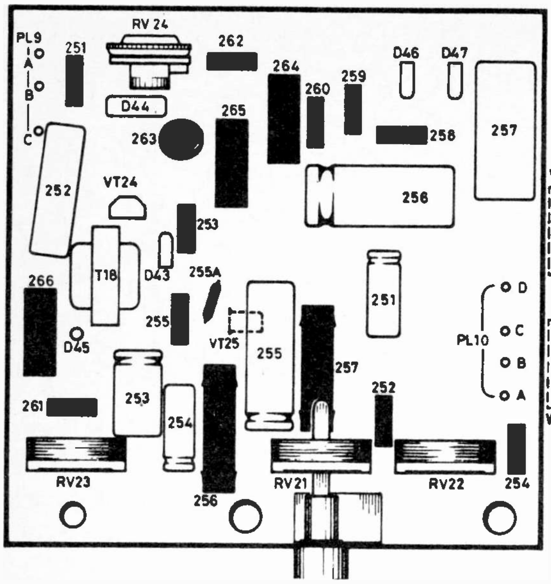


Fig. 4: Layout of the field timebase panel used in the Pye 697 chassis (component side).

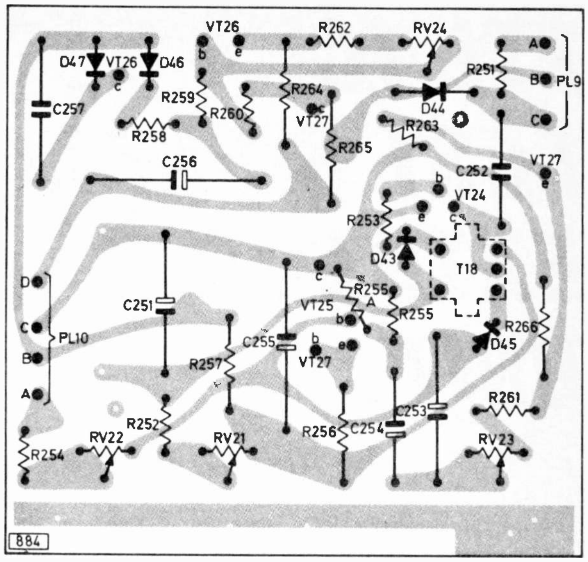


Fig. 6: Print side of the field timebase panel used in the Pye 697 chassis.

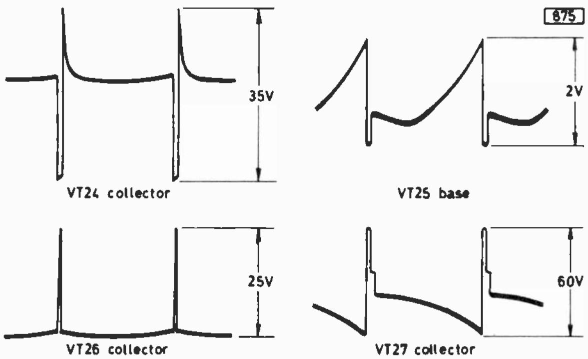


Fig. 5: Waveforms around the circuit.

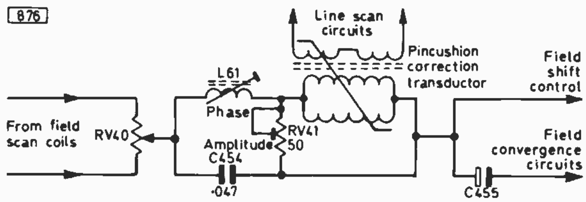


Fig. 7: Connections between the pincushion distortion correction circuit and the field scan and convergence circuits. RV41 tends to go open-circuit.

warms up; or a very narrow picture due to the capacitor being open-circuit. For those in difficulty a desperation chart is given in Table 1.

Here are a couple of "quickies" on the Pye chassis. C255 can dry up resulting in hold troubles. RV41 in the pincushion correction circuit (Fig. 7) tends to burn out, resulting in light lines across the top section of the screen.

Other Chassis

The basic circuit described has been used in several chassis. An almost identical version, but with the BD124 output transistors connected between a +42V line and chassis, was used in the BRC 2000 dual-standard colour chassis: as the 42V supply is stabilised on the regulator board the "eight-way perm" trouble is avoided. In the subsequent 3000 single-standard chassis BRC reverted to a choke for the output stage load, taking full advantage of its healthy flyback pulse. In the BRC 8000 chassis a class B output stage is used.

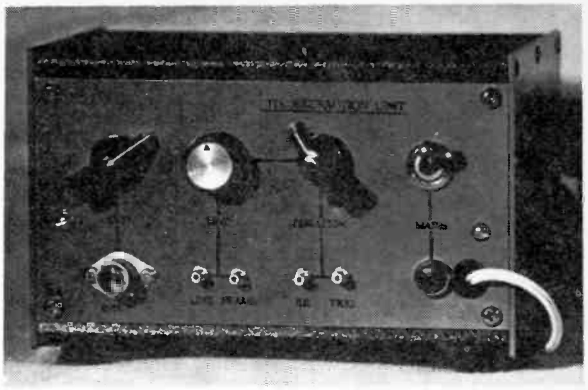
RBM in their 90° single-standard colour chassis, Philips in their G8 and GEC in their latest C2110 series chassis all use the basic circuit though with the transistors between approximately +40V and chassis and the blocking oscillator replaced by a silicon controlled switch—sometimes called a four-layer diode—which works rather like a thyristor but has four instead of three external connections. Beware of checking this device with a meter when the set is working as the meter loading will produce field collapse and you know what. A high-impedance 'scope or digital voltmeter should be used instead. The 40V supply in these chassis is obtained from a rectifier circuit fed from a winding on the line output transformer: a fault here can result in lack of height or bottom foldover therefore.

In the RBM chassis BD131 output trans tors are used, in the G8 BD124 transistors and in t e C2110 BD237 output transistors. An odd fault re orted in the RBM chassis is poor field sync as a result of the 125μF electrolytic 2C37 which decouples the collector of the a.g.c. amplifier on the i.f. board being faulty. A fault sometimes encountered in the G8 chassis is a break in the print leading to one of the field hold control connections.

Field roll on camera change on 90° RBM sets fitted with varicap tuners can be overcome by fitting two 4·7μF electrolytics in series, negative to negative, from 1RV2 slider to chassis (as in later production). ■

TTL IC TEST SIGNAL EXTRACTOR UNIT

by Alan C. Ainslie



General view of the unit. Note that a round knob is used for the ten-turn potentiometer (R10).

IN THE November 1973 issue of *Television* the author's design for a vision test signal extractor unit was published. The original prototype was built using Marconi diode-transistor logic (DTL) i.c.s. As these are somewhat dated I have since developed a transistor-transistor logic (TTL) version which incorporates a couple of refinements.

Conversion to TTL

The conversion from a DTL design to TTL is reasonably straightforward although the TTL devices have somewhat different input specifications. The Marconi i.c.s originally used were "open-collector" devices requiring output resistors. The specified TTL device, type SN7400, has no such requirement, saving eight resistors for a start.

The full circuit of the TTL design is shown in Fig. 1. The gates all perform the same functions as in the original DTL version and the configuration is basically similar. There is no need therefore to repeat the circuit description given last November.

Modifications

The first major difference is in the inclusion of diode D1 between the input to gate G4 and chassis. This is to prevent the inputs being driven negative when G3 output goes to logic 0. This is not permitted by the device specification and can lead to eventual breakdown. Similarly G5 input is protected by D2 which clamps the negative excursion as G4 output goes to logic 0. The diodes can be any small-signal germanium (preferably) or silicon devices.

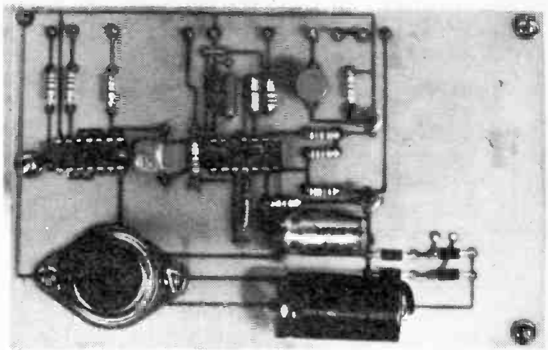
T1 may have a Vce(sat) of about 1V in which case G1 input may not sink to logic 0 with R4 820Ω as in the DTL design. To ensure reliable operation R4 has been changed to 100Ω.

The delay potentiometer R10 has been changed to a ten-turn type. This is easier to operate than the two controls used in the original design. With C3 4·7μF almost the full field can be covered with R10.

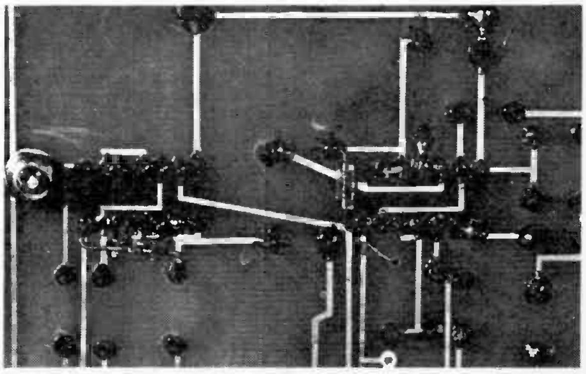
C4 has been increased to 0·1μF and this together with making R12 2kΩ variable enables the length of the bright-up pulse to be varied from one line to about ten lines. This means that at one end of the range of R12 just a single line pulse appears at the trigger output for displaying a single line while at the other end of the range a brighter trace can be obtained for strobing the colour bars out of the test card.

Power Supplies

With a circuit of this nature the monostable formed by G3 and G4 is rather prone to erratic firing from extraneous pulses present on the supply rails. For this reason the supply must be well smoothed and earth loops avoided as these can inject pulses present in other parts of the circuit into sensitive areas.



Top view of the circuit board. Reservoir/smoothing capacitor values used happened to be handy: better to use the values specified.



This view of the underside of the board shows the position of the gate protection diodes D1 and D2.

FAULT FINDING GUIDE

11 John Law

THORN 960 CHASSIS contd.

Line Timebase Circuit

The same line timebase circuit is used in both the basic and the portable versions of the chassis, see Fig. 4. Sync pulses from the anode of the sync separator section of the PFL200 are fed via the integrating network R402/C408 and the coupling capacitor C403 to the junction of the two flywheel sync discriminator diodes W401/W402. A line flyback pulse from winding J-H on the line output transformer is applied to this circuit via the integrating network R401/C402 with shaping provided by C401. Depending on whether the reference sawtooth thus obtained leads or lags the sync pulses a positive or negative voltage will be developed across the diodes. This voltage is filtered and then amplified by the EF80 d.c. amplifier V401 whose output is used to control the timing circuit connected to the grid of the line blocking oscillator V4B. V401 cathode is connected via R411 and switch section S2L to the sliders of the hold controls which are connected across the h.t. supply. Variation of the line hold potentiometers provides manual control of the oscillator frequency by varying the bias applied to the EF80. Changing the bias alters the anode current and thus the anode voltage of this valve, and since the anode is d.c. coupled via R412 to the grid of the line oscillator valve the biasing of this stage, and thus the frequency, are also varied. C51 and C52 (405-lines only) charge via R64 to provide the line drive waveform which is coupled via C104 to the grid of the PL500 line output pentode. Width stabilisation by means of the voltage-dependent resistor Z3 (type E298ZZ/05) is incorporated in the grid circuit of this stage.

Stock Faults

A number of stock faults have arisen in these portable models over the years.

In sets using the circuit shown in Fig. 2 confusion can arise due to the sequence of events after switching on. The eight a.c. fed valves heat up quickly and the screen lights up in the normal manner. The remaining four valves cannot reach their working temperature until activated by the h.t. current. There is a gap of nearly a minute therefore before the sound and vision come through. This can seem a long time to an impatient customer. If one of these sets is used as a loan set therefore a word of explanation can save a service call for "no picture and we switched the set off in case something else broke down". As we have seen the true fault with a raster present but no sound or vision and R152/R153 running hot may well be an open-circuit heater in V3, V5, V6 or V7.

A common fault with early 950 chassis was failure of one section of the main electrolytic capacitor smoothing can. The section concerned was usually the main smoothing capacitor itself, C113. Symptoms vary from curved verticals, poor sync, and weak field lock to complete inability to lock the picture. With the latter symptom there is usually hum on sound which gives a clue. The can contains C112, C113 and two subsidiary h.t. line smoothing capacitors and whilst it is possible to add a replacement capacitor for C113 it is more professional and neater to fit a complete replacement can.

Line Slip

Line slip or intermittent loss of line hold has been traced to one of the flywheel sync discriminator diodes being defective. The forward and reverse resistance readings obtained across each diode should show a wide difference while the forward readings across both should be identical. In an emergency almost any small diode will operate satisfactorily in the circuit but use a pair matched as nearly as possible.

Striations

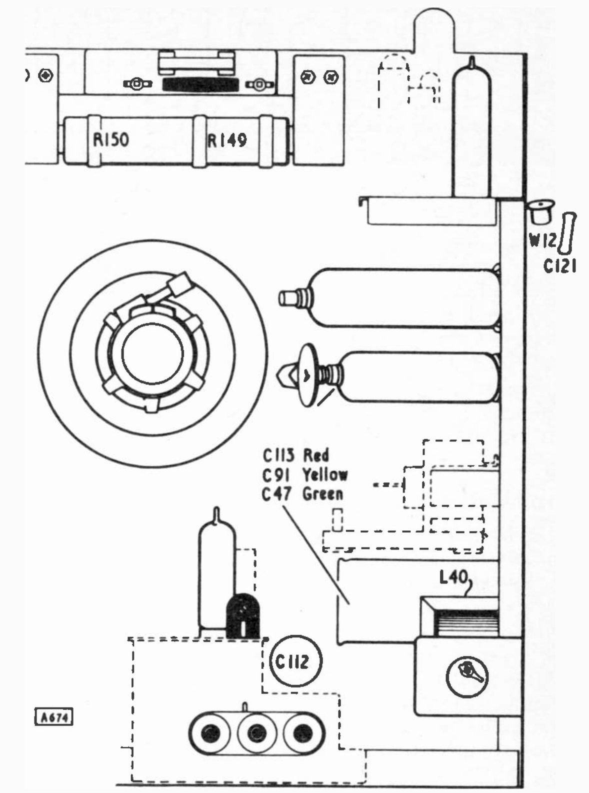
Striations, especially on the left-hand side of the screen, can appear if the diode (W9) in the line flyback blanking circuit breaks down. A dry-joint on tag H of the line output transformer can give similar symptoms.

EHT Tray

Arcing or sizzling on the picture is usually caused by failure of the e.h.t. rectifier tray. One or more of

—continued on page 269

Fig. 5 (right): Component location differences in chassis which use a diode heater dropper.



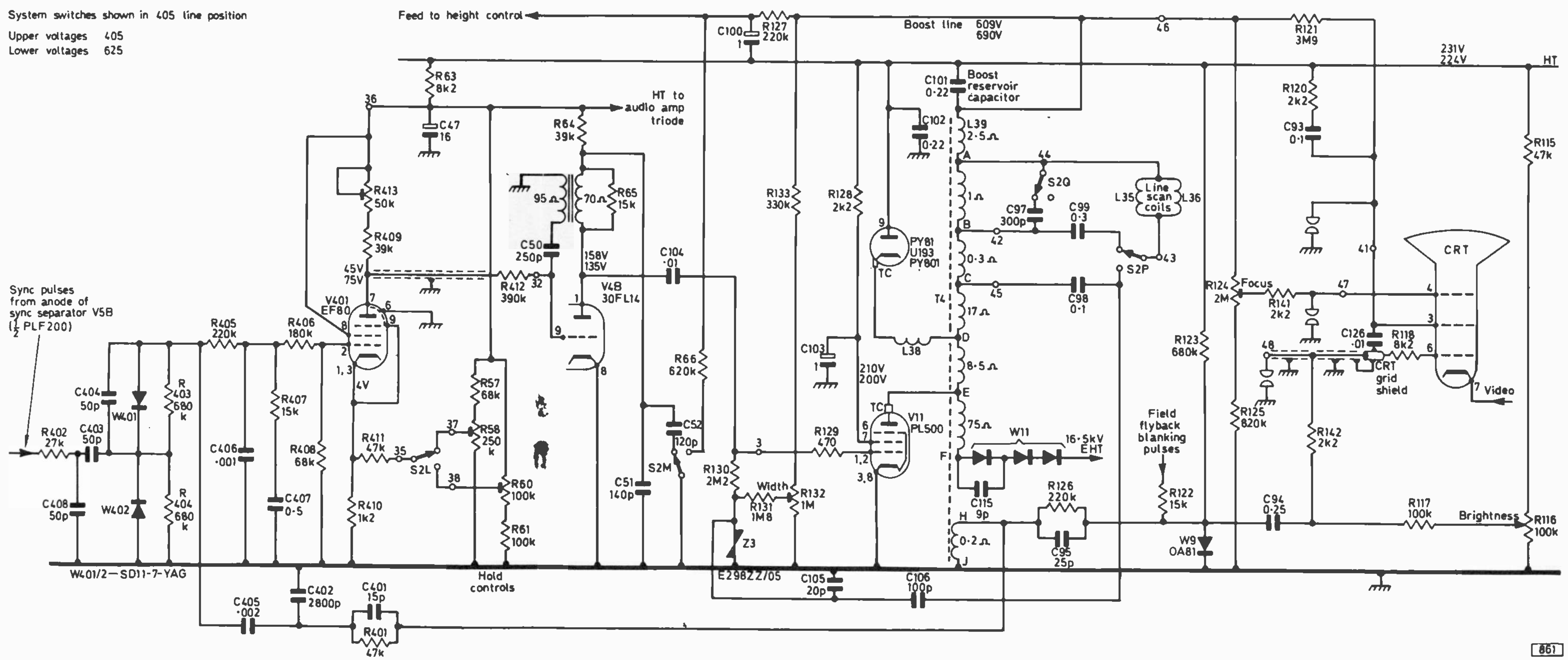


Fig. 4: Line timebase and picture tube circuits used in the BRC 960 chassis.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

LAST month I suggested various u.h.f. stations to "look for" during good tropospheric conditions and had intended this month to give details of several East European u.h.f. outlets. Conditions have overtaken me however. In fact there has been what can only be described as a period of quite fantastic tropospheric propagation, with the reception of many of these stations already! In two cases signals were received from Band III transmitters even farther afield!

Notable Tropospheric Opening

Following a period of extremely high winds in the middle of January a high pressure weather system established itself over the UK and Central Europe and from Saturday the 19th through to early on the 22nd there were enhanced tropospheric conditions for all television frequencies from Band I up to Band V. Hugh Cocks noted high-level signals at v.h.f./u.h.f. from the South during the 19th, spreading up to the UK from the South of France. The most impressive signals were from Band III transmitters in Spain—ch. E5 Inoges at 24kW (ENE of Madrid at approximately 730 miles) and ch. E8 Burgos at 13kW (S of Bilbao). Sunday morning presented for many enthusiasts substantial signals from the Swiss u.h.f. service. The ch. E34 La Dole transmitter predominated but there was the full spectrum of Swiss u.h.f. transmitters between ch. E27 and E34. ORF (Austria) on chs. E8 and E24 was also observed, struggling in over a mass of West German transmitters, and Hugh also noted the ch. R10 Czechoslovakian transmitter at Plzen.

An interesting point is that the old W. German circular electronic test pattern (with white grid) was observed at both v.h.f. and u.h.f. during this opening. Some days earlier I had noted this on ch. E4 via MS (meteor scatter) during lunchtime—care must be taken therefore to avoid incorrect logging as RUV (Iceland).

Monday morning produced Swiss u.h.f., West German, East German, Danish and Swedish reception apart from closer transmitters. Subsequently a belt of rain passed over my area (Hampshire) during the night of the 21st and the morning of the 22nd left empty bands. Fortunately this belt didn't reach East Anglia until later in the morning which meant that reception of sorts was still possible there. Graham Deaves (Norwich) certainly took advantage of this—in a 'phone call during the morning he reported reception of the ch. R25 Polish transmitter at Wrocklaw (1000kW)! This must have been via an elevated duct since no other transmitter was visible (fortunately). Our congratulations must certainly go to Graham and Hugh for their quite dramatic reception.

For my part I received 16 new stations including Swiss E34; ORF E8; DFF E8, 11 and 34; Sweden E10 (780 miles); and several WG u.h.f. stations. Undoubtedly this was the best tropospheric opening for some years. It certainly livened up what is usually a very quiet month.

Somewhat overshadowed by the above was a good Sporadic E opening on January 1st, producing JRT (Yugoslavia); ORF; TSS (USSR); MT (Hungary); and several unidentified stations including skiing championships.

Matters Arising

Several matters arise from all this reception. First, the small identification noted over the past few months ahead of the Czechoslovakian electronic pattern (type CS U 01) is apparently "Programm 1." This was observed during the tropospheric R10 Plzen reception. It appears that TVP (Poland) are using the PM5544 test card with *no* identification. This card was noted at 0745, changing at 0800 to the standard RETMA (with black letters/figures), during the ch. R25 (Wrocklow) reception. Consequently greater care will be required this coming season as both Hungary and Austria use this card on this channel. The identification on the Hungarian PM5544 is "MT" at the top and "Budapest" at the bottom (not "B'pest" as originally stated—noted by James Burton-Stewart, Buckingham).

Due to the lengthy report this month I am omitting my own log. Following the January 1st SpE opening there was MS activity of note on the 16th, 17th and 18th and excellent trops on the 20th, 21st and 22nd. The month (up to and including 26th) ended with virtually nothing, the 25th and 26th being rather unusual in that the MS scene was absolutely dead! All in all January 1974 will be a TV DX month to be remembered.

Meteor Showers 1974

		Peaking
Quadrantids	Jan. 1–5	3rd at 13.00
Lyrids	April 19–24	21st at 22.00
May Aquarids	May 1–8	5th
Delta Aquarids	July 15–Aug. 15	July 27-28th
Perseids	July 25–Aug. 18	Aug. 12th at 10.00
Orionids	Oct. 16–26	21st
Taurids	Oct. 20–Nov. 30	Nov. 8th
Leonids	Nov. 15–19	17th at 11.00
Geminids	Dec. 7–15	14th at 07.00
Ursids	Dec. 17–24	22nd

Our grateful thanks to the British Astronomical Association for providing this information.

MS Reception

Having listed the 1974 meteor showers it may be an idea to outline for the benefit of newcomers the mechanism of MS reception. Each day the Earth in its orbital movement encounters debris—small rocks, sand, etc.—some of which enters the atmosphere and burns, producing a trail of ionisation through the E Layer some 70 miles high (and at night a visible streak commonly known as a "shooting star"). This ionised trail is able to reflect signals at v.h.f.—particularly the lower frequencies—for a short period depending on the

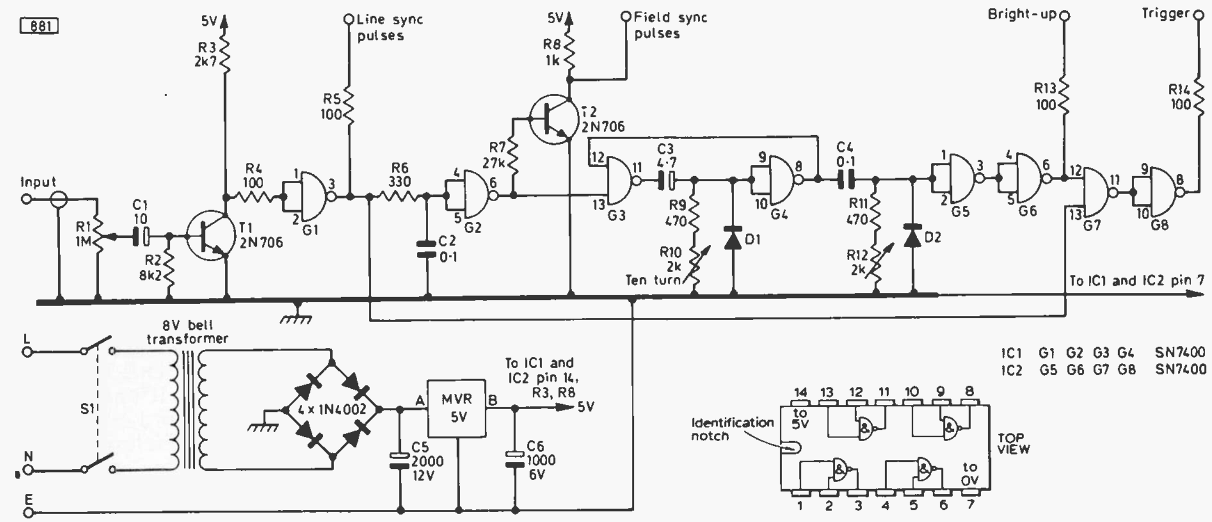


Fig. 1: Full circuit of the TTL test signal extractor unit.

In order to simplify the power supply a little and at the same time provide improved line noise rejection an RS type MVR5V regulator has been chosen to stabilise the mains powered version.

Constructors wishing to power the unit from a 4·5V flat battery may find that pulses on the power rail cause premature and erratic firing of the delay monostable. A 500μF capacitor across the supply rail prevents this. As the battery runs down just a little the delay will vary. It is recommended therefore that the supply circuit shown in Fig. 2 is used. This incorporates a simple regulator and provides many hours of operation from a single PP9 battery.

Construction

Fig. 3 shows a suitable print layout for the TTL design. No positions are shown for D1 and D2: these can be mounted on the copper side of the board directly between the circuit connection points. Construction is very straightforward and no difficulty should be experienced in getting the unit to work first time.

Operation

Operation of the TTL design is the same as for the previous DTL design except for the inclusion of R12 to select the number of line pulses present at the trigger output. For displaying a single sweep R12 should be set to minimum resistance. When displaying a repetitive part of the waveform (e.g. the colour bars at the top of the test card) R12 should be set to the greatest resistance possible without unwanted lines appearing on the oscilloscope display.

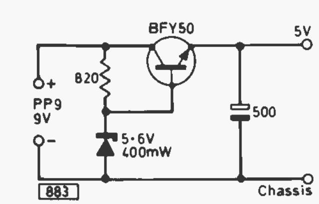


Fig. 2: Regulator for use with a PP9 battery.

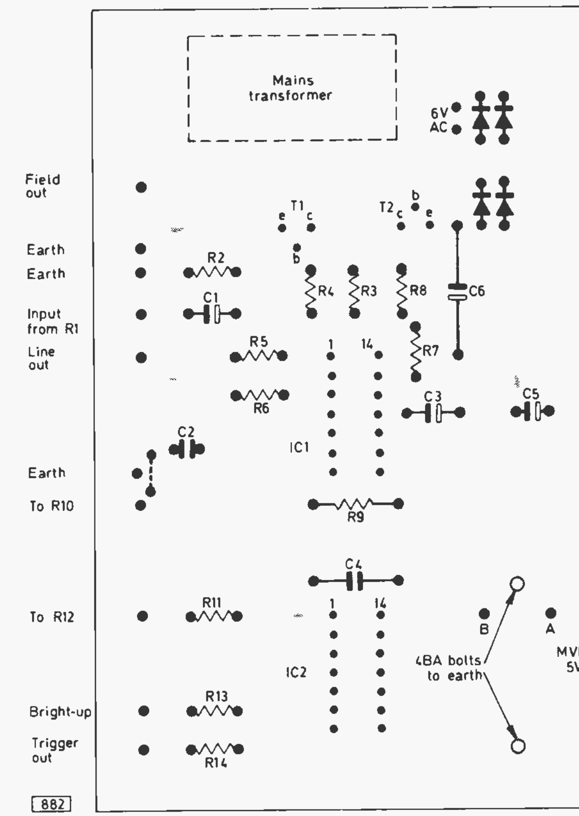
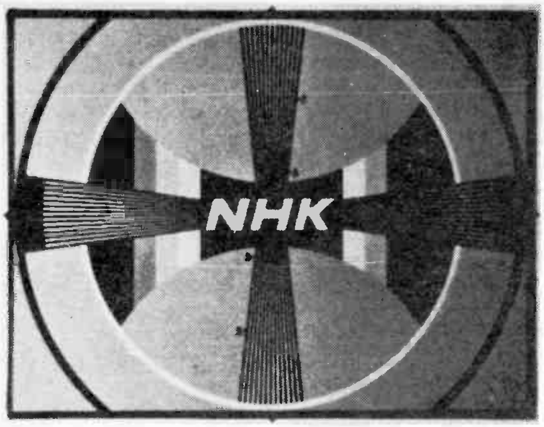


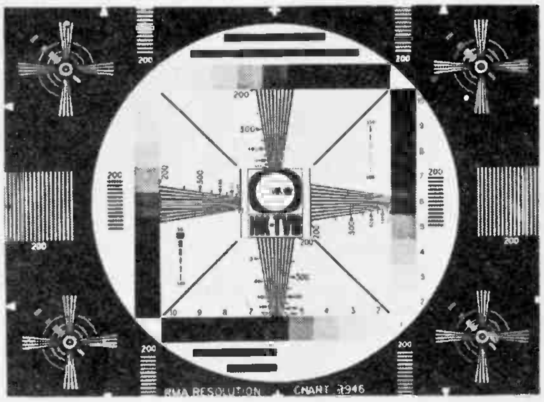
Fig. 3: Suggested board layout, viewed from the component side. D1 and D2 are mounted on the print side.

As before the input required is roughly 1V with positive-going sync pulses. In most TV sets this can be obtained from the c.r.t. cathode via a 100kΩ resistive probe. ■

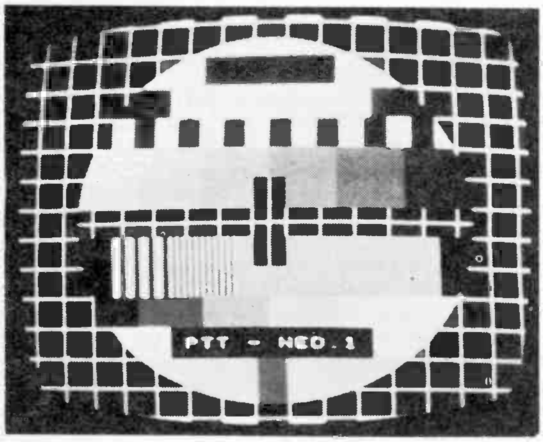
Note: The inclusion of D1 and D2 is most important. Trouble has been reported with the circuit shown in Fig. 9 in the original article due to their omission.



NHK (Nippon Hoso Kyokai) Tokyo test card. Courtesy K. Hamer.



HK-TVB (Television Broadcasts Ltd.) Hong Kong test card. Courtesy G. Smith.



The new Dutch (NOS) type PM5544 test card. Courtesy P. Vaarkamp.

The WDR-3 Wesel transmitter's station identification crest.

density of the trail. The reflected signal may be just a short flash or it may be maintained for 10 seconds and upwards. If the trail is very dense (i.e. heavily ionised) it is possible for Band III signals to be reflected.

Apart from the above random signal scatter there are times when the Earth encounters regular (and predictable) streams of debris which can give really spectacular signal reflection. These streams are known as Meteor Showers. Since the ionisation takes place in the E Layer the distances covered are similar to those experienced with Sporadic E propagation, namely 600–1300 miles. Quite recently a letter from Ryn Muntjewerff (Holland) mentioned reception of YLE (Finland) ch. E9 on January 3rd for about four seconds—this is typical of a dense trail producing reflection in Band III. Incidentally this was another "first": well done, Ryn!

News

Luxembourg: We understand that the studio operation at CLT is in PAL, conversion to SECAM taking place at the transmitter for the ch. E21 outlet. It seems that the ch. E7 outlet radiates the signal as it comes from the studio since Graham Deaves received the Band III signal with PAL information sufficient to lock colour!

Spain: In spite of recent comments it seems that TVE will *not* be going to colour in the near future. Colour is sometimes radiated as it comes in via Eurovision and at times locally originated colour bars are radiated however.

West Germany: ARD-1 is now inserting a data signal on line 16 (at the top of the field). This can be seen as a series of stationary dots. It will be a further aid for SpE identification.

Malta: Following recent observations on a projected "overseas" TV programme from a Malta based transmitter one of our contacts has now visited the site and confirms that a transmitting array and building already exist. No other information is forthcoming at this stage however.

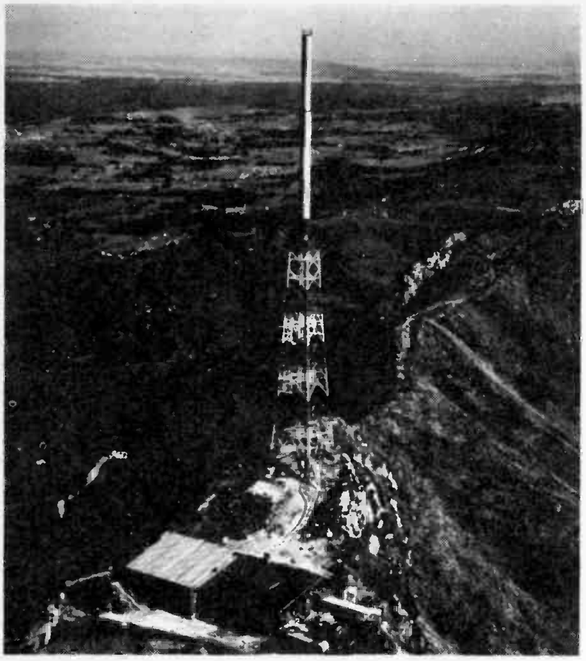
Iceland: Programme times are as follows. Monday–Friday, 20.00–22.40 (excluding Thursday when there is no TV); Saturday, 18.00–23.30; Sunday, 18.00–22.40 (all local times).

Sweden: Marconi are to install two u.h.f. transmitters, each 10kW, at Karlstad in South Sweden.

South Africa: Wally Roome tells us that the aerials for the new TV service are now in place atop the Johannesburg transmitting mast and that test transmissions may commence in April.

Wideband Band I Aerial

We had hoped to be able to announce the availability of a wideband Band I aerial kit. An alternative suggestion has been made however and this if anything will be



The Grunten transmitter, photograph courtesy of the Bayerischer Rundfunk, W. Germany.

somewhat cheaper than the original project. Cook Electronic Services (90 Ewhurst Road, West Green, Crawley, Sussex) have available a large number of brand new Belling-Lee arrays. Versions of the wideband Band I arrays featured last month and in May 1972 can easily be constructed from these aerials.

The arrays are as follows: four elements, with boom varying between 9-12ft., both of 1in. and 1¼in., and having Belling's catalogue no. "Type 4A". These are priced at £5.00 each which includes a mast clamp.

A number of Band III arrays are also available, ranging from five to nine elements, at £3.00 each. These would I feel be useful for Band III aerial experiments.

Carriage is extra at cost—all arrays are in cartons. In the event of quantity purchase there are reduced rates. This may interest aerial riggers. Extra elements are available at £0.50 should anyone wish to try out a variation on the Antiference patent "Tru-Match" dipole system. Aerials can be collected from the above address. If you write please enclose an SAE.

Transmitter Sites

Along with the world-wide series of test cards I propose as space permits to include photographs of the various TV transmitting stations from which many of our DX signals originate. We commence this month with the Grünten transmitter of the Bayerischer Rundfunk in South Germany. This radiates programmes on ch. E2 (100kW e.r.p.), ch. E43 (500kW) and ch. E46 (470kW). The height above sea level is 1704 metres. The ch. E2 radiators are mounted on the side of the lattice work.

From Our Correspondents . . .

There has been a massive postbag this month, due in part to the conditions already mentioned! Antonio Carvalho at Porto (Portugal) has sent us a card telling of a change to the RTP-1 clock. It now resembles the Swiss clock apparently. Conditions in Porto have been quiet recently. Peter Vaarkamp (Holland) has sent us valuable information on the NOS test card. The PM5544 appeared on January 2nd less side panels and initially with no identification. The situation has now settled down to a PM5544 with identification "PTT-NED.1" (see photograph). Peter also tells us that the blockboard that had been used by NDR-1 on ch. E2 (Steinkimmen transmitter) is no longer in use. An excellent town badge/emblem/crest as radiated by the WDR-3 ch. E48 transmitter is included this month, thanks again to Peter. Such crests are commonly seen during good tropospheric openings.

Des Walsh (Eire) has corrected earlier comments of mine relating to a possible RTE-2 channel. Apparently a commission on broadcasting within the Republic will give its views over the next few months and it is possible that an Island channel will be suggested with the BBC, IBA and RTE cooperating in its running.

John Penruddocke, Ch. Islands (ex ORTF reception project near Salisbury!) has written listing the signals he receives in Jersey using a Thompson 625/819 line portable. The ch. F5 Rennes signal is very strong all the time. ORTF-3 ch. E42 opened just before Christmas and is producing reasonable signals along with the ORTF-2 on ch. E45. With a good array the Southern part of Jersey is well within the service area for Rennes.

N. Breward (Stoke-on-Trent) is now using a much modified Bush Model TV75 and by all accounts this worked extremely well over the past season. One query that has arisen with other hopefuls: the ch. F2 transmitter that is often mentioned in station lists for Tele Monte-Carlo does *not* operate, nor indeed has it for some years. Confusion could well occur as a result of ORTF regional variations if for example the Caen,

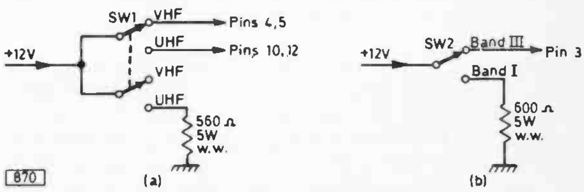


Fig. 1: Band switching arrangements for use with the Mullard ELC2000S varicap tuner. (a) U.H.F./V.H.F. switching. (b) Switching the supply to the Band I/III switching diodes. SW1 and SW2 are RS miniature toggle switches.

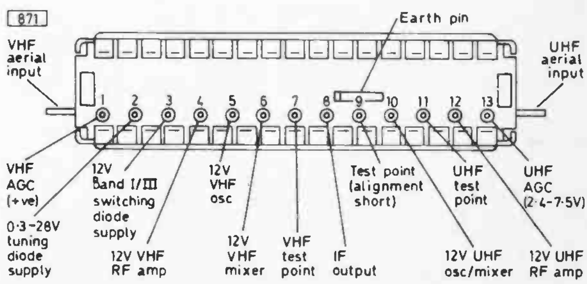


Fig. 2: ELC2000S varicap tuner pin connections. Note that the output from the u.h.f. section is coupled to the v.h.f. mixer.

North France ch. F2 transmitter was being received together with another ORTF F2 transmitter on a regional programme such as Bastia in Corsica.

Mullard ELC2000S Varicap Tuner

Mullard have recently provided us with a sample varicap tuner which is very useful for TV-DX use. It is an integrated v.h.f./u.h.f. unit and of even more importance is the fact that it is designed for use in Continental receivers. It has coverage from ch. E2 through to ch. IC in Band I in one continuous sweep —this has obvious application for Band II TV use. The one that has been in use here covers from just h.f. of ch. B1 to well into the local f.m. services at approximately 93MHz. The Band III lower frequency coverage reaches well below the TV frequencies into various taxi and other communications organisations.

In the October 1973 issue I gave details for making a tuning system using the varicap tuners then on offer. Certain modifications are required to the circuit given (page 541) to enable the ELC2000S to be used in the same way. Basically two extra switches are required, a two-pole two-way miniature toggle to switch between v.h.f. and u.h.f. and a second switch to switch to either Band I or III or when v.h.f. is selected. See Fig. 1.

The circuit is self explanatory and Fig. 2 shows the tuner pin connections. The a.g.c. voltage is applied to pins 1 and 13 since a miniature toggle switch with three poles is not available and the value of R3 changed to 470Ω (½W). A +12V feed is connected to pin 6 (mixer supply v.h.f.) since this stage is in circuit on both v.h.f. and u.h.f. operation. R2 is changed to 920Ω (5W W.W.).

With two small tin brackets soldered to its side the tuner can just be fitted into the Eddystone box used for the original arrangement. In addition to the extra switching separate v.h.f. and u.h.f. aerial input sockets will of course be required.

The i.f. output coil can be adjusted through a hole in the base of the tuner. Peak it for maximum signal on a weak station.

We would like to pass our grateful thanks to Mullard for providing the tuner and information for our evaluation and testing. Mullard point out that the tuner is intended for use in Continental Europe and that some difficulty may in consequence be experienced in obtaining it from the usual component sources.

FAULT FINDING GUIDE

—continued from page 265

the pencil rectifiers may be affected and may be discoloured. When they fail completely a foul smell is emitted. Individual pencils can be replaced but once again fitting a complete new unit is preferable. Other symptoms traceable to the e.h.t. tray are picture ballooning or the appearance of a black hole in the centre of the picture as the brightness is turned up, and complete absence of e.h.t.

Loss of Picture

Complete loss of picture can be caused by a change in the value (3·9MΩ) of R121 which feeds the c.r.t. first anode; or C93 which decouples this electrode to the h.t. rail in series with R120 becoming short-circuit. These faults are shown up by making a voltage check: the c.r.t. pin 3 voltage may be right down to the h.t. rail voltage.

Width Faults

A number of width faults are commonly found in these sets. The most common case is due simply to a low-emission PL500 line output valve. A good picture with a gap at each side which sizzles and arcs as the width control is advanced is probably due to the width stabilising v.d.r. (Z3) being defective—the picture improves at low width settings because R131 then shunts Z3. An increase in the value of R133 (330kΩ) in series with the width control reduces the control range. Intermittent width can be caused by a dead spot in the width potentiometer itself, R132. Cleaning with Servisol will sometimes give the control a new lease of life, but replacement is the permanent cure.

Capacitor Troubles

Three capacitors in the line timebase, C98, C99 and C106, can be troublesome. The first two give the symptoms of no raster or excessive width, depending on which capacitor has failed and on which standard the set is switched to. C106 tends to go short-circuit, killing the line timebase operation and sometimes damaging the width stabilisng v.d.r. Z3 as well.

Video Stage Faults

An early fault, not so common with newer PFL200 valves, was loss of field hold or line hold or occasionally both on 625 lines. A replacement PFL200 usually cured the fault but Thorn also brought out a modification to the video stage input circuit to overcome the trouble.

In any case where the video stage is suspect check its anode load (R41, 3·6kΩ) and screen grid (R43, 7·5kΩ) resistors. They tend to change value with time. R41 can go open-circuit, giving sound (on 405 lines) and a raster but no picture. The screen grid decoupling capacitor (C41, 4μF) should also be checked as it tends to dry out.

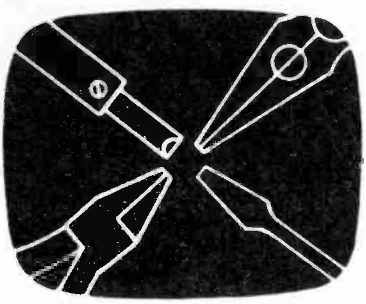
Lack of Contrast

Lack of contrast in these sets can be caused by R22 (4·7MΩ) which is in series with the contrast control slider going high-resistance.

Conclusion

All in all however the Thorn 16in. portables are reliable and relatively free from trouble. Because of their compact design a little care is called for when replacing some components. Do not rush this: take care when wielding the soldering iron inside the chassis, and when reassembling the chassis in the cabinet watch out for trapped leads.

NEXT: FIELD TIMEBASE CIRCUITS USED IN PHILIPS MODELS



SERVICING television receivers

L. LAWRY-JOHNS

PYE 169 CHASSIS

The basic Pye 169 chassis is used in a large number of models released under the Pye, Invicta and Ekco banners. The chassis type is usually to be found next to the serial number on the top right side. The variations can be briefly summarised as follows.

The 169 chassis uses a silicon push-button tuner and has two i.c.s, one for the intercarrier sound channel and the other for a.g.c., sync separation and video preamplification.

The 569 chassis is similar to the 169 except for the use of discrete components in place of the video i.c.

The 769 chassis uses two i.c.s as in the 169 but is fitted with a varicap tuner. There is also a later version of this, the 173 chassis.

Some idea of the models may be gained from this short list: The Pye models 80, 81, 85, 86, 92, 95, 96, 97, 155, 156 and 161 use the 169 or the 569 chassis. Models 98, 150, 151 and up (apart from the above) use the varicap 769 chassis. Ekco models T530, T531, T542 and T543 use the 169 or 569 chassis, with the T540, T541 and up fitted with the 769 chassis. Invicta models 7048, 7120, 7124 and 7353 use the

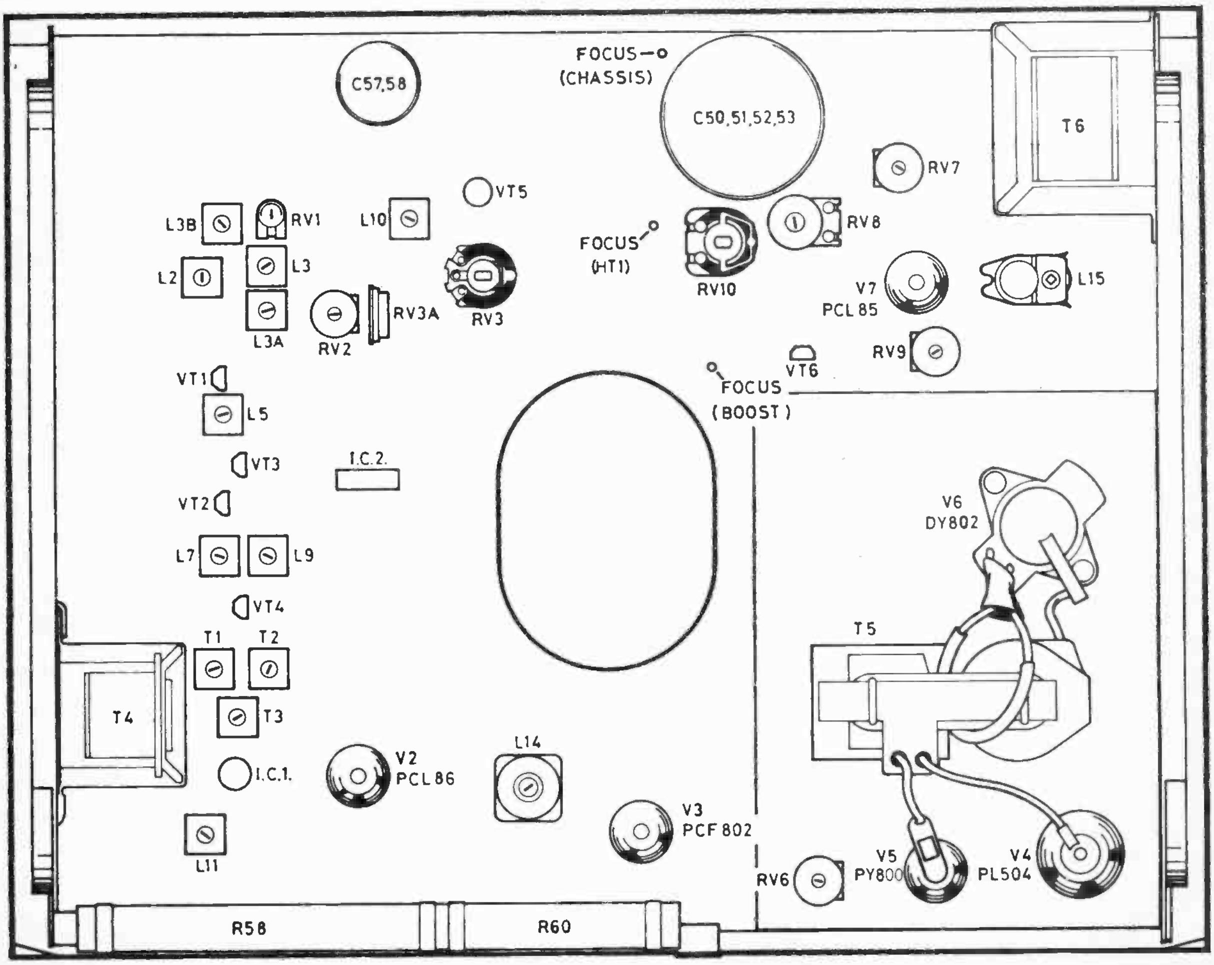
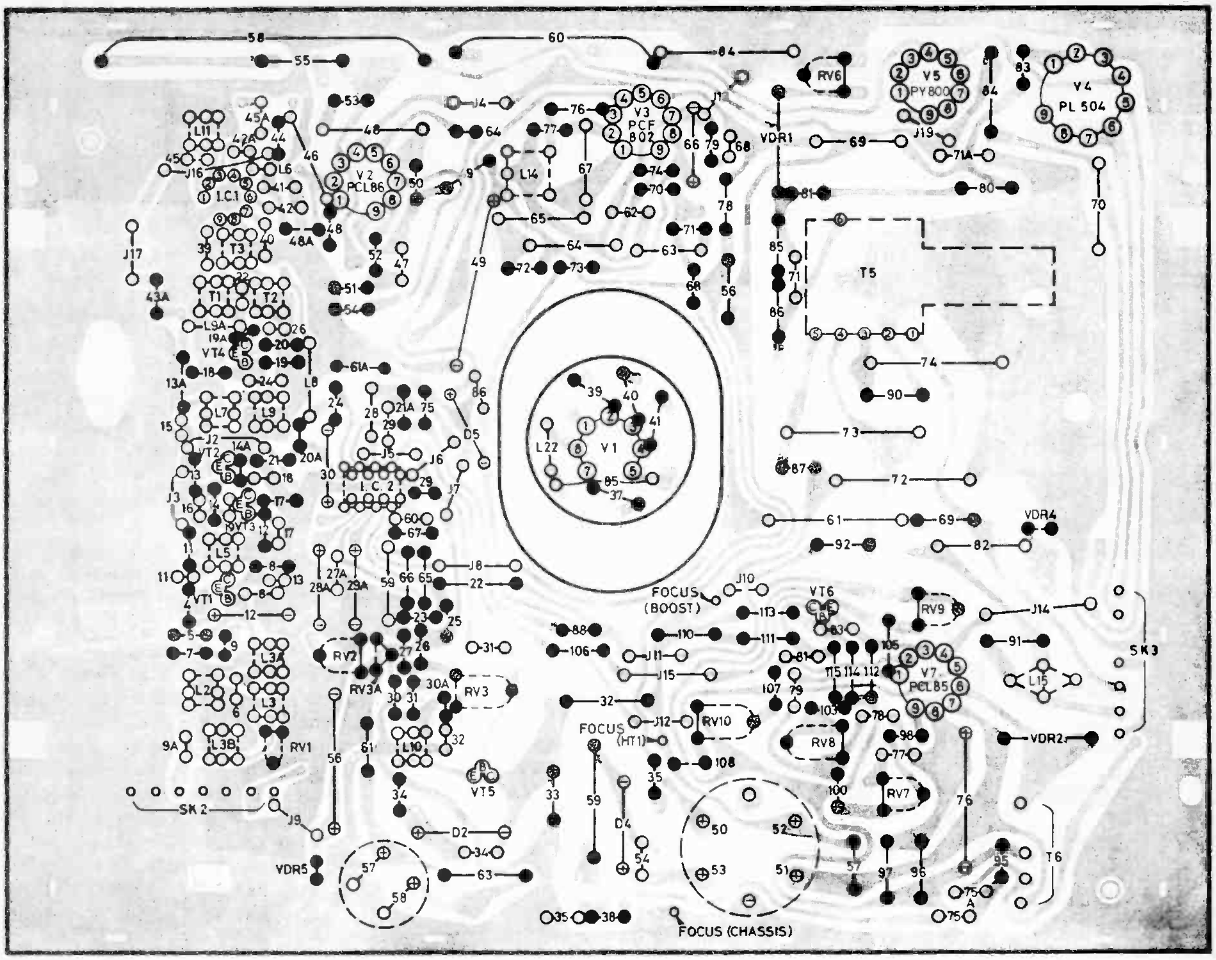


Fig. 1: Plan view of the basic 169 chassis.



RESISTORS CAPACITORS

Fig. 2: Print layout of the basic 169 chassis panel.

169 or 569. The numbering can be confusing since for example the 7355 used the earlier 368 chassis.

Intercarrier I C

The intercarrier sound channel i.c. was originally a type TAA570 which was itself modified. The later version is coded with a white paint spot: pin 4 of this version must be cut off so as to make no contact with the print, failure to do this resulting in no sound. Later models use a type TBA480Q with the value of many components altered to suit.

Video I C

If the video i.c. is replaced it may be necessary to add (or remove) resistors R21b and R21c to prevent field jitter or poor line sync under some reception conditions. R21b may be between pin 13 and the 12V line with R21c to chassis. R21b is 15kΩ and R21c 8·2kΩ: both are 5% types.

Field Timebase

The field timebase may be found to differ from that shown in our complete circuit as there have been several modifications. The main feature in all sets however is the use of a transistor (VT6) working in conjunction with the triode section of the PCL85/PCL805 to form the field oscillator. The emitter of VT6 (BC147) is connected to pin 3 of the PCL85 (triode cathode) so that coupling is across R112 (560Ω) to chassis, charging C83.

Complete field collapse which is not due to the PCL85/PCL805 is most often due to either a dry-joint in the vicinity of the transistor or the transistor itself not operating (the emitter voltage then being low and the collector voltage high, well in excess of its rated 50V and its actual operating 12V or so).

Later models have a 1MΩ resistor in place of link J10 shown on the original circuit, with a v.d.r. to chassis in the conventional manner, the height control (RV9) then being 680kΩ with R105 180kΩ. Even so the 680kΩ RV9 can be unreliable and cause variation in height. When this proves to be the case a 1MΩ replacement should be used.

VDR2 (type E298ED/A258) across the field output transformer primary winding may sometimes crack leaving peaky voltages which damage other components in the circuit. The items that suffer depend upon whether the original or later modified

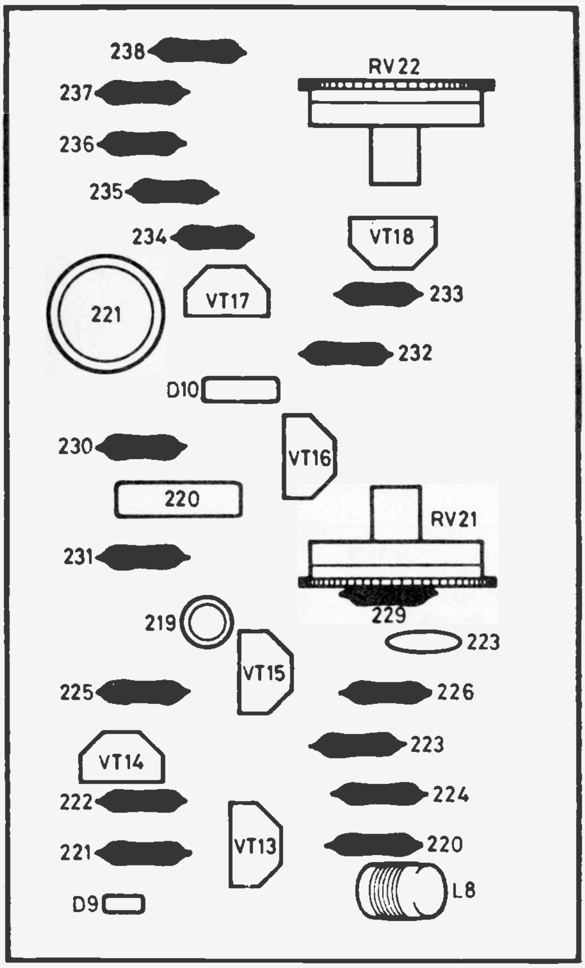


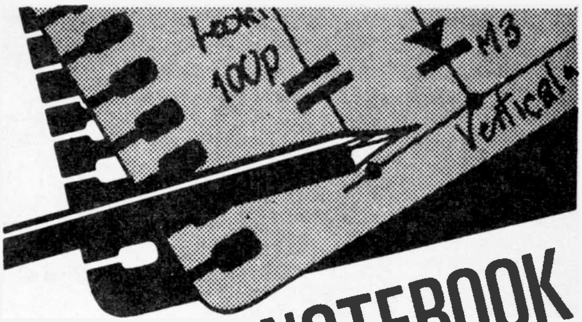
Fig. 3: Layout of the discrete component a.g.c./sync/video board used on the 569 chassis.

circuit is fitted. For example in later models there is a feedback linearity loop. The 0·047μF feedback capacitor wired from the pentode anode (pin 6) of the PCL805 may well break down, with damage to RV7 and R98A. In earlier models the heater circuit diode D5 is connected directly in series with the PCL85 heater pin 5: the high voltage appearing at pin 6 due to VDR2 becoming open-circuit can arc across to pin 5 and thus be applied to the diode which may not take kindly to this. If the diode shorts a high current will pass through the heater chain to be conducted to chassis via C58. This will of course stop the transistors working, thus calling attention to the condition. If the heaters are overbright therefore first check D5 which is most likely to be short-circuit. Then check the condition of VDR2 to ensure it has not cracked.

PCL805 Variants

The PCL805 fitted may not be of standard size and if a normal size valve is fitted the retaining clip will have to be discarded while some adjustment to the linearity may be necessary.

CONTINUED, WITH FULL CIRCUITS, NEXT MONTH



SERVICE NOTEBOOK

G. R. WILDING

No Results

A colour set fitted with the Philips G8 single-standard chassis came in with the complaint "no results". All the fuses were intact but it was found that the ceramic former under the 2·2Ω surge limiter in the mains input circuit was cracked and had broken the winding. We removed the component and found the wire to be very brittle, as if it had been subject to prolonged or repeated overload currents. There was no h.t. short so as an exact replacement was not available we wired into circuit two high-wattage 5Ω resistors connected in parallel. On switching on quite good results were obtained but after about fifteen minutes there was a sudden momentary increase in picture size together with a general increase in the overall brightness level and a marked deterioration in focus. After about twenty minutes or so the symptoms recurred, lasting only a few seconds, and it became clear to us that the surge limiter had broken down as a result of these excessive h.t. current strains.

In common with many other single-standard colour chassis these sets use a controlled thyristor rectifier to produce a stabilised h.t. supply, the thyristor's firing point during the positive excursions of the mains input being determined by a regulator transistor in a feedback circuit. The cause of the short-term h.t. changes could therefore be a defect in any of a number of components in this circuit, or even a dry-joint. We carefully examined the power supply unit for discoloured resistors or evidence of sparking at badly soldered connections but everything appeared to be normal. The next step with such circuits is to check the semiconductor devices—a diac and a zener diode are used in addition to the thyristor and regulator transistor. We decided as a first move to replace the BT106 thyristor: it proved to be a fortunate choice since after fitting a replacement surge limiter unit and making slight adjustments to the various presets the symptoms did not recur and a first class picture was obtained.

Intermittent Field Jitter

Intermittent field jitter on a dual-standard GEC Model 2038 could usually be cured temporarily by carefully readjusting the field hold control. A new PCL85 and PFL200 video/sync valve failed to produce any improvement and the height control and both linearity presets were found to be free of bad spots on their tracks—a common cause of jitter or bands of varying line spacing. Complaints of field jitter usually suggest impaired h.t. smoothing or an increased value pentode grid leak resistor but it was noticed that if the height was reduced when the fault was present two or three horizontal lines appeared above the top of the picture. This would normally indicate a fault in the section of the field linearity circuit affecting the top of the picture but as the overall linearity was good and both presets were in order this was discounted. We then found that applying pressure to the printed panel between the PCL85 and the PCF802 line oscillator could start and stop the jitter, at the same time removing the unusual lines. Further probing revealed that the v.d.r. connected across the primary winding of the field output transformer but mounted on the board was only intermittently connecting at one end. After resoldering it the fault symptom disappeared. It is general practice to connect a v.d.r. across the field output transformer primary winding to limit the flyback voltage appearing at the anode of the output valve.

Misleading Voltages

No raster due to absence of e.h.t. was the fault in a set fitted with the BRC1400 chassis. All valve possibles were tried without improving matters. As we are all so well aware, one of the most difficult tasks in TV servicing is to establish with certainty whether a suspect line output transformer actually is faulty. Due to the interconnections between different stages linked to the line output transformer and common h.t. rails, voltages will be incorrect even in stages completely without fault.

Tests at the anode of the PL504 line output valve produced only a very small spark. Our first move was to take off the PY801 boost diode top cap connection to see whether this action left h.t. at the PL504 anode and an increased spark as it would if the boost reservoir capacitor was short-circuit. Removing the PY801 top cap left zero anode voltage on the PL504 however so the cap was replaced. Next, in case there was a short inside the e.h.t. tripler this was unclipped but the spark size at the PL504 anode and the connection point to the tripler remained very small.

The flywheel sync discriminator output in this chassis is fed to a d.c. amplifier which controls the bias applied to the grid of the line blocking oscillator. All positive voltages in this area were incorrect. Unfortunately the negative voltages developed at the grid of the line oscillator and the grid of the PL504 were not given—often the case in service manuals since these voltages can vary markedly from set to set due to differing line hold control and width control settings. We had another set fitted with the 1400 chassis available however and as this was working perfectly it seemed a good opportunity to take some comparative readings. On 405 lines we obtained a reading of about −75V at the PL504 grid in the working model but only −35V in the faulty one. This appeared to indicate that the inadequate line output was due to insufficient grid drive. Unfortunately since the PL504 was passing excessive anode and screen currents due to the low negative grid bias plus effects in the transformer itself the h.t. to the line oscillator anode was reduced, resulting in a low-amptitude drive waveform. It was difficult therefore to be sure where the origin of the fault lay. It was also possible that a leak to chassis from the line oscillator anode via the charging capacitor was lowering its anode voltage to some extent, this becoming further accentuated by the excessive PL504 current consumption.

Comparative resistance tests were then made on the two receivers but they seemed similar enough. The width control circuit of the faulty set was checked in case excessive positive voltage from this was reducing the PL504's negative grid bias but there was no fault here. There seemed no conclusion other than that the line output transformer was defective. A replacement was tried and restored normal e.h.t.

The point that this brings out is how misleading an incorrect negative grid bias voltage at the line output pentode can be when investigating absence of e.h.t.

In the field timebase, loss of output due to failure of the timebase to oscillate will result in low field generator anode voltage since there will be no self-produced negative grid bias and consequently excessive anode current: reduced generator anode voltage is thus a coincident symptom rather than the cause of no field output.

Lack of Field Lock

There was almost non-existent field lock but normal line lock in a receiver fitted with the ITT CVC5 single-standard colour chassis. Since the line lock was good the sync separator and preceding stages were assumed to be in order. It was hardly to be expected that a new PCL805 would cure the trouble completely but one was tried just in case. There was no improvement, so it was clear that there was a fault somewhere in the sync pulse feed to the triode section of the PCL805. This is quite unusual (see Fig. 1): the negative-going sync pulse from the BF117

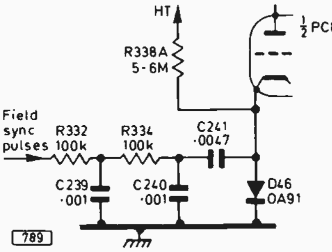


Fig. 1: Sync pulse feed circuit to the field oscillator in the ITT CVC5 colour chassis.

sync separator collector is fed via the dual-integrator R332/C239, R334/C240 and the coupler C241 to the triode cathode which is returned to chassis, via the OA91 diode D46. This diode is held conductive by the bias applied to its anode via R338A but is cut off when the negative field sync pulse arrives to initiate the flyback. A resistance test across the diode revealed a complete short-circuit in both directions so that the field sync pulses were being short-circuited to chassis. Replacing the diode restored normal field lock.

CORRECTION: An error occurred in our note in *Teletopics* February 1974 on the amended u.h.f. aerial groups. There are now four groups, not three. The one omitted was the wideband group E covering channels 39-68 (colour code brown).

Assembling a modular colour set

DAVID ROBINSON

PART 2

EHT Stabilisation

The line output stage used in my receiver was built around a surplus line output transformer from the Pye CT70 series and employs a valve e.h.t. rectifier and PD500 e.h.t. shunt stabiliser triode. Readers may well ask why do this when the usual practice nowadays is to employ an e.h.t. tripler and dispense with the stabiliser. There are several disadvantages to the shunt stabiliser system. It is very bulky; a good deal of heat is produced; X-ray shielding is essential; and heavy demands are made on the line output valve and power supply. To my mind however the improvement in e.h.t. regulation outweighs all these factors. As the beam current varies from zero to 1·2mA the e.h.t. voltage drops by only an insignificant 100V or so. With a typical valve line output stage and a tripler the e.h.t. drops from 25kV at zero beam current to about 23kV at maximum beam current; with some transistor line output stages it may drop below 22kV.

What effect does this poor regulation have on the picture? The most noticeable effect is an increase in picture size as the e.h.t. voltage falls and the deflection sensitivity of the c.r.t. increases. This is usually called "breathing". Various techniques are in use to reduce the scan currents automatically so as to reduce this increase in displayed picture width and height. Often these arrangements have a significant time-constant however so that the picture size "bounces" when there is a sudden picture change. Ugh! The change in e.h.t. voltage can also have adverse effects on the purity, convergence and, most noticeable of all, the focus. The shadowmask tube resolution is not as good as we would like at the best of times: with poor e.h.t. regulation it becomes much worse! The effect is often lessened by arranging that the focus voltage tracks changes in the e.h.t.—a case of shutting the stable door after the horse has bolted if ever I heard of one! Seriously however the shadowmask tube is very awkward in its e.h.t. requirements, demanding anything from zero to 30W of e.h.t with good regulation. A fully satisfactory method of providing this has in my opinion yet to be devised. The ideal system would have the performance of the shunt stabilised system but without the disadvantages previously listed. In the long run the answer will no doubt lie in a new display device rather than new circuits. In the meantime I have opted for the circuit with the better performance.

Convergence Circuits

The convergence circuits are standard except that d.c. control of static convergence is used. Considering that three extra potentiometers and three extra leads from the convergence board to the convergence coils are involved I'm not so sure that this method really is more convenient. One can on the other hand adjust the static convergence from the front of the set and this is undoubtedly easier. The convergence coils to go with this system may be difficult to obtain now.

Power Pack

An unfortunate feature of a colour set is the assortment of supply voltages it requires. In my set these are as follows: 6·3V a.c. at 900mA (c.r.t. heaters); 7·3V, 40V and 42V a.c. at 300mA (valve heaters); 12V line (tuner r.f. amplifier); 20V line (i.f., decoder, RGB board, line drive, sync separator); 33V line (varicap tuning); 40V line (audio amplifier, field timebase); 280V line (RGB outputs, line drive, line output). It would be hard to contrive a more difficult set than these!

A power supply design was needed that would produce all these at low cost and with a minimum of heat dissipation. On this latter count the use of a mains dropper for the valve heaters was ruled out since with only three valves the dropper would get very hot indeed—even with a series diode in the heater chain.

HT Supply

Let us turn first however to the h.t. supply. The immediate quandary is do we derive this directly from the mains, thereby having possibly a "live" chassis, or do we derive this and all other supplies from a mains transformer and have the chassis earthed? This has been and probably always will be a subject of controversy, especially as far as home constructed sets are concerned. The following are purely my own personal views on the matter.

No one would question that an isolated and earthed chassis is necessary for all servicing and testing operations. But this can be done by using an external isolating transformer, which a TV workshop should have. So I wonder what advantage is gained in having such a transformer built into the set, especially when the disadvantages of cost, size, weight, magnetic field, etc. are considered? It does not remove the need for the set to be enclosed in a cabinet which prevents contact with all internal parts, and for a home constructed set a tailor-made transformer may not be available, making it necessary to use two in order to get all the required voltages.

The only problem with a live chassis is that controls and the essential external connections must be accessible. Controls are no problem however now that potentiometers with plastic spindles are readily available. The only external connection will be the aerial socket, and ready made isolator panels are available for this purpose.

The circuit finally evolved is shown in Fig. 13. You will notice that the h.t. supply is derived not from a half-wave rectifier but from a bridge circuit. This means that whichever way the mains is connected the chassis is at about 120V a.c. with respect to earth. The reason for this policy is that it gives a higher ripple frequency (100Hz) and a higher voltage on the reservoir capacitor than does half-wave rectification. This permits resistive smoothing to be used, avoiding a smoothing choke which is bulky, expensive, has a high magnetic field and, to get to the point, is almost impossible to obtain. Attempts to use a choke from an old monochrome set resulted in a very hot choke and a very strong smell!

Another useful side-effect of using an e.h.t. shunt stabiliser is that the h.t. current consumption is virtually constant so the regulation of the h.t. supply does not have to be especially good. A thermistor (VA1104) is used in the circuit—as is normal—to limit the switch-on surge.

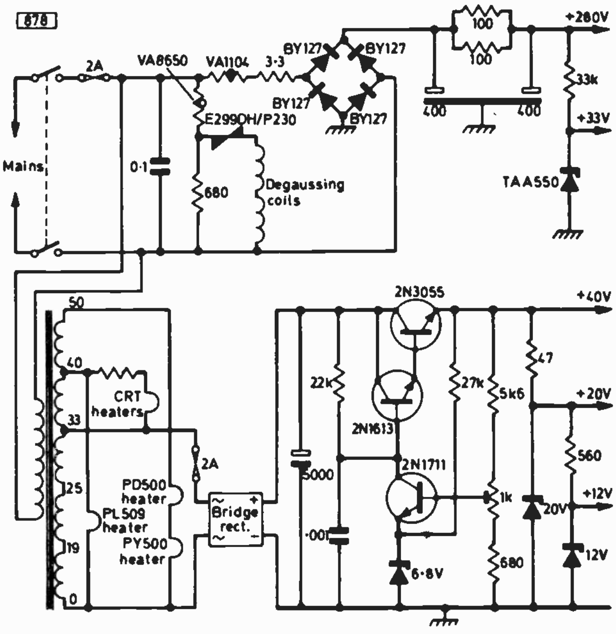


Fig. 13: Power pack circuit.

LT Supplies

Since a tailor-made transformer was not available for the low-voltage supplies the only course open was to obtain a standard multi-tap transformer and use the various taps to get the right voltages. I used a transformer with 19V, 25V, 33V, 40V and 50V taps, the maximum current *for each section* being 2A. The valve heaters are then no problem. The 40V PL509 heater can be fed directly, and the PD500 and PY500 heaters add up to 49.3V which can be obtained safely from the 50V tap. The tube heaters need 6·3V however so these are fed from 7V (40V −33V) via a suitable dropper which is made from 30 s.w.g. enamelled wire wound on the body of a 1W resistor. The tube heater voltage is quite critical for optimum tube life, so an accurate voltmeter was borrowed and used to set up an accurate 6·3V by adjusting the amount of wire used for the dropper resistance. A bridge rectifier fed from the 33V tap gives a basic 45V on its 5000μF reservoir capacitor.

Regulator Circuit

A series regulator circuit gives a stabilised 40V output. This is fail-safe because if the stabiliser goes wrong the voltage will only rise to about 45V which will do no harm.

The 20V line is derived from the 40V line by a 47Ω dropper resistor and shunt zener. A series regulator was avoided here because a fault in this could put 40V on the 20V line, which is unthinkable! The wirewound dropper resistor in the present arrangement is hardly likely to go short-circuit and in the unlikely event of the zener going open-circuit the voltage rise would not be very great.

The 12V tuner supply is dropped from the 20V line in the same way. The 33V tuning line is derived from the h.t. line by a 33kΩ dropper resistor and is stabilised by a TAA550 regulator. In this way the supply to the TAA550 approximates to a constant-current source, giving optimum stabilisation.

These were the circuit arrangements evolved then: now for the constructional methods adopted.

Layout

A useful bonus with a varicap tuner is that it can be mounted away from the control panel. The user controls take up very little space behind the panel therefore. The line output unit, which is the most bulky, was therefore mounted in the space behind the control panel. This was the first stage in designing a "slim-line" layout. The line output assembly used in the Pye CT70 series has the e.h.t. rectifier valve mounted upright above the transformer and the PD500 stabiliser valve above this. So it is quite a tall unit. It is very convenient to use however since all the e.h.t. wiring is already done, including the c.r.t. connector. The only addition needed is a base for the PD500. It is then ready to go. The assembly is mounted together with the PL509 and PY500 valves on a small metal chassis. The high-voltage line driver stage is mounted under the chassis on a small piece of Veroboard. A metal "chimney" over the line output transformer assembly provides the X-ray shielding.

The tuner, i.f., decoder, video output, timebase and crosshatch generator boards are mounted on a wooden frame which can be hinged down for access to the reverse side of the boards. The photograph shows the tuner and i.f. strip on the left of the frame, the timebase board on the right, the decoder at the bottom right and the RGB outputs at the bottom left. The two small boards at the top of the frame contain the a.f.c. and crosshatch generator circuits. It would have been more logical to have interchanged the positions of the timebase and i.f. boards but unfortunately the timebase board is too large to enable this to be done.

There is a small Veroboard panel mounted on the tube base. This contains the tube feed resistors, spark gaps etc., and also the flyback blanking

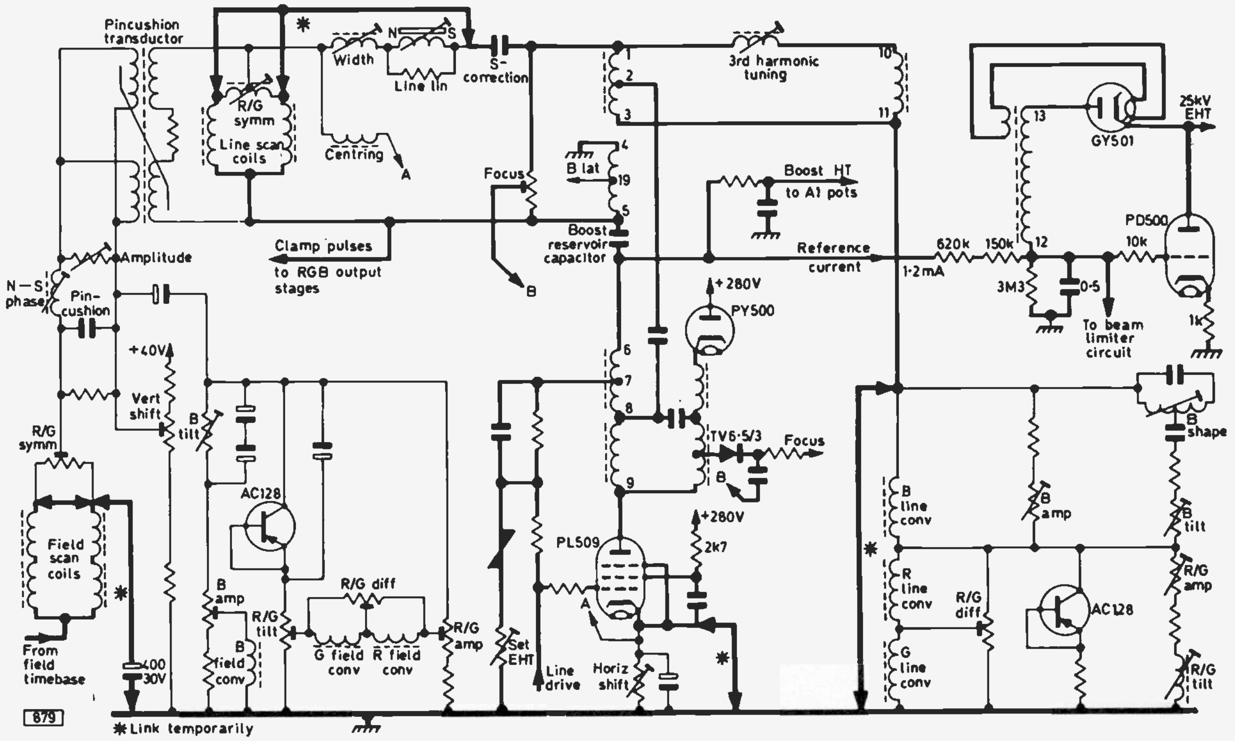


Fig. 14: Showing how the timebases can be tested without the convergence circuits. The sections shown in fine line are shorted out as indicated. The e.h.t. circuit is also shown. As is usual the PD500 cathode resistor is connected to chassis, instead of to h.t. as in the original Pye circuit. This was done in order to provide the appropriate range of grid voltage to operate the beam limiting circuit, and required a change in the value of the resistance between the grid and the boost line in order to obtain the correct reference current. A home-made R/G tilt control was used: this only provides one-way tilt correction (a centre-tapped coil is generally used) but works perfectly with the combination of tube and convergence yoke used in the set.

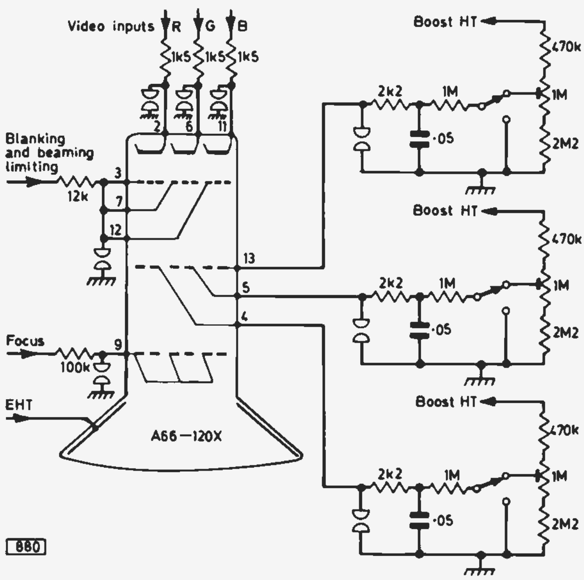


Fig. 15: The tube feed circuits.

circuits. The three controls at the extreme left in the picture are the c.r.t. first anode "background" grey-scale controls. These controls are very critical and large potentiometers should be used, fitted with fairly large knobs. Adjustment should be carried out only in a darkened room so they need to be easily reached. To aid convergence and purity adjustments beam on-off switches are very useful: in my set these are on the c.r.t. base panel.

The power supply and audio amplifier circuits are mounted at the bottom of the cabinet but the h.t. smoothing resistors are mounted on the side of the line output unit where the heat from them will cause no harm.

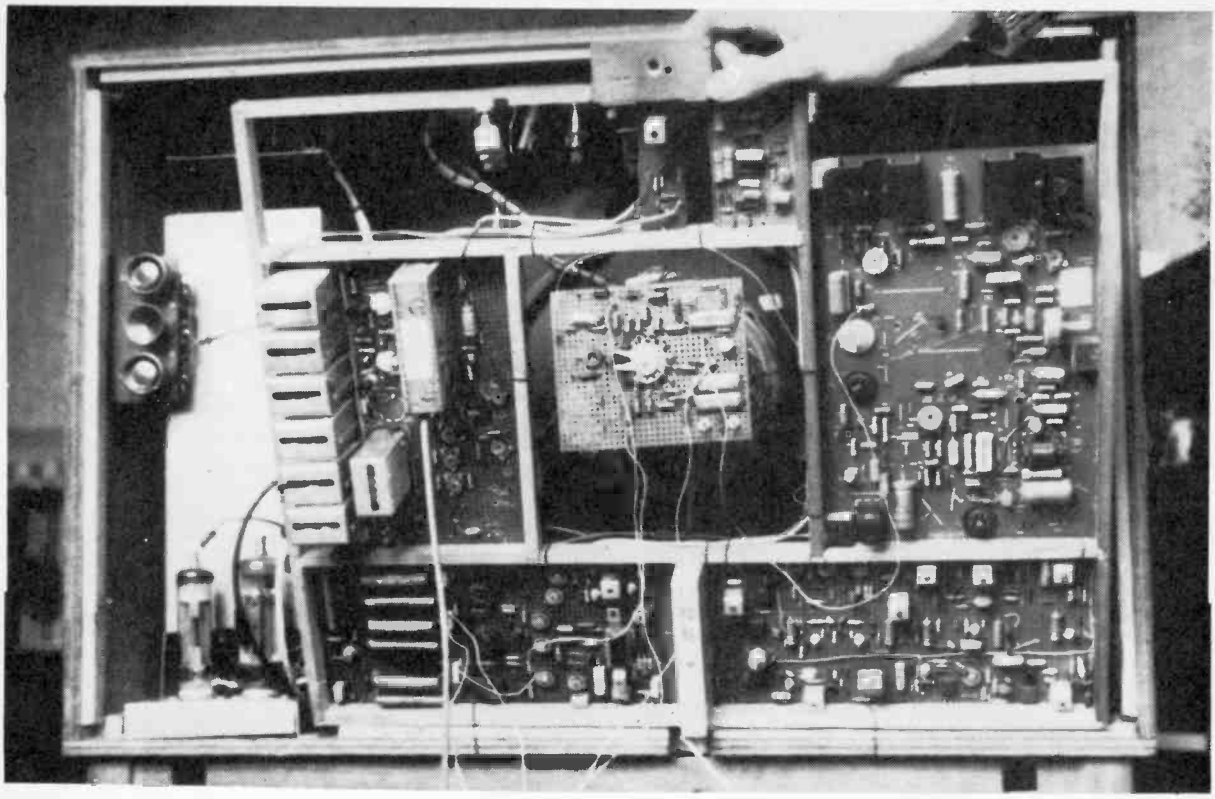
The mains transformer is screwed to the top of the cabinet above the line output unit. This is not a very good position! The trouble is that it is too close to the picture tube and hence has some small effect on the purity. In fact I originally had the same problem—but much worse—from the speaker and had to change it for a type with a lower external field.

The convergence board is mounted at the top centre and can be lifted out and placed on top of the set for easy adjustment.

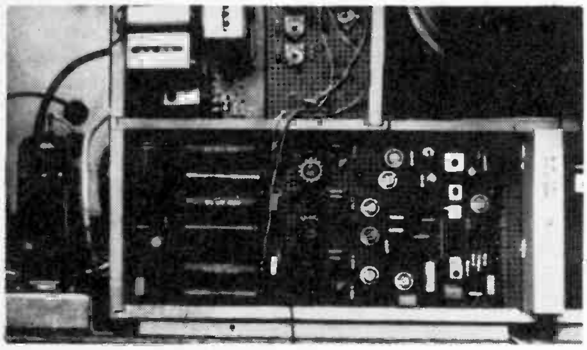
The leads to the convergence board and in one or two other places are cableformed. This is more or less essential to avoid complete chaos. It is really amazing how much wire goes into a colour TV set!

Testing

It would be sheer folly to build the whole set,



General view from rear, showing how the frame hinges down.



Video board (includes the SL901 i.c.).

switch it on and see what happens—on your first set at any rate! The chances are that several things will be wrong in several places and the combination could be quite bewildering. In any case we all like to see some sort of results at the earliest possible time! It is well worthwhile then to plan carefully the order of construction to permit testing at each stage.

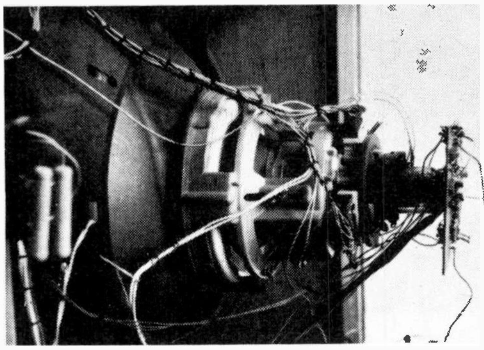
A good way of starting is to make the cabinet first and then mount in it the tube together with the tube screen, scan and convergence coils, tube base and major items such as the mains transformer. The next logical step is to build and test the power pack since we cannot test anything else without this. The timebases can now be built. It is possible to test these without the convergence circuits! Fig. 14 shows the idea. The convergence networks are in series with the line and field scan coils so they can be simply bridged across—via a capacitor in the field case. This provides scanning with the convergence circuits deleted.

Getting a Raster

It would be unwise to switch the line output stage on without ensuring that the field scan and line drive are present since if the former is missing a line could be burnt on the tube phosphors, while lack of the latter could damage the line output valve and possibly the line output transformer. The line output stage can be "switched off" temporarily by removing the 2·7kΩ line output valve screen grid resistor.

We now need to rig up the tube connections so that some sort of display can be obtained. We really need the full first anode and focus feed circuits (see Fig. 15) but the grids can be temporarily earthed. To obtain the correct c.r.t. bias, the cathodes can be strapped together and taken to the slider of a 100kΩ "brightness" control connected from h.t. to earth, this being initially set at the h.t.+ end of course.

We can now switch on—with the c.r.t. base removed—and check the c.r.t. heater supply voltage. If all is well switch off, replace the c.r.t. base and switch on again. If you have an oscilloscope the line drive and field scan current can be easily checked of course. The line drive needs to be fairly near the right frequency if the line output stage is to work properly. The best way to check this is to have another TV set nearby tuned to a broadcast programme, preferably a fairly weak signal. If a wire is attached to the colour set line output valve control grid and brought near to the aerial lead or video



View of the neck components, wired up.

amplifier of the other set an interference pattern will appear on the screen. The frequency can then be set to make the pattern as nearly stationary as possible.

In the absence of a 'scope the field timebase can be checked by feeding its output into the field scan coils of another set. *Great care must be taken if either the colour receiver or the other set has a live chassis.*

Having checked these points we can proceed to the part of the project where most sweat will pour from your brow—running up the line output stage. Switch off and reconnect the line output valve screen grid supply. Set the various controls as follows: height and field linearity, line linearity and focus midway; width (if this is a coil in series with line scan coils) to maximum; shunt stabiliser current (where fitted) and (double check both of these) set e.h.t. and brightness to minimum; vertical shift (if fitted at this stage) midway; horizontal shift to position of minimum effect; all beam switches should be off. The e.h.t. lead should be connected to the tube and also to an e.h.t. meter—this is an essential piece of equipment.

Now switch on and during the warm-up period watch the e.h.t. meter carefully and ensure that the reading does not rise much above about 20kV. If it does or if there is any flashover switch off at once. If all is well the e.h.t. will be present but very low of course—about 15-20kV. Next check the tube base voltages and ensure that the cathodes are more than 150V positive with respect to the grids and that the first anode voltages are present (on the "hot" side of the beam switches of course!). The focus voltage cannot be measured with a normal meter of course but this is not important yet.

Now switch on the beams. This should not result in any screen illumination. On slowly advancing the brightness control the screen should light up with a small, dim, defocused and strangely coloured raster.

Obtaining a Picture

No setting up can be done until the timebases are synchronised and a picture is being displayed. My approach to this problem was to build a "temporary" video amplifier (see Fig. 9 last month) which I connected to my i.f. strip and tuner—these being ready made of course. The output of this I fed to the tube cathodes and also via a resistive divider (R1, R2) to the sync separator. No brightness control is included, but at this stage the first anode potentiometers can be used for this purpose. In this way some sort of monochrome picture can be obtained. After adjusting the purity, e.h.t., width, height, linearity etc. I obtained an almost viewable picture—though with some incredible grey-scale and convergence errors! It was not possible to turn up the e.h.t. to 25kV however since without the convergence circuits this would have given far too much width.

I then installed the crosshatch generator and realised just how bad the errors were!

Setting Up

Next I brought into circuit the convergence circuits so that I was ready to set up the scanning side of the set properly.

The problem is that many of the adjustments interact. They must be done in the right order therefore *and the whole sequence repeated until no further improvement is possible.* The e.h.t. should be set first, followed by purity, focus, centring, width, height, linearity, red-green convergence, blue convergence and finally pincushion correction. It is difficult to adjust the pincushion controls before carrying out convergence since the rasters will all be different shapes, making it difficult to see the correct pincushion settings. The pincushion adjustment does not have any great effect on the convergence.

There are two pincushion correction adjustments. The amplitude control (see Fig. 14) affects all four sides of the picture while the "N-S phase" coil is adjusted first to maximise the correction at the top and bottom and finally to make the top and bottom correction symmetrical between the left- and right-hand sides. The coil must be adjusted with the amplitude control at other than the minimum setting otherwise nothing will happen. Pincushion distortion can be judged only by looking at the screen from a few feet away. Don't overdo it—a slight pincushion effect is preferable to a barrel effect. Note also that the horizontal lines never come out quite straight even across the centre of the picture due to the asymmetrical arrangement of the three guns. With pincushion correction we are aiming only for consistency over the screen. The procedure is in fact quite easy with practice and is certainly child's play compared to setting-up the i.f. strip!

Unlike monochrome practice the focus adjustment in a colour receiver is quite critical and must be set with care, a crosshatch pattern being the best means of checking focus. Picture shift adjustment in a colour receiver will be found much easier however than setting those tedious ring magnets found in monochrome sets.

As is well known the final convergence adjustment should not be done until the set has been running for about half an hour since convergence does drift slightly as the set warms up. The brightness control should be advanced during this time to give a reasonable beam current since a crosshatch pattern represents a very low mean beam current level. By running at a more normal "brightness" the shadowmask is brought to something like its normal operating temperature.

The question is how good can the convergence be? It can never be perfect of course but it can be considered good enough if no errors are visible on the test card at a distance of about six feet from the screen. If the same can be said when a crosshatch pattern is being displayed you can congratulate yourself on having achieved very good convergence.

LETTERS

"TELEVISION" COLOUR RECEIVER

The following modifications which I have incorporated in my "Television" colour receiver may help others who are experiencing the same troubles I had.

(1) *Poor line sync, cogging and no immediate lock after channel changing.*

The modifications I made to overcome this trouble are as follows: replace R334, R335 and C316 with a single 47kΩ resistor rated at 2W; add a 68kΩ resistor in series with C313 and change C314 to 100pF.

Set up the line oscillator by shorting C319 to chassis and adjusting the line oscillator coil L301 for as near a stationary picture as possible. Remove the short-circuit and your line sync problems disappear—especially in weak signal areas.

The sync performance can be checked by connecting a high-impedance meter or d.c. 'scope across C319. With a normal picture the reading should be near zero. This voltage is affected by the value of the resistor added in series with C313. By altering its value the line sync can be accurately phased or line foldover cured. Now tune the set to a blank part of the band or disconnect the aerial: the meter should still read near zero, the reading being determined by the value of the 100pF capacitor (C314). By altering its value the problem of failure to lock after channel change or when the set is first switched on can be overcome.

The line oscillator coil modification previously reported must first be carried out. If the above modifications are then made excellent results are achieved without the drastic redesign of the line oscillator stage suggested in *Colour Receiver Forum* in the January issue.

The inclusion of the 68kΩ resistor results in the line sync being upset by the field sync pulses, giving rise to flickering at the top of the picture. This is very slight and is not detectable at normal viewing distance.

(2) *Poor bistable triggering.*

To overcome this problem I fed the −80V line pulses at input connection 1D on the decoder board via an 18kΩ resistor to the junction of C30 and C29. The only alteration necessary apart from adding the resistor is to break the print connection between L5 and C29/C30.

(3) *Improved beam limiting.*

I obtained improved results by modifying the circuit as shown in Fig. 1. Tr701, D701 and R704 in the original circuit are removed and the junction R703/Tr702 collector connected to the junction R708/R707. A 10kΩ resistor (R704 can be used) is connected from the 40V rail to Tr702 emitter. The transistor previously used in the Tr701 position can be used for the field flyback blanking modification necessary (see previous articles).

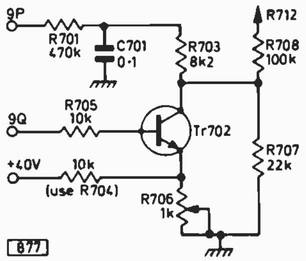


Fig. 1 (left): Modified beam limiter circuit used by W. Hill in the "Television" colour receiver.

To set up this modified circuit rotate R706 to the end of its travel giving the highest positive voltage at the junction R707/R708 (about 30V) before carrying out grey-scale adjustments. When all other adjustments are complete advance the brightness and contrast controls until the picture is defocused. Then adjust R706 to correct this. Do not over advance this control: at moderate brightness the voltage at the junction R707/R708 should remain steady and fall only when the brightness is excessive.

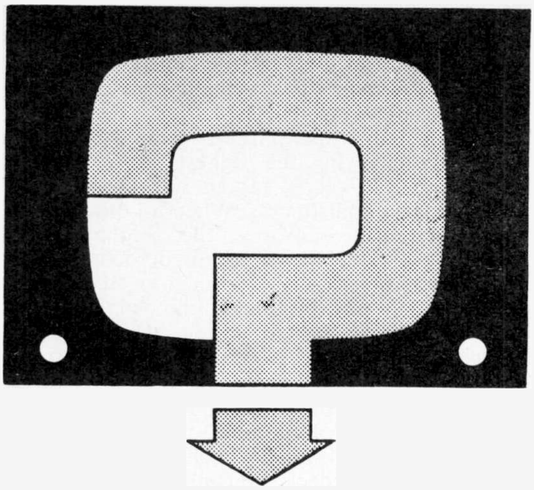
(4) *Grey-scale adjustment.*

I have found that the following procedure works well. Disconnect the aerial and turn the contrast, colour and c.r.t. first anode ("background") controls to minimum. First check that the voltages at the collectors of the RGB output transistors can be reduced to 130V with still something to spare in the brightness control setting: if not increase the value of R249 (27kΩ) in the clamp pulse feed to the RGB output stages to 39kΩ. Connect a meter across any one of the RGB drive controls (R401-3), e.g. between 5BB and the junction R404/R407, and adjust the brightness control for a reading of zero volts (reduce the meter range to 10V). Then disconnect the meter. This is the correct brightness control setting and it should not be touched further. Next adjust each individual background control (R435-7) in a darkened room, using the beam switches (SW401-3), for the point of raster extinction. This establishes the correct black level. Add a resistor—say 150kΩ—in series with the boost h.t. feed to the control panel if the c.r.t. first anode voltages cannot be reduced sufficiently. Reconnect the aerial and obtain a normal monochrome picture. Then adjust the RGB drive controls (R401-3) for no colouration in the white parts of the picture, at least one drive control remaining at maximum drive when adjustment is complete (in my set all three drive controls are at maximum). Finally if any further adjustment to the background controls is necessary to remove colouration in the dark parts of the picture *ensure that at least one of these controls is left untouched.* **W. Hill** *(Bristol).*

HORIZONTAL STREAKS

We have experienced the same trouble described in Test Case 131—bright horizontal streaks across the screen in a set fitted with the Philips 210 chassis. After lengthy testing we noticed flashes between the top of the scan coils and the tube coating. Tapping the timebase panel stopped these flashes. The deflection coils were removed and cleaned and seemed to be in order, the c.r.t. was also cleaned, but the fault persisted. Moving the coils back about ¼in. eventually cured the trouble. In other similar cases sparking from the system switch (scan deflection contacts 23/24/25) or a discharge from the boost test point has been experienced. Again, moving the coils back has cured the fault.—**S. Darley** (*Edinburgh*).

Comment: We have not experienced this particular trouble ourselves. Compression of the flare end of the coils against the tube could however result in winding leakage. Changing the coils would prove whether this was the case.



YOUR PROBLEMS SOLVED

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ULTRA 6657

On sound there is a buzz which increases as the setting of the volume control is advanced. This buzz almost disappears when the set is detuned but the quality of the picture then suffers.—L. Tamplin (Ilfracombe).

This buzz is vision-on-sound of course and we assume that the trouble is on 625 lines. First make sure that the video amplifier screen grid feed resistor R36 is 8·2kΩ, a manufacturer's modification introduced to help with this problem. Then check that the ratio detector balance preset R87 is adjusted correctly and that both detector diodes have low and fairly equal forward resistance. There is a chance that one or more of the 6MHz intercarrier sound tuned circuits may have drifted, so after tuning the push-button for best picture definition try carefully tweaking the cores in L20/21, L24 and L27/8—return them to the initial position if there is no improvement. A slightly soft valve can also introduce the effect. (BRC 1400 chassis.)

GEC 2047

We are unable to obtain full width on this set in spite of replacing all the line timebase valves. Sound distortion seems to have arisen along with the lack of width. Advancing the set boost control enables the width to be increased.—J. Owen (Peterborough).

Lack of width on this chassis is generally the result of R228 (10MΩ) which provides a d.c. feed from the boost rail to the width control circuit being faulty—probably open-circuit. Also check the width control itself. The reason for the sound distortion is that the intercarrier sound i.c. is fed from an l.t. supply which is obtained from the line output stage. To avoid damage and obtain best sound the width control must be correctly set—for the specified voltage (varies according to scan coils and linearity arrangements used) at SC6.

RGD RV202

The trouble with this set is a completely blank screen, with the sound normal. I have replaced the line output/e.h.t. valves—PY801, PL302 and DY86—but there is still no e.h.t. The PY801 and PL302 overheat badly. When the PY801 top cap is removed the overheating ceases but there is still no e.h.t. whatsoever. There do not appear to be any scorched resistors or other faulty components.—D. Capern (Redditch)

If no arcs can be drawn from the PL302 or DY86 anodes—even with the DY86 top cap removed—it is certainly a case of failure of the oscillator to provide line drive. Replacing the PCF802 line oscillator valve is likely to result in restoration of e.h.t. and a normal picture. If not, check the voltages in this stage. Due to non-oscillation these would not be normal, but some readings must of course be obtained. As you say that there are no discoloured resistors, if a new valve doesn't cure the trouble you will have to check the capacitors in the line oscillator circuit—either by replacement or by stabing equivalents across each in turn to see whether any are open-circuit. (STC/ITT VC2 chassis.)

BUSH CTV182S

When the set is switched on the picture quality is excellent but if a push-button channel selector is operated the new picture fails to lock, the symptom being like loss of line hold. If the aerial is disconnected and then plugged in again the picture can be resolved. An eighteen-element aerial is used and we are in a good signal area.—T. Jones (Birmingham).

The circuit to check is the flywheel line sync circuit. First check the setting of the discriminator balance control 5RV2. This should be adjusted to give an adequate pull-in range so that when the aerial is removed and then reconnected the picture locks every time. If this cannot be achieved by adjusting 5RV2 the discriminator circuit must be checked thoroughly from the discriminator driver transistor 5VT2 through to the balance control, including 5D1, the ringing transformer 5T1, the discriminator diodes 5D2 and 5D3 and the two 1·8MΩ resistors 5R16 and 5R17 connected to each end of 5RV2.

FERGUSON 3661

A full picture is obtained on switching the set on but after two-three minutes there is complete field collapse—just a horizontal white line across the screen. If the set is switched off and left a few minutes then switched on again the same thing happens. On the third attempt however the collapse does not usually occur and the picture remains for the rest of the evening, though with field bounce at the bottom and horizontal streaking. The PCL805 field timebase valve has been replaced.—J. Walton (Castle Donington).

The most likely cause of the fault is that C104 which smooths the boost supply to the field oscillator stage is breaking down. It is often defective in this chassis: the replacement should be a 1μF type. If this does not solve the problem check the height control and the resistors associated with the boost supply. The streaking is likely to be a video stage fault: try a new valve (6F28) and check the associated components. (BRC 1400 chassis.)

GEC 2038

The picture is perfect but there is no sound on this set. I have replaced the EH90 detector/amplifier valve and the PCL84 audio output valve and checked the screen grid and cathode resistors of the latter. The sound output transformer and loudspeaker have also been tried.—J. Evans (Derby).

The most likely cause of the trouble is change of value of one or more of the resistors which bias the EH90. Check its cathode resistor R90 which can be damaged by a faulty valve, then the screen grid bias resistors R92 and R93 which regularly change value —note that R92 should be a 5W type and R93 2W. The trouble could also be the sound i.f. valve of course (V6 EF80). Signal injection at the control grids of the sound valves will establish which stage is inoperative.

FERGUSON 3639

Once the set has warmed up the picture is excellent and stable. After switching on however the set takes a long time to lock horizontally. The pull-in range is good but different line hold control settings are required as the set warms up. Also the width control is hard over and the picture only just fills the screen. All line timebase valves have been checked but a PL81 line output valve instead of a PL81A has been fitted.—L. Knight (Wanstead).

First try a new 6-30L2 line oscillator valve. Then, even though the line lock is good, check that the flywheel sync discriminator diodes have low and equal forward resistance. Try replacing the 1μF electrolytic capacitor which decouples the h.t. feed to the line oscillator. If any of the resistors in the oscillator circuit are even slightly discoloured change them. If the fault persists replace the line oscillator cross-coupling capacitors. Lack of width, assuming that the line output valve is up to standard, is usually due to the 330kΩ resistor in series with the width control being high-resistance or alternatively to the same fault in the 2·2MΩ resistor connected to the slider of the width control or the 2·2MΩ resistor which links this to the line output valve grid stopper resistor. There is not much difference between the PL81 and the PL81A: the latter gives slightly less output and is designed for use in portable receivers. (BRC 980 chassis.)

PYE 11U

The set is all right on 405 lines but on 625 lines there is a "pop" after about twenty minutes and the width is then reduced by about three inches on each side. The line timebase valves have been renewed. —J. Paynter (Watford).

The problem seems to be due to C98 (0·001μF) which provides line output transformer third harmonic tuning on 625 lines being faulty.

PHILIPS 19TG171A

The following intermittent fault occurs on this set. The right-hand edge of the picture towards the lower half pulls in to the left, distorting the picture at the same time. An improved aerial has reduced the incidence of this fault which occurs mainly on advertisements. The fault cannot be cured by resetting the line hold control and all line timebase valves have been replaced. A light picture background seems to trigger the fault off.—J. Bentham (Rochester).

Assuming that the right-hand side slowly contracts rather than that the whole picture moves to the left we would first suggest replacing the two high-value resistors (8·2MΩ) in the width circuit since these give so much trouble in this chassis. One or other may be going intermittently high-resistance. Also check the line output valve screen grid decoupler (2·5μF) and the 1·8MΩ resistor which links its control grid to the width circuit.

If the entire picture jumps slightly to the left one would suspect a sync separator, flywheel sync discriminator or line generator fault. The first move would be to try a new PFL200 video/sync valve. The miniature thermistor (R412) in the discriminator output circuit in this chassis tends to give trouble. As a test, disconnect it—as the line frequency will shift quite a lot however you may have to substitute a resistor of about 100kΩ to restore line lock. Look for any discoloured resistors, check the PFL200 voltages and if the fault persists check the resistor values and replace all the capacitors in the discriminator (V401 ECC82) and line oscillator (V402 ECC82) circuits. This kind of fault rarely gives voltage indications so it may be necessary to change all suspect components. (Philips Style 70 chassis.)

MARCONIPHONE 4800

The fault with this set is that there is an effect that looks like a snow shower behind the picture. The trouble is present with all four stations that can be received here.—B. Haynes (Epping).

If the picture is grainy and generally noisy and the aerial is in order, including the downlead and plug, there could be a defective transistor (r.f. amplifier stage) in the tuner unit. This is the transistor nearest the aerial input: an AF139 can be used in this position. If on the other hand the snow is not due to weak reception but more like interference which worsens as the brightness control is advanced the e.h.t. tray on the side of the line output transformer should be replaced. (BRC 1500 chassis.)

DECCA DR20

I have only recently tried to use this dual-standard set for u.h.f. reception. It is impossible unfortunately to get good picture and sound together on this system. When the set is tuned for best picture there is no sound while to get sound it is necessary to tune in the h.f. direction and the picture then becomes distorted. It seems that some of the coils might need adjustment and your advice on this would be appreciated.—J. Carroll (Ayr).

It does seem as you say that there has been drift in one or more of the u.h.f. circuits but it is impossible to suggest in exactly which one this has occurred. Complete realignment needs a fair amount of equipment, and the manufacturer's stage by stage instructions should be followed. One can't just have a go at any trimmers or slugs. If you can get good resolution of the test card gratings when the set has been tuned for optimum picture quality however it is likely that the 6MHz circuits have drifted—their tuning is much sharper than that of the vision tuned circuits. Try trimming L22, L30 and L31 therefore. These are in the same cans as the 38·15MHz coils but can be identified after removing the screens since they will be the coils with the greater number of turns. If the slug is well down in the coil inserting a screwdriver tip inside the former will identify a coil by causing slight mistuning. We take it that the correct valves (frame grid types) are fitted: using non frame-grid types or "equivalents" can cause mistuning.

EKCO T521

There is a white band down the left-hand side of the screen, and a tendency for slightly wavy verticals. I have changed the line timebase valves, the video amplifier and line output valve screen grid electrolytic decouplers, the line linearity coil damping resistor and the line flyback pulse integrating resistor to the flywheel line sync discriminator circuit.—S. Collingwell (Hull).

We suggest you make sure that the preset contrast controls are not set too high and that your aerial installation is in order. Check that the long l.t. lead which passes across the timebase to the i.f. deck is not too close to the line linearity control. It is possible that one of the two S-correction capacitors C122 (625 lines only) and C123 is short-circuit. (Pye group 368 chassis.)

BUSH TV128

There is persistent vision-on-sound buzz which cannot be eliminated by careful tuning. The effect is much worse when there is a caption or writing on the screen. The set is used on 625 lines only and the fault is present on all channels.—D. Hillmore (Neasden).

First reduce the contrast as far as possible without loss of picture quality. If the buzz persists tune the button as accurately as possible and then adjust the ratio detector transformer coils 2L32-2L34 for minimum buzz. These are in the top coil can above the PCF80 sound limiter stage 2V6a. There is no balance preset in this circuit. The OA79 ratio detector diodes inside the can could be out of balance but this is less likely than shift in the tuning.

EKCO CT106

The following fault condition started to appear recently on this set which is now two years old. When first switched on the picture appears with no red: there is a green cast and also lack of brightness. After 30-40 seconds the picture flashes up bright with normal colouring. This may happen two or three times during the first few minutes, the set then settling down and working normally for the rest of the evening. The fault is now persistent, occurring each time the set is switched on.—T. Manning (Wincanton).

The c.r.t. could produce this symptom if faulty, or alternatively the trouble could be due to the R—Y PCL84 colour-difference amplifier. The latter possibility can be easily checked by substituting the R—Y PCL84 with one of the others to see whether this results in a different colour tint when the fault is present. (Pye 691 chassis.)

KB SV148

There is a $\frac{1}{2}$in. black edge on the right-hand side of the picture—also about $\frac{1}{4}$in. of foldover. A new PL504 line output valve has been fitted, giving improved results but not completely curing the trouble. The picture appears before the sound though I thought it was usual for the sound to come on first. —G. Chiltern (Hove).

The lack of width is almost certainly due to a changed value resistor in the width circuit. The usual culprit is the 10MΩ resistor R159 which provides the boost feed to the width circuit—you may find physically that it comprises two resistors connected in series. The trouble could however be due to either of the 1MΩ resistors R153/4 in this circuit. Obtaining full width will probably cure the foldover though the line oscillator coil may require a slight tweak—get the width right first however. Sound usually comes on before the picture appears, but not always: in this chassis the l.t. supply for the transistors is derived from the line output stage. (ITT-KB VC200 chassis.)

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TELEVISION APRIL 1974

TEST CASE

136

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 GEC Model 2047 suddenly developed the symptom of a "rough" buzz on sound and severe sound-on-vision. The receiver is located in an area of reasonably high signal strength and it was found that both effects virtually disappeared when the signal was coupled to the aerial input through a 12dB attenuator. Under this condition the picture was more grainy than hitherto however and the contrast control had limited operational range.*

With the signal applied to the receiver directly the contrast could be reduced slightly but there was no difference so far as the symptoms were concerned. A study of the circuit diagram (pages 72-3 December) showed that contrast is controlled by varying the level of the video signals fed to the a.g.c. detector and also by varying the gain of the PFL200 video output pentode (through its effect on the feedback in the cathode circuit). The circuit around the contrast control was checked and the d.c. conditions were found to be perfectly normal, the control regulating the PFL200 cathode voltage in the correct manner.

In view of the symptoms, what was the most likely cause of the trouble? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 135

Page 235 (last month)

Yellow is a complementary colour, the complementary of blue. Thus when the blue output is reduced or removed the result is excessive yellow in the display. Since the yellow tinting was less when the blue drive preset was fully advanced the fault was the result of an attenuated blue primary colour signal. In other words the gain of the blue channel was low.

It will be recalled that the transistor voltages in the blue channel were all correct, and since there was some blue drive (otherwise the picture would have been completely yellow) the lack of gain in the blue channel pointed to a faulty signal coupling component.

As mentioned last month a.c. coupling is used between the colour-difference matrix transistor and the subsequent two stages in each channel. The 2·2μF coupling capacitor in the blue channel was temporarily shunted by a similar value component therefore and on taking this action the blue drive was restored, proving that the capacitor was faulty. After fitting a replacement it was only necessary to readjust the drive and first anode presets for a correct grey-scale: this resulted in a perfect tint-free display.

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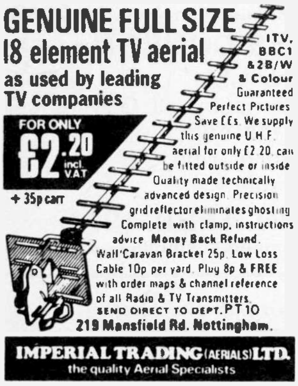

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FOR EXAMPLE: NEW TUBES TWO-YEAR GUARANTEE

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CME1702, AW43-80, CRM173, MW43-80, CRM172, AW43-88, AW43-89, CME1705, CME1703, C17AF	17"	£6.46 +	66p
CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W, C19AH	19"	£9.25 +	71p
CME2101, AW53-88, AW53-89, CRM211, CRM212, MW53-20, MW53-80, CME2104 (when available)	21"	£8.66 +	77p
CME2303, CME2301, AW59-90, AW59-91 A59-15W, CME2308	23"	£12.10 +	77p

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19"/20"/23"/24" rebuilt Rimbands as available.

NEW MULLARD A56/120X **£49.50**
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One Year Guarantee — Also
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EXTENSION **£7.70** extra
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A49/191X (A4911 & A49 120X)	£53.90 + £1.65 cge/ins.	
A55/14X & A56/120X	£58.30 + ,, ,,	
A63/200X (A63.11X & 120X)	£62.70 + ,, ,,	
A67/120X	£64.90 + ,, ,,	

All prices subject to alteration without notice due to market conditions.

Also 20" colour.

NEW TUBES

*TSD282 (TSD217)	£13.75
MW31-74	£3.30
TSD290/CME1201	£11.00
A31/120W-CME1220	£11.55
*13BP4	£15.40
MW36/24 & 44	£5.23
CME1601	£10.45
CME1602	£11.55
CME1713	£14.30
CME1906 / A47-13W	£14.30
A47-11W & 26W	£12.65
A50-120W/CME2013	£11.55
†CME2306 / A59-13W	£15.40
A59-11W & 25 or 23W	£14.85
CME2413/A61, 120W	£15.40

Two year Guarantee Except TSD282 and 13BP4 1 year.

Please enquire regarding availability of rebuilds. Also seconds in colour tubes.

Telephone enquiries welcomed.

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NOTE: Above prices exclude 10% V.A.T. Add 10% on Mono, Colour inclusive of V.A.T.

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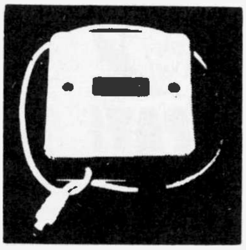

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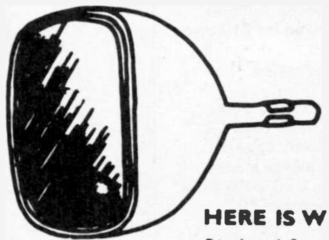

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HERE IS WHAT YOU PAY:

Mono		*Rimband & Twin Panel*		*Colour*	
15-17"	£5.00	19"	£7.00	19"	£25.00
19"	£5.50	23"	£9.00	22"	£27.50
21"	£6.50	24"	£10.00	25"	£30.00
23"	£7.50			26"	£32.50

Carriage 75p — Exchange Basis (carriage-ins. £1.50)

INC. VAT

Cash or cheque with order, or cash on delivery

★ Each tube is rebuilt with a completely new gun assembly and the correct voltage heater.

★ Each tube comes to you with a guarantee card covering it for Mono Tubes 2 years, Colour Tubes 1 year, against all but breakage.

★ Each tube is insured on the journey.

★ Each tube is rebuilt with experience and know-how. We were amongst the very first to pioneer the technique of rebuilding television tubes.

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