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FEBRUARY 1974

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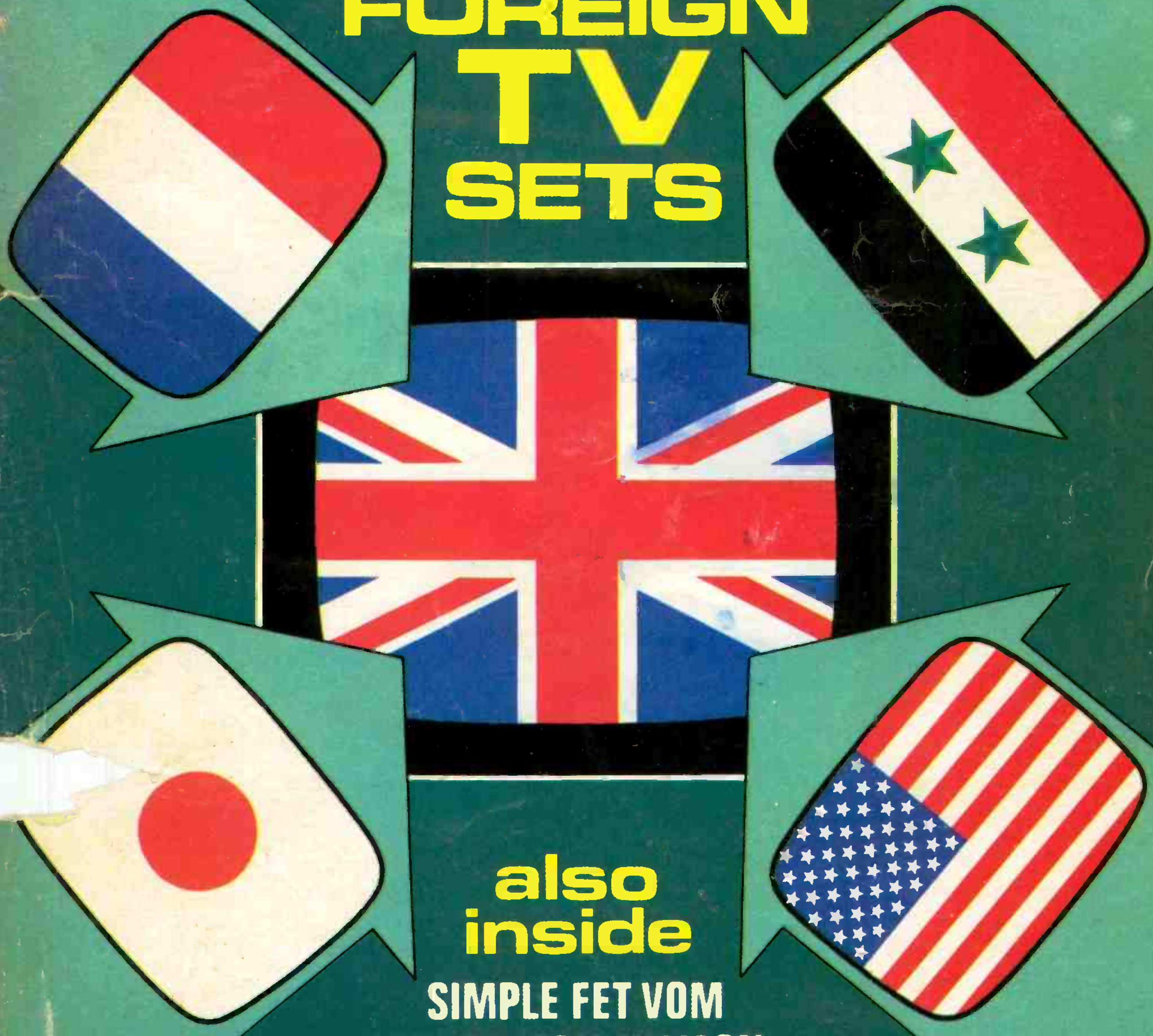

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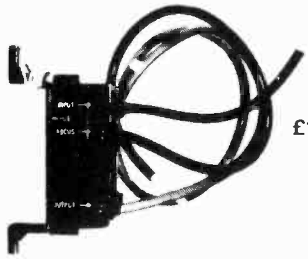

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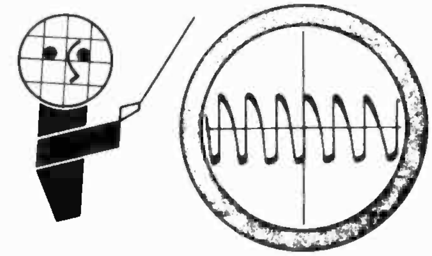

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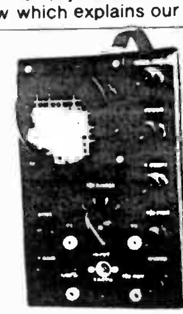

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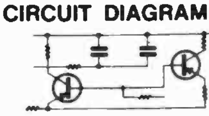

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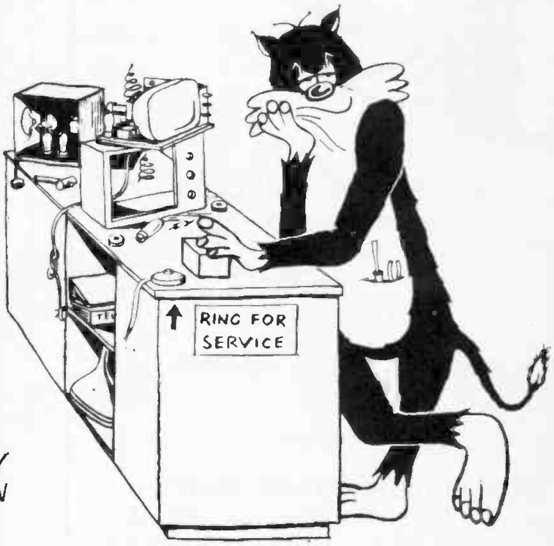

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TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

VOL 24 No 4
ISSUE 280

FEBRUARY 1974

TOPSY-TURVY

At the time of writing this the season of good cheer is fast approaching. The traditional festivities are being overshadowed however by the gloomy prospects of a hard winter. It seems that we shall either have to face up to severe cutbacks in our social services and in what were once called luxuries or else hibernate in the hope of better things to come in the spring. Arguing over government policy or complaining bitterly about industrial disruption of one sort or another is becoming a perennial pastime. And now through no one's fault in the UK we are being threatened over our dependence, so long taken for granted, on petroleum and its by-products.

The extent of our dependence on this one raw material is truly surprising. Apart from its obvious uses in supplying heat and power it is used in the manufacture of almost all plastics. So how does this apply to television? Although it is not possible at present to see exactly how the situation will develop internationally it seems nevertheless quite clear that the supply situation—and for that read growing shortages—relating to electronic components and tools will be seriously aggravated by the Arabian petroleum embargoes.

Just think where you find plastics in a television receiver: capacitors, potentiometers, switches, coil formers, tube neck components, cabinet work and back panels, printed-circuit boards, small hardware and so on. You see what we mean! And all this while the factories are still attempting to satisfy an insatiable demand for colour sets—those luxury goods we know we can't really afford but manage to at all costs, government squeeze or no.

Does this all too typical aspect of our present-day life really make sense? We heard the other day that one television engineer of our acquaintance had a build-up of servicing work amounting to about 70 receivers. We reckon that within a year, when many of the recently purchased colour sets start to blink tiredly from continual operation, the general problem of servicing will be out of control. Perhaps if the service engineer's lot is not considerably improved in 1974 those used car dumps will have to be turned into old telly dumps. Yet, thinking back to oil, to keep existing sets going makes more sense than to keep on churning out new ones.

What the solutions to these problems are we don't pretend to know. If we sound too gloomy all we can say is that we are trying to be realistic. At least TELEVISION can perhaps in some small way help, by keeping up the flow of vital information to help readers deal with their television problems. And on this note we sincerely wish you good luck and all the best for 1974.

M. A. COLWELL—*Editor*

THIS MONTH

FOR MARCH ISSUE PUBLICATION DETAILS SEE MESSAGE TO READERS ON PAGE 159

TELETOPICS

UK SATELLITE TV PROSPECTS

At the Royal Television Society's convention at Cambridge late last year R. J. Clayton, Technical Director of GEC, spoke of the prospects for setting up a satellite TV service for the UK. He believed that by the end of the present decade the technology required will be available so that the decision on whether to start space broadcasting "will be one of need, desire or choice". Preliminary CCIR studies have suggested that four channels in Band VI (11·7-12·5GHz) will be made available to the UK, each carrying a wideband f.m. vision transmission. The use of f.m. for s.h.f. TV transmissions has considerable advantages such as reduction of the transmitter output power, less stringent converter noise factor and oscillator stability requirements and better co-channel performance.

A parabolic reflector receiving aerial of between 80cm and 1m diameter would be required and this would have to be installed with a pointing accuracy of about 0·5°—rather more accurate than present day installation standards!

The Television Advisory Committee's 1972 report suggested that only national, not regional, coverage could be provided by a UK satellite TV service. Mr. Clayton commented that subsequent work indicates that deployable satellite aerials could be produced which would track ground beacons with sufficient accuracy to make regional programming in the UK possible.

A number of firms are engaged in development work to ensure that suitable converters will be available. To reduce signal loss it is likely that conversion from s.h.f. to u.h.f.—also from f.m. to a.m. vision—will be undertaken at the masthead. To improve image-frequency rejection and suppress local oscillator radiation a double superhet circuit is likely to be employed. Temperature compensation and a.f.c. are likely to be necessary to obtain the stability required. Mr. Clayton felt that low-cost, mass-produced converters will be produced without difficulty and that the costs previously suggested—between £50 and £80 for a dish aerial plus converter—are "on the high side for 1980 at today's money values".

In conclusion Mr. Clayton pointed out that much of the technology for space broadcasting is already available and that likely costs can be predicted more accurately in this field than in many other areas of technology. He felt that the main problem could be that the demand will not be there by the time the technology is available; this would be particularly unfortunate for the UK industry which has built up a significant ability to develop and manufacture satellites. Mr. Clayton reported that there is the capability within at least one UK company to design and manufacture broadcasting satellites and the associated ground equipment, and that such companies could well be prepared within the next year or so to discuss "firm prices and guarantees of satisfactory operation for definite periods". Absence of a home market could make it difficult for UK firms to participate in the development of satellite TV systems in overseas markets.

HOME VIDEO SYSTEMS

Another speaker at the convention was Sir John Stewart-Clark, managing director of Philips Electrical Ltd., who spoke on video systems for domestic use. What he had to say was of particular significance since Philips are active in both the videotape and video disc fields. The well known Philips VCR machine offers flexibility in being able to record a programme being watched, or one programme while the viewer is watching another, or under the control of a time switch in the viewer's absence, in addition to providing playback. It is understood that present demand is already in excess of the capacity of Philips plants (on the Continent) to produce these machines. The view held by Philips is that one in ten colour set owners is eventually likely to want a VCR machine, giving a projected potential market of some 1·5 million machines by the time the number of colour receivers has risen to 15 million (the estimated saturation point for the UK).

It appears however that Philips feel that the real mass market will lie in a cheaper domestic video system providing playback only, which is where the video disc comes in. The Philips video long-playing record (VLP) system is still in the development stage. It employs a laser beam to scan the coded information which consists of a series of dots and dashes recorded on the disc as a spiral. The dots and dashes are of uniform width and depth but vary in their lengths and spacings to give the information required to regenerate a complete colour television signal. Since the laser beam is the only mechanical contact with the disc there is no surface wear, and as the material used is the same as that used for audio records the eventual production cost could be only a few pence per disc.

Sir John concluded that "with such machines we are on the edge of a revolution that will lead to a substantial change in home entertainment equipment. There are still problems to be solved, but I predict that in a few years' time we shall be able to produce a video long player with records giving up to an hour's programme that can be fed into any colour set, and with the records costing not significantly more than a long-playing gramophone record today".

Longer reports of the RTS convention are given in the November/December 1973 and subsequent issues of the *Royal Television Society Journal.*

UHF AERIAL GROUPINGS AMENDED

The Radio and Electronic Component Manufacturers Federation has revised the standard u.h.f. aerial grouping/colour coding system. The amendments are only slight but should be noted. There are now three categories as follows: group A, channels 21-34, colour code red; group B, channels 39-53, colour code yellow; group C/D, channels 48-68, colour code green.

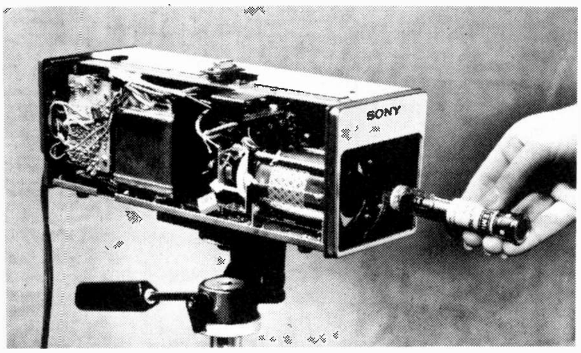
TRANSMITTER OPENINGS

The following relay stations are now in operation:
Buxton (Derbyshire) BBC-1 channel 21, IBA (ATV programmes) channel 24, BBC-2 channel 27. The station will relay BBC-1 Midlands regional programmes: later it is hoped that programmes from Manchester will be relayed. Receiving aerial group A.
Ladder Hill (Whaley Bridge near the Cheshire/Derbyshire border) IBA (Granada programmes) channel 23. Receiving aerial group A.
Plympton (Plymouth, Devon) IBA (Westward programmes) channel 61. Receiving aerial group C.
Abertillery (Monmouthshire) IBA (HTV Wales programmes) channel 25. Receiving aerial group A.

All these relay transmissions are vertically polarised.

FIRST UK PRODUCED ⅔in. VIDICON

The Electron Tube Division of EMI Electronics Ltd. (Blyth Road, Hayes) has introduced an 18mm (⅔in.) vidicon, type 9831, for use in compact TV cameras. It is intended at present as a direct replacement type. The new vidicon features a low-wattage heater,



EMI's new 18mm vidicon type 9831.

separate mesh construction and a high quality target layer to give better shading characteristics and improved sensitivity. Specialised versions of the tube for various industrial applications are also to be produced.

NEW SETS

The Pye group have introduced into their **Ekco** range two 110° colour receivers. Model CT262 is fitted with a 22in. c.r.t. and has a recommended price of £292; Model CT266 is a 26in. version with a recommended price of £320. These sets are fitted with the group's 731 chassis. This is an all solid-state chassis incorporating eight i.c.s. Four of these are used in a four-i.c. decoder of the type described in our November issue. The others are a TBA750Q intercarrier sound i.c., TCA270Q demodulator/a.g.c./a.f.c./video preamplifier i.c., an SN76544N07 sync separator plus line and field generator i.c. and a TAA550 to stabilise the tuning voltage for the varicap tuner. A wide neck 110° tube is used, with Mullard Phase II convergence and timebase circuitry of the type described recently (see October issue) in connection with the RRI 110° chassis. A single BU108 transistor is used in the line output stage, a single BD183 in the field output stage and a pair of BD131 transistors in the audio output stage. The h.t. supply is obtained from a stabilised thyristor circuit, with slow-start system to limit the initial switch-on current and a thyristor overvoltage protection circuit which short-circuits the h.t. line if it rises above a preset value.

A new UK setmaker, **Steepletone Products** (Cinema House, Middle Barton, Oxford OX5·4DA), has announced that it can now take "substantial orders" for colour receivers for delivery to the trade during 1974. Three models, all UK made, have been announced, the S074 fitted with 20in. tube, M274 fitted with 22in. tube and L674 fitted with 26in. tube. No recommended prices have been suggested but the sets are said to be in the "de luxe" class and each will undergo a four-hour soak test before leaving the factory. The chassis uses hybrid circuitry, and Toshiba c.r.t.s which have a guarantee that can be extended to four years are fitted.

Two new colour sets from the Continent have been announced. The **Indesit** Model T26LGB comes from Italy and is priced at £390. It incorporates a 110° 26in. tube and a hybrid chassis. The **Siemens** Model Alpha FC387 comes from Germany and is in the luxury class with a price tag of around £500. It is a 110° 26in. model. Siemens are also introducing a videotape cassette recorder, Model FM101, which records in colour and includes a 26in. monitor colour set. The suggested price is about £700. It takes standard Videocord type cassettes giving 30, 45 or 60 minutes recording time.

Finally this month two new mains-battery monochrome portables. The **Ultra** Model 6830, fitted with a 12in. tube, incorporates the Thorn 1621 chassis which was described in this column last November. The recommended price is £67. From **ITT** comes a 15in. version of their Featherlight 12—the Featherlight 15. This carries a recommended price of £73.50.

GOVERNMENT SUPPORTS CABLE TV

Recent statements by the Minister of Posts and Telecommunications Sir John Eden indicate the favourable view the government takes of cable TV operations. Sir John has stated in the House of Commons that consideration is being given to "the best way in which the future of cable television could be encouraged". For the present the Ministry appears to wish to see further experiments along the lines of the local cable TV services already in operation at Greenwich, Bristol, Swindon and Sheffield, but of wider scope. This is felt to be necessary before the "delicate" questions of the form of control and finance of cable TV operations can be finally decided.

SERVICING television receivers

L. LAWRY-JOHNS

DECCA MODELS MS2000 & MS2400

THESE are hybrid receivers using a combination of valves, transistors and an i.c. for the intercarrier sound channel. As they are single-standard sets the absence of a v.h.f. tuner means that the amplification this would have provided must be made up either in the i.f. strip or in the u.h.f. tuner. The latter arrangement is adopted, a three transistor tuner unit being used. The aerial signal is amplified by the normal r.f. transistor (AF239) and is then passed to the mixer stage (AF139) where the required i.f. is extracted and passed to an AF106 transistor for amplification before being conducted via a screened lead to the filters on the main chassis. The main i.f. amplification is then carried out by the controlled EF183 stage and the straight EF184 amplifier.

Demodulated Signals

The composite waveform is detected by D202, filtered and capacitively coupled to the video amplifier section of the PFL200, with d.c. restoration by means of D205. D204 is an anti-lockout diode to limit the video drive under high contrast conditions. The picture signals and sync pulses are developed across R230 and passed through correction components to the c.r.t. cathode and the sync separator control grid.

Sound Circuits

The 6MHz intercarrier sound signal is picked off at the video amplifier cathode and fed to the ceramic crystal CF201. This passes the 6MHz f.m. signal only to the MC1351P integrated circuit which carries out amplification, limiting, detection and a.f. preamplification. The a.f. signal appearing at pin 2 of this i.c. is coupled via C225 to the volume control and is then returned via C232, D203 and C236 to pin 9 of the i.c. D203 is included in this feed to mute the a.f. circuits until the valves warm up and the picture appears. Once the EF184 conducts sufficiently the voltage across its cathode resistor R215 biases D203 on and the a.f. channel is no longer cut off. The amplified a.f. signal at pin 10 of the i.c. then passes to the output transistor TR201 (which is clamped through its insulator to chassis—more about that later). The collector-base junction of this transistor is protected by D201.

Timebases

The anode load resistor of the sync separator section of the PFL200 is R112. C107 couples the line sync pulses to the flywheel discriminator (V115) circuit while C110 feeds the field sync pulse shaping network.

The line timebase follows the usual Decca pattern. The flywheel line sync and oscillator circuits are basically as used in the DR100 series which we covered in the March and April 1971 issues. The line output stage also follows established practice and offers no headaches.

Field Timebase Valve

The field timebase uses a 30PL14 valve in an otherwise commonly encountered oscillator-output circuit. Let us be clear however that the pin connections of the 30PL14 are not the same as those of the PCL85. The 30PL14 in fact is an up-rated version of the earlier 30PL13 which was not too far removed from the PCL82 (although far enough to preclude using a PCL82 as a replacement in most timebases).

H T & Heater Supplies

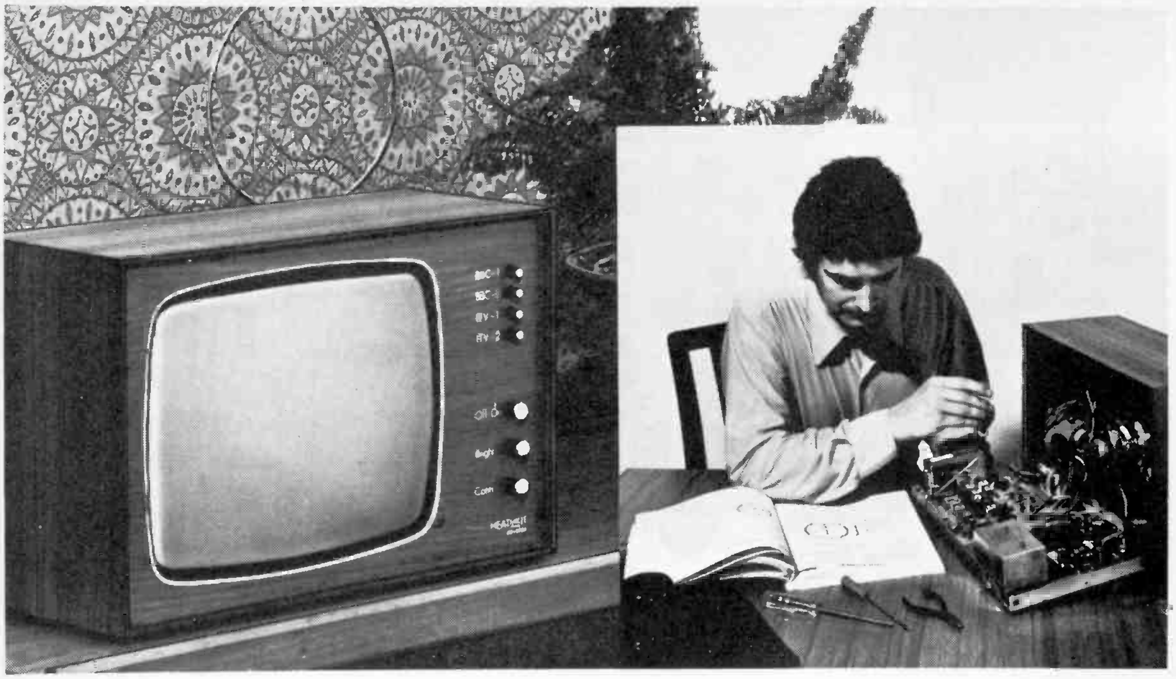
The power supplies are conventional from both the heater and h.t. point of view. A thermistor is included in series with the heater circuit dropping diode (D104) and there is a separate 1A fuse in series with the h.t. diode (D101). The smoothing choke (CH1) is followed by a fairly elaborate smoothing system of resistors and electrolytics which supply the various parts of the receiver including the sound output transistor. It should be appreciated that this transistor works at a fairly high collector voltage (about 120V) but we will have more to say about this stage later.

L T Supplies

The supply to the tuner is derived from the h.t. line through the 15kΩ resistor R302 and is clamped to 12V by the zener diode D301 (ZG12). A similar arrangement is used to supply the MC1351P i.c. In this case the supply is taken from the same h.t. line that feeds the audio output transistor, via R217 (5kΩ) with clamping to 12V by D206 and additional smoothing provided by R242 and C227.

No H T

Complete absence of h.t. is most often due not to the h.t. fuse F2 failing but to one of the 17Ω sections (R104/5/6) of the mains dropper going open-circuit. The value of the replacement used is not too critical within 14 to 20Ω but the temptation to short out the faulty section must be resisted as all sorts of



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The new Heathkit GR-9900 portable 12" UHF Monochrome Television kit. A unique chance to double the pleasure available from any other television set — because you build this yourself.

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The GR-9900 is portable too—equally at home on the mains or off your 12 volt battery for car, boat or caravan use. Add to this Heath's world renowned experience in the design of equipment for first-time kit builders, and you will be impressed on all counts of engineering, styling, and performance.

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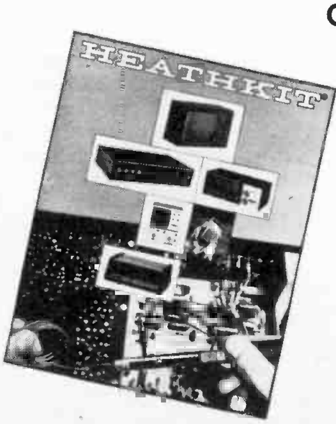

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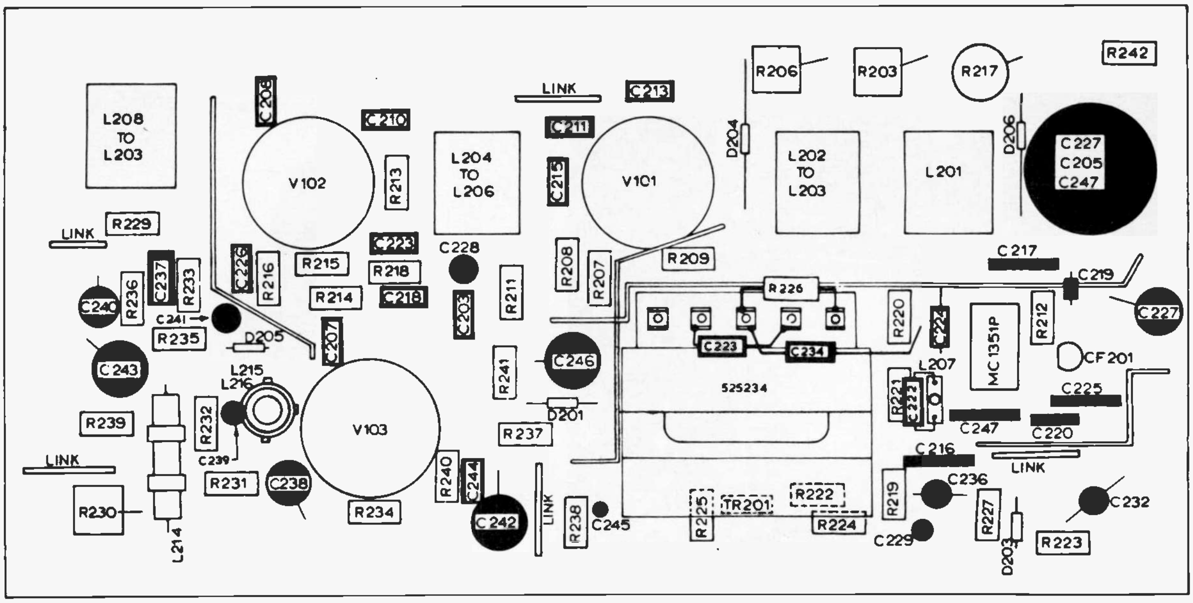


Fig. 1: Layout of the i.f. panel

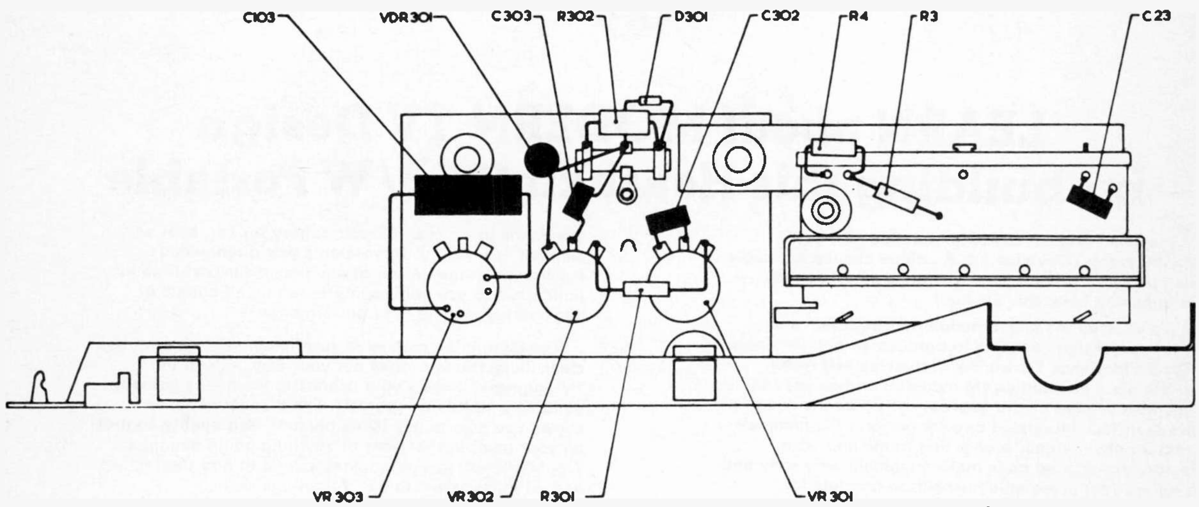


Fig. 2: Control panel layout

funny things can happen if the supply voltage is raised—though they may not appear to be likely at the time. Failure of the line output transformer is one of the not so funny things that can result from this action, together with early deterioration of the main electrolytics.

Effect of faulty R107

Still on the subject of resistors R107 is one of the h.t. supply components that can cause a lot of trouble if it becomes open-circuit. Whilst the line output stage is fed direct from the junction R124/R107 (R124, 1Ω, provides field scan correction—note that it is in series with the field deflection coils) the line oscillator is fed from the junction R107/C105. Should R107 become open-circuit or be overloaded by a partial short the ECC82 line oscillator (V116) cannot work and line drive to the PL504 line output valve is thus absent. This results in the PL504 and the PY800 boost diode overheating. The PY800 may not survive this sort of treatment: in fact it may well register its objection by developing a cathode-to-heater short, resulting in the heater going open-circuit before the fuses have time to respond. The fault may at first sight therefore appear to be one of an open-circuit heater chain. When the PY800 has been replaced and has had time to warm up however the overheating will be obvious and should immediately direct attention to the ECC82 and its h.t. supply. This sequence of events does not always occur and the PL504 and PY800 may simply sit there glowing away waiting to be relieved of their burden.

CONTINUED NEXT MONTH

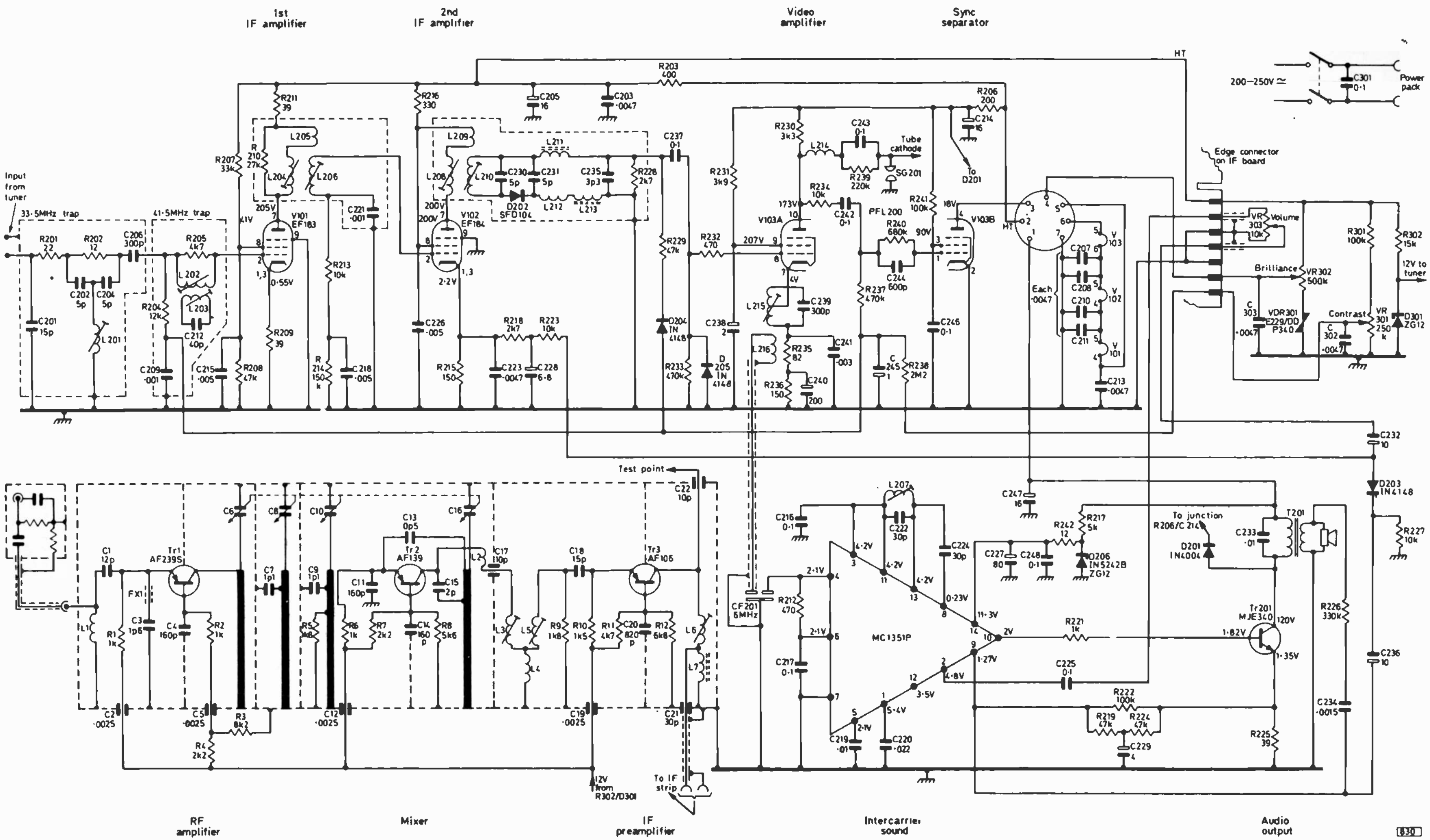


Fig. 3: Circuit diagram of the tuner unit and signal stages, Decca Models MS2000 and MS2400.

BEAM LIMITING IN COLOUR RECEIVERS

S. GEORGE

APART from a few early models all colour receivers incorporate beam limiting circuitry. The reason for this is as follows. Since e.h.t. circuits have a considerable internal resistance, even small increases above the designed-for e.h.t. current result in a reduction of the e.h.t. voltage, degrading the convergence and focusing, while really excessive current demand imposes a heavy strain on the entire e.h.t. and line output circuitry, a condition which it is especially necessary to avoid in solid-state receivers.

Colour-Difference Tube Drive

Receivers employing colour-difference c.r.t. drive are usually of hybrid design and in these it is a simple matter to incorporate a low-value resistor in the cathode lead of the line output valve to sense the e.h.t. current demand. The general arrangement used, much simplified, is shown in Fig. 1. A fairly constant average potential is developed across R1 during pictures of normal brightness level but if the e.h.t. current, and thus the loading on the line output valve, increases excessively there is a marked increase in this voltage. This control voltage is applied to the base of a normally non-conducting transistor (Trl) in the brightness control network which is in the grid circuit of the luminance output stage. When the control potential is sufficient to drive Trl into conduction the luminance output valve's grid voltage is driven negatively so that its anode voltage rises and the c.r.t.'s beam current is thus reduced. Trl usually conducts when the c.r.t. beam current reaches about 1·2mA: the precise point at which it conducts is determined by the bias, which is set by R2, applied to its emitter. When Trl conducts the voltage across R3 increases and the voltage at the junction R3/R4 moves negatively.

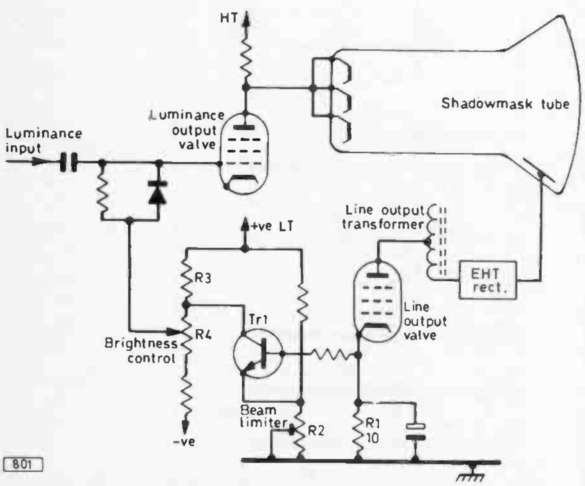


Fig. 1: Basic beam limiting circuit used in many sets that employ colour-difference tube drive. The beam current is sensed as the voltage developed across R1 in the cathode lead of the line output valve. In many earlier colour-difference drive chassis employing a PD500 e.h.t. shunt stabiliser triode the beam sensing point is the grid circuit of this valve. A typical example was shown in Fig. 3, page 70 of the December 1973 issue.

R G B Tube Drive

Some chassis employing RGB tube drive have a valve line output stage in which case a variation on this basic arrangement can be used—but with the control action applied to a low-level amplifier stage in the luminance channel or alternatively to the a.g.c. circuit.

The majority of chassis employing RGB drive are completely solid-state however. In these the e.h.t. current can be sensed as the voltage change developed across a diode, zener diode or resistor combination which returns the earthy end of the line output transformer e.h.t. overwinding or the earthy end of the e.h.t. tripler circuit to chassis. This control potential is then used to reduce the voltage at the grids of the shadowmask tube.

Limiting at the C R T Cathodes

In Asa receivers which, uniquely, employ grid RGB tube drive a simple and ingenious diode arrangement returns the tube cathodes to chassis and cuts off if the beam current rises to an excessive figure. Since this circuit is based on the effect of two currents flowing in opposition, a feature employed in most other limiting circuits used in chassis employing RGB tube drive, we will take a close look at this particular circuit (see Fig. 2).

−350V peak-to-peak pulses are fed via R332 to diode D38 which develops a voltage of −264V across its reservoir capacitor C267. This voltage biases D37 on so that when the receiver is switched on a small current of about 1·3mA is drawn through R331, S1 and D37 to chassis. Since D37 is fully conductive the c.r.t. cathodes are also returned to chassis, via R330, S1 and D37. The c.r.t. cathode (beam) current flows in the opposite direction however to the current drawn by D37 from C267. So long as the c.r.t. beam current is less than the current drawn from C267, D37 remains fully conductive. If however the total beam current tries to rise above 1·3mA D37 will be driven to cut-off. The resultant high impedance in the

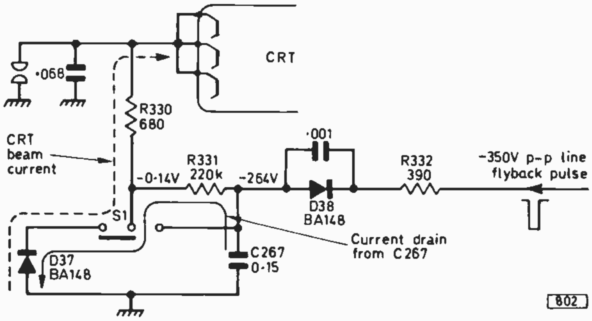


Fig. 2: Beam limiting and spot suppression circuit used in the Asa CT5003/4 series. Beam limiting occurs at the c.r.t. cathodes: the chassis is very unusual in employing RGB drive to the c.r.t. grids.

c.r.t. cathode circuit reduces the c.r.t. beam current and the brightness level. The basic feature made use of here therefore is that when a semiconductor pn junction is forward biased current can flow across the junction in both directions.

The circuit also provides switch-off spot suppression. When S1 which is ganged to the mains switch is changed to the off position R331 is short-circuited and the high negative voltage across C267 is applied to the tube cathodes. As a result the three beams are briefly turned full on, discharging the e.h.t. capacitance before the timebases cease to scan out the raster.

Limiting at the C R T Grids

Another simple limiter which acts directly on the c.r.t. is shown in Fig. 3. This is used in the latest GEC colour chassis, the C2110 series, and is linked to the e.h.t. tripler earth return path.

Under normal operating conditions the c.r.t. grids are held at 25V by the clamping action of D604. The bleed current through R611, D604 and R701 sets the voltage at the junction of R609/R611/D604 at 25V and since D604 is fully conducting the voltage at its anode is also 25V. The bleed current through R611/D604/R701 is approximately 1mA. The tripler earth return is also connected to the junction R701/D604 however and as the broken line shows the beam current flows through R701 in the opposite direction to the bleed current through D604. When the beam current exceeds about 1·2mA the voltage at the

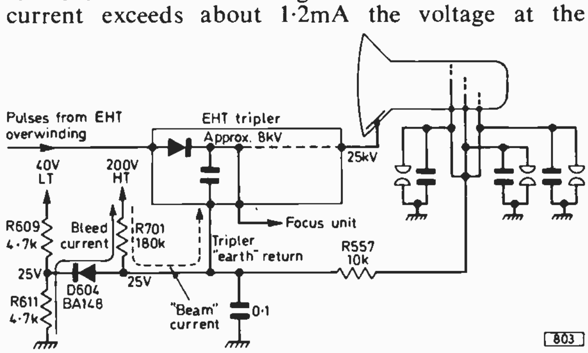


Fig 3: Beam limiting circuit used in the GEC C2110 series. The e.h.t. beam current sensing point is the e.h.t. tripler earth return lead, the control action taking place at the c.r.t. grids.

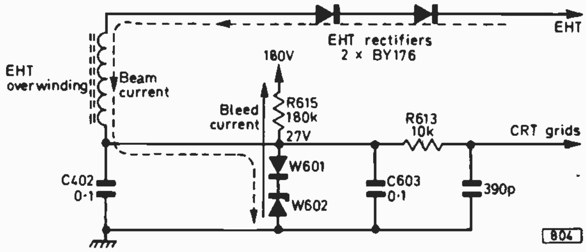


Fig. 4: Beam limiting circuit used in the BRC 8000 chassis. Here the beam current is sampled at the earthy end of the e.h.t. overwinding on the line output transformer, with control action at the c.r.t. grids.

junction R701/D604 moves markedly negative, cutting off D604 which no longer provides clamp action. This drives the c.r.t. grids negatively and consequently the c.r.t. beam current is reduced.

B R C 8000 Circuit

A circuit which operates in a similar fashion is used in the BRC 8000 series chassis (see Fig. 4). This time the e.h.t. sensing is carried out at the earthy end of the e.h.t. overwinding on the line output transformer. The e.h.t. overwinding earth return to chassis is via W601 and the zener diode W602. These diodes are normally biased into conduction by the connection to the h.t. line via R615 and the zener clamps the voltage at the junction W601/R615 to 27V. The bleed current through the diodes and R615 is about 1mA. As the broken line shows the c.r.t. beam current flows through the two diodes in the opposite direction to the h.t. bleed current. If the beam current is excessive W601 cuts off and the voltage at the junction R615/W601 moves sharply negative—the zener diode no longer providing a clamp action. Since the junction R615/W601 is linked via R613 to the c.r.t. grids these are also driven negatively and the beam current is thus reduced. At switch-off the charge on C402 and C603 holds the grid voltage constant for a

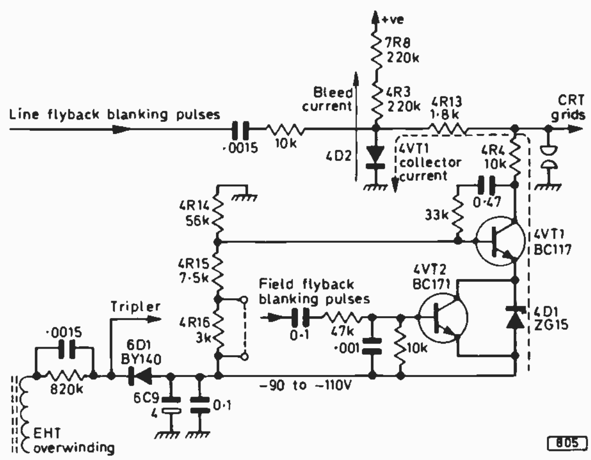


Fig. 5: Beam limiting and flyback blanking circuits used in RBM single-standard colour chassis. Rectifier 6D1 produces a negative output proportional to beam current. 4D2 cuts off when 4VT1's collector current reaches 1-1.5mA (depending on tube size).

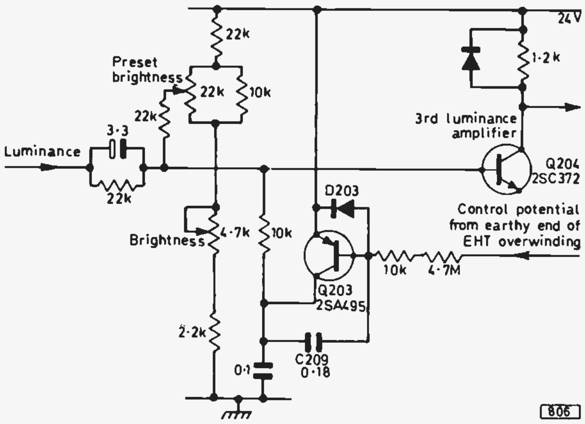


Fig. 6: Beam limiting in the luminance channel as used in the Toshiba Model C81B. Control is also applied to the c.r.t. grids along the lines described in previous examples of beam limiting arrangements.

short period to prevent the appearance of a switch-off spot.

R B M Circuit

The circuit (Fig. 5) used in RBM single-standard models is also based on the effect of two currents flowing in opposition through a diode but is rather more elaborate. During normal operation 4D2 is forward biased, a bleed current of approximately 700μA flowing via 4D2, 4R3 and 7R8. As a result the c.r.t. grids are effectively clamped to chassis potential. 6D1 produces across 6C9 a negative potential of -90V to -110V dependent on the beam current. This potential biases 4VT1 which is normally non-conducting. If the beam current reaches 1mA however 4VT1 conducts sufficiently for its collector current to switch 4D2 off, a negative potential then being applied to the c.r.t. grids to reduce the current demand. With the larger sizes of tube 4R16 is linked across, limiting then occurring when the beam current reaches 1·5mA.

Line flyback blanking is achieved conventionally by applying negative-going pulses to the tube grids. For field flyback blanking positive-going pulses are applied to 4VT2 base, switching it on and thus shorting out 4D1 to produce a negative-going pulse at 4VT1 emitter so that it too switches on. The result is a negative-going pulse at the c.r.t. grids, switching the tube beams off.

Limiting in the Luminance Channel

In many imported receivers beam limiting is achieved by altering the bias applied to one of the stages in the luminance channel: with d.c. coupling maintained right up to the tube this results in the required brilliance level reduction. As an example, Fig. 6 shows the circuit used in the Toshiba Model C81B. Beam current sensing takes place at the earthy end of the line output transformer e.h.t. overwinding and the control potential is applied to the base of Q203. As can be seen the forward bias applied to the base of the third luminance amplifier Q204 is set by the user and preset brightness controls. The emitter of Q203 is fed from the 24V l.t. rail and it conducts only when its base voltage is negative with respect to the l.t. rail. When the beam current is excessive Q203 is driven to conduction and in effect shorts the brightness control network to l.t. positive driving Q204 into heavy conduction. The fall in Q204's collector voltage is reflected through the succeeding stages to the c.r.t. to pull the beams back.

D203 protects Q203's emitter-base junction while C209 prevents the circuit responding to abrupt changes of brightness level or rapid, momentary increases of the brightness control setting.

I T T/K B Circuit

Not all receivers with RGB tube drive employ a transistor line output stage of course, a notable case being the ITT/KB CVC5/7 chassis. As a final example of beam limiting arrangements Fig. 7 shows the circuit used in this chassis. With this we return to beam current sensing at the cathode of the line output valve—across the 10Ω resistor R423.

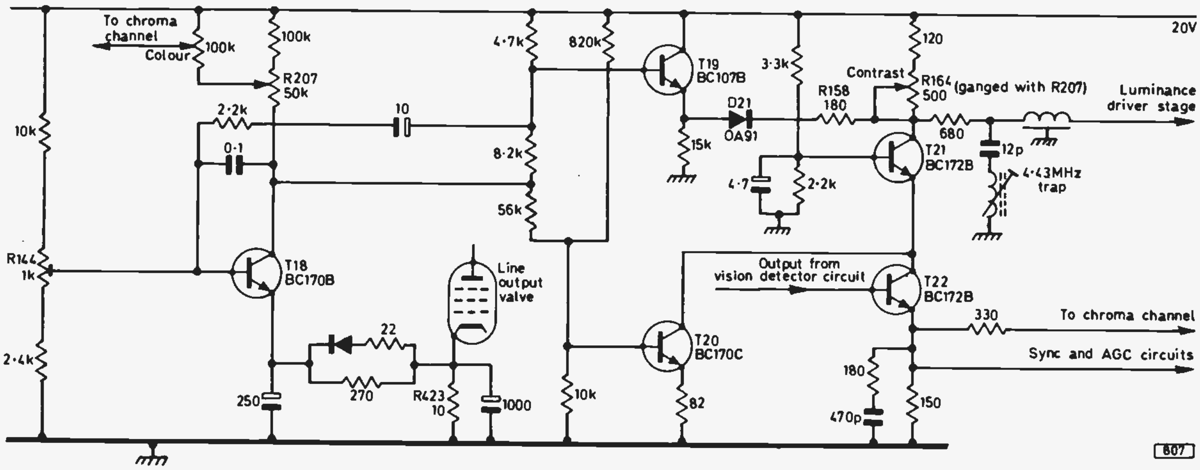


Fig. 7: In the ITT/KB CVC5/7 chassis beam limiting occurs in the cascode distribution amplifier stage which feeds the luminance driver stage. When the beam current is excessive the amplitude of the luminance signal is reduced since T19, D21 and R158 shunt T21's collector load components. Beam sensing occurs at the cathode of the line output valve.

The output from the vision detector circuit is applied to the cascode "distribution amplifier" T21/T22 which feeds the chrominance channel, the sync and a.g.c. circuits, and the luminance driver stage. The beam current limiter circuit comprises T18, T19 and T20. The base voltage of the "beam current detector" T18 is set by the limiter onset control R144 while its emitter is taken to the top of R423 which develops 2·2V with zero beam current and approximately 3·4V when the beam current reaches 1·2mA. While the beam current is within normal limits T18 is held fully conducting—at zero beam current its collector voltage is 2·4V and its emitter voltage 2·3V. When the beam current rises excessively the voltage at T18 emitter rises and its collector current falls. Its collector voltage rises, reaching 10V when the beam current is 1·2mA. Since the collector of T18 is d.c. coupled to the bases of T19 and T20 the conduction of both these transistors increases. T19's emitter voltage rises and in consequence D21 conducts on the negative peaks of the luminance signal at T21 collector, adding R158 in parallel with T21's collector load components and in effect lowering the luminance signal amplitude. The effect of T20 conducting more heavily is to increase the standing current in T21 to stabilise the black level. The overall effect is that the c.r.t. beam current is reduced until the overload condition is removed.

Conclusion

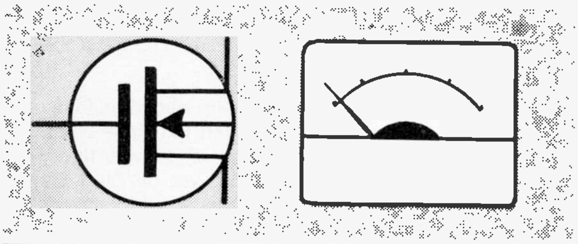
Maximum beam currents with these limiting arrangements range from the 1mA of the BRC 8000 chassis to the 1·5mA of RBM sets fitted with the larger sizes of c.r.t. As these beam current values are usually measured as a potential developed across components in the e.h.t. circuit, the only sure check if the beam limiting action is suspected is to go through the manufacturer's recommended adjustment procedure and make sure that the correct test point figures are obtained. ■

IMPORTANT MESSAGE TO ALL READERS

Three-day working in much of the printing industry together with difficult communications and delivery problems have had a serious effect on magazine publishing. We are sure that readers will understand the situation but nevertheless ask for your patience should publication of this and future issues be unavoidably delayed.

On top of this a world shortage of paper has resulted in a massive increase in the price of this our basic raw material. Because of this and other cost increases we regret that we have been compelled to increase our cover price to 25p as from the next (March) issue.

simple FET Voltmeter



R. MacCLAY

WHEN measuring voltages in transistor circuits even a meter with a sensitivity of 20,000Ω/volt can give false readings due to its shunting effect on the circuit. A meter with a really high input impedance will give accurate readings and have minimum effect on any biasing arrangements used in the circuit being tested.

Traditionally a valve voltmeter was used to obtain a high input impedance. Bipolar transistors are not really suitable because of their low input impedance —about 1,000Ω. Field effect transistors are now available at low cost however. These operate under similar conditions to valves, with a high input impedance. This article describes a simple but extremely useful voltmeter devised around a field effect transistor.

The type selected for the instrument is an insulated-gate (i.e. m.o.s.) n-channel type operating in the depletion mode (i.e. f.e.t. conduction decreases as the gate-source voltage is increased). Insulated-gate f.e.t.s have an extremely high input impedance and like valves do not require current biasing at the input. This makes it possible to use a simple high-impedance potentiometer input circuit for voltage selection.

The basic circuit adopted is shown in Fig. 1. The resistor (R3) connected to the transistor's source terminal biases it so that the voltage at its drain terminal equals half the supply voltage. The meter itself is connected between the transistor's drain terminal and a potentiometer across the supply. This potentiometer is adjusted so that with zero input there is no meter deflection. R4 is a preset adjustment which is set to give full scale deflection with 0·5V applied to the transistor's gate. The voltage range is selected by S1 (Fig. 2) and the value of R2 (Fig. 1) calculated from the formula:

$$R2 = \frac{V2 \times R1}{V1 - V2}.$$

In the complete circuit (Fig. 2) C2 is added to damp the meter movement and C1 to prevent the transistor's gate going open-circuit when switching between ranges. This latter capacitor must have a high insulation value to prevent it shunting the input potentiometer. To prevent drift of the zero setting

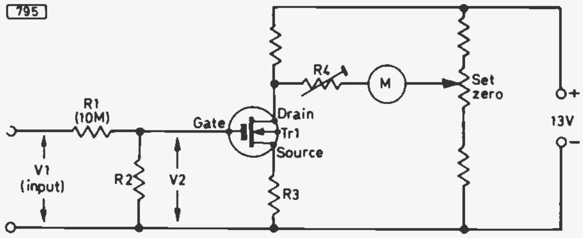


Fig. 1: Basic circuit of the f.e.t. voltmeter.

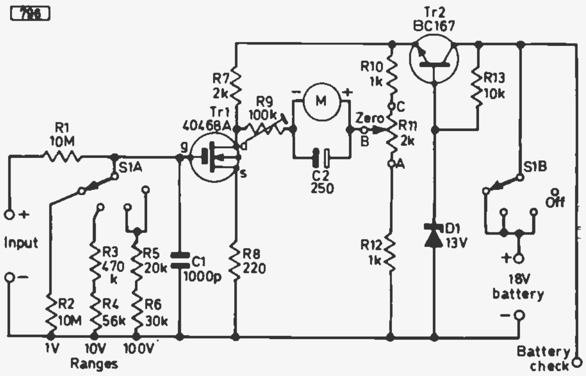


Fig. 2: Complete practical circuit.

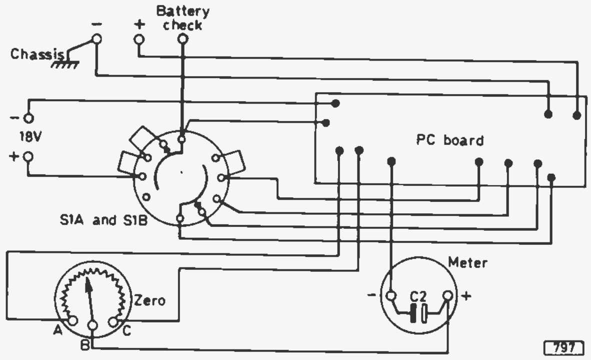


Fig. 3: Wiring diagram for the voltmeter.

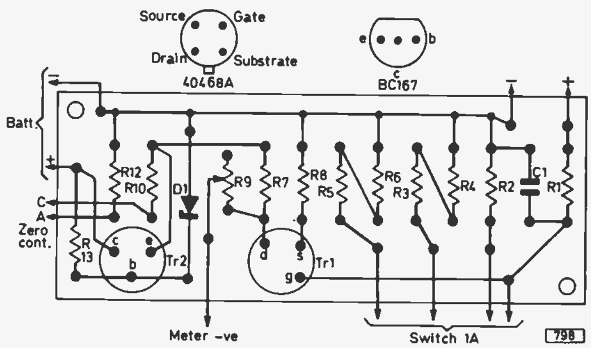


Fig. 4: Suggested layout for the printed board on which the small components are mounted. The actual size of the board is 3½ x 1⅜ in.

and variations in sensitivity with changes in battery voltage it was found desirable to incorporate a simple

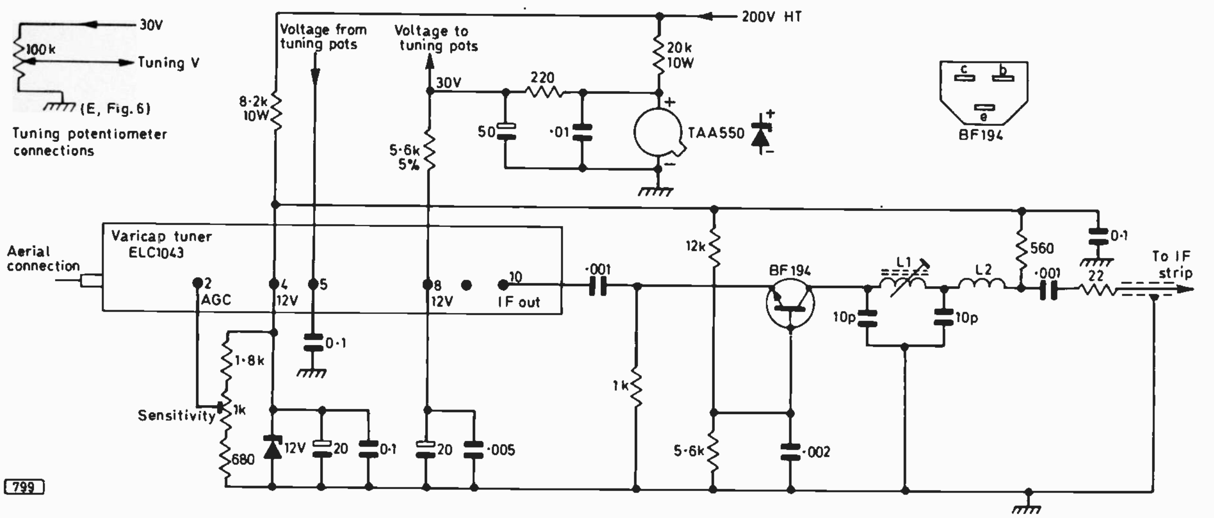


Fig. 5: Varicap tuner plus transistor i.f. preamplifier circuit used by R. MacClay in renovating old sets.

supply voltage stabiliser circuit. Almost any small-signal npn transistor could be used for this purpose (Tr2, Fig. 2). The transistor acts as an emitter-follower with its base and thus its emitter clamped by the zener diode D1.

The three ranges provided are 1V, 10V and 100V. The sensitivity on the 1V range is 20MΩ/volt and on the 10V and 100V ranges 1MΩ/volt. + 100 kΩ/V respectively

The voltmeter should be built in an aluminium box whose size depends mainly on the particular type of 100μA meter used and the batteries. In the author's prototype a couple of PP4 batteries are used giving about six months' operation with intermittent use. The current taken is about 7mA.

Fig. 3 shows the basic wiring while Fig. 4 shows the layout of the printed circuit on which most of the components are mounted. The RCA 40468A f.e.t. is available at about 44p from Electronic Component Supplies (Windsor) Ltd.

Because of its very high input impedance the f.e.t. can be damaged by electrostatic discharges during handling. This is prevented by a clip or other shorting device which is supplied by the manufacturer to short all the leads together. This clip should not be removed until all soldering has been completed.

When the voltmeter has been constructed and checked switch it on and make the zero adjustment with no input. Then select the 10V range and with 10V applied to the input adjust R9 for full scale deflection. After checking the other ranges the meter is ready for use. The total cost should not be more than about £1 plus the cost of the meter movement.

★ components list (Fig. 2)

R1	10MΩ	R8	220	C1	1,000pF 160V polystyrene
R2	10MΩ	R9	100kΩ preset	C2	250μF 6V electrolytic
R3	470kΩ				
R4	56kΩ	R10	1kΩ		
R5	20kΩ	R11	2kΩ W.W.	Tr1	40468A
R6	30kΩ	R12	1kΩ		
R7	2kΩ	R13	10kΩ	Tr2	BC167
R1-R8, R10, R12, R13 ½W 5% carbon film				D1	13V 400mW
				M	100μA

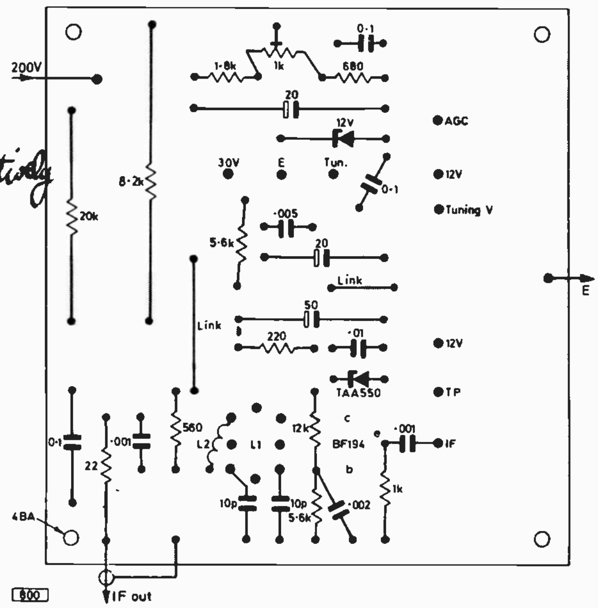


Fig. 6: Printed board layout for the varicap tuner plus i.f. preamplifier circuit. Connect E to the receiver chassis with heavy-gauge wire.

Finally, referring back to my article last May on transistor i.f. preamplifiers, readers may find the information in Figs. 5 and 6 of interest. I have recently renovated some sets fitted with the Thorn/BRC 850 chassis, converting them to 625-line only operation in conjunction with a varicap tuner unit. Fig. 5 shows the circuitry required by the varicap tuner, and the BF194 i.f. preamplifier stage I added, while Fig. 6 shows the physical layout of the arrangement on a small board 3¾ x 4in. L1 consists of 15 turns on a 5mm. former with core, close wound at the base. Choke L2 consists of 10 turns close wound (a 7/64in. drill was used). The wire is 38 s.w.g. in both cases. Provision is made for a screening can on L1 but this has not been found necessary. ■

THE SILICON VIDICON

IAN SINCLAIR

IF we were designing a TV system from scratch and had just started thinking about how a TV camera should work there is little doubt that we would start by taking a very close look at the human eye. Fig. 1 shows the basic features of the human eye. There is a lens whose focal length can be adjusted by a set of muscles (the ciliary muscles), enabling us to adjust our vision equally to near or far objects; an iris which adjusts the amount of light passing through; and most important of all a retina which is a light-sensitive surface from which a "cableform" of nerves starts out to the brain. We can imitate the variable focus and the iris actions easily enough, but the processes that take place in the retina are neither so clearly understood nor easily imitated.

The Human Eye

As far as we know at present the retina is not a continuous surface but is composed of sets of pieces (called "rods" and "cones" from their shape) of light-sensitive material. Light produces a chemical change in these elements. This in turn results in a voltage, which is communicated by the nerves to the brain, being generated. The brain acts as the system computer. There are additional complications concerned with colour vision and the use of different elements in bright light and in dim light but these are not essential to the formation of an image which is the purpose of television.

Each element in the retina seems to have a separate connection to the brain. Thus no scanning action takes place *in* the eye though *large scenes* are scanned since only a small area of a scene is in active focus at any one time. Whether scanning action takes place in the brain we are not at present sure, but there is some evidence that it may do since light which flickers at certain frequencies can cause remarkable illusions of colours and images, as if a "beat" effect of some sort is taking place.

The first step in imitating the eye would be to construct a "retina", and the best devices to use would be silicon photodiodes. Such a photodiode consists of a pn junction which is reverse biased and conducts when light falls on it. The conduction is due to the generation of electrons and holes from previously neutral atoms as a result of the action of the light.

Scanning

We next have the problem of using the information from each photodiode. Since we have to transmit TV pictures as a modulated waveform we require some sort of scanning to convert our picture information into a sequentially varying waveform. The scanning could be done by switching each photodiode in turn to an output cable as shown in Fig. 2. If we were content with a low-bandwidth picture such as Baird's original 30-line system such an "eye" would be comparatively easy to make though some 900 diodes would be needed to get a square picture of equal vertical and horizontal resolution. The switching is a problem. It would be carried out best by means of a ring counter actuating a set of switching transistors (Fig. 3) so that each time a pulse is applied to the input of the counter a switch closes (i.e. one of the switching transistors conducts) and the previously closed switch opens. Even with a 30-line resolution this is a formidable piece of wiring: the difficulties of making such an "eye" with 625-line resolution are apparent.

Nevertheless integrated circuit techniques are being developed for this purpose. The problem is not the difficulty of forming so many elements but of ensuring that the switching is 100% reliable. To have the photodiodes on one chip and the switching on

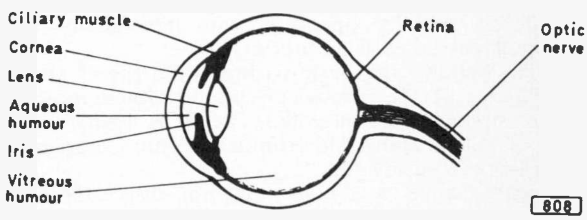


Fig. 1: Horizontal section of the human eye. The aqueous and vitreous humours are liquids of slightly different composition which preserve the shape of the eye and act with the lens in refracting light to the retina.

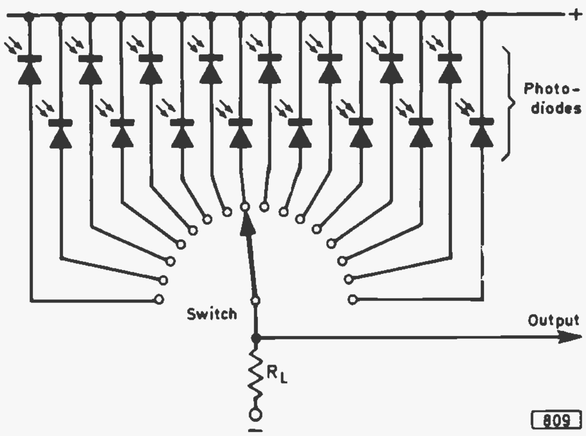


Fig. 2: A crude method of switching a photodiode array.

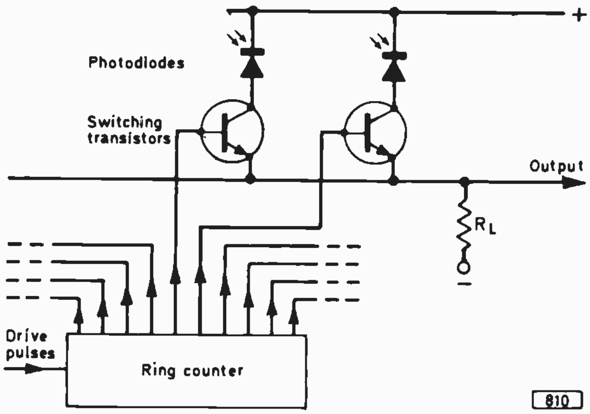


Fig. 3: Using transistors to switch the photodiodes.

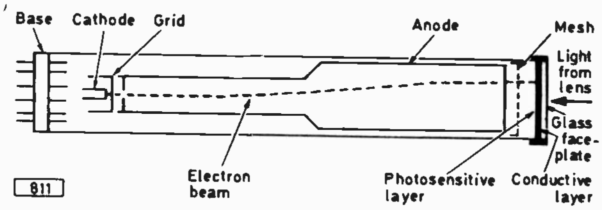


Fig. 4: The vidicon tube.

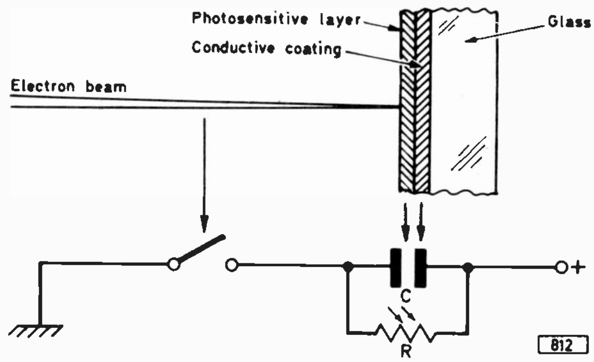


Fig. 5: The vidicon target and its equivalent circuit.

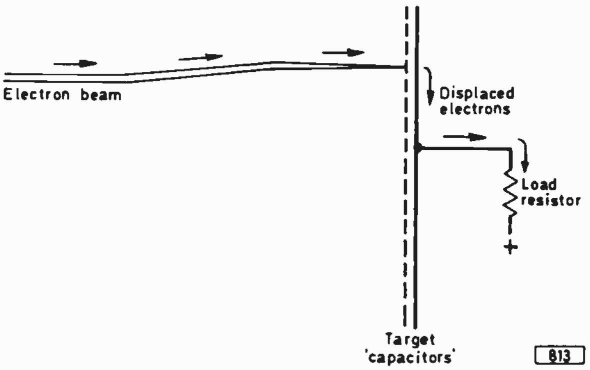


Fig. 6: How the output signal is obtained. When any capacitor charges, electrons gather on one plate (making it negative) while electrons leave the other plate (making it positive). In this case the electrons leaving one plate are forced to pass through the load resistor. As the beam scans the target "capacitors" the voltage across the load resistor varies, providing the video output waveform.

another is unthinkable because of the interconnections required. Thus the whole photodiode surface, switching matrix and counter has to be formed on a single chip. One error in the counter will prevent scanning. Such chips have been announced by various firms, e.g. Bell, Fairchild and RCA, but it seems likely that their price will preclude widespread use of them for some time. Also, those so far announced provide limited resolution.

Silicon Photodiode Advantages

For the time being we can use an intermediate stage: a photodiode array with a conventional scanning system. Why use photodiodes? There are several features of silicon photodiodes that compare very favourably with the behaviour of the camera tube photocathodes used at present. One feature is their chemical stability: they are not easily damaged by heating or by exposure to excess light (remember what happened to the first Moon pictures?) or by long exposure to fixed images. Present day light-sensitive camera tube surfaces *are* easily damaged, and suffer from image "burning" if left exposed to an unchanging scene. Then the response of silicon diodes to light of different colours is fairly uniform over the range seen by the eye. And the efficiency is good: on average every two units of light energy separate an electron from a hole (some other surfaces need 10 or more units of light energy). Another advantage is that there is no visible image persistence with silicon diodes—unlike the "lag" seen when vidicon tubes are used or when image orthicons are operated at too low a temperature.

Vidicon Principle

To scan our silicon photodiode array we can use the basic vidicon principle—hence the "silicon vidicon." This relies on an electron beam which is deflected to scan the photodiode array.

The basic elements of a vidicon camera tube are shown in Fig. 4. The electron beam scans a sheet of photoconductive / sensitive material on to which an image of the scene to be televised is projected by means of a lens. A voltage is applied across the thickness of this photoconductive material (called the target). If we think of the target as being divided into small sections, each will be found to behave (Fig. 5) like a capacitor shunted by a resistor. The capacitance is that always present when a material has a voltage applied across it; the resistance is that of the photoconductive material and changes as the level of the light striking it varies.

With a positive voltage applied to the front of the target but no electron beam scanning, the voltage at both sides of the target will be the same. When the beam scans the target it has the effect of momentarily connecting each portion (on the beam side of the target) to the cathode. Since the cathode is run at earth potential this action *charges* the target capacitance. Between scans the target capacitance discharges back to the voltage at the front through the target resistance. The speed at which this happens depends on the value of the target resistance and this in turn depends on the amount of light falling on that

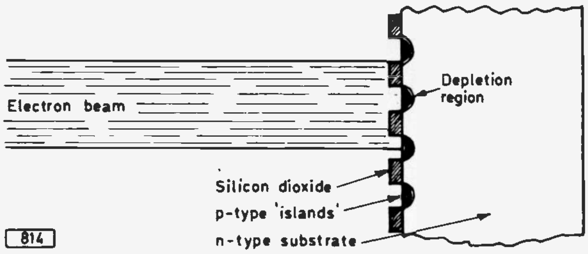
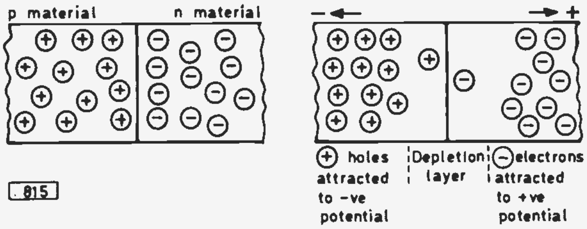


Fig. 7: Cross-sectional view of an early type of silicon photodiode target.



(a) Junction without bias (b) Reverse-biased junction

Fig. 8: Formation of a depletion layer at a pn junction when reverse bias is applied. Note that the positive and negative charges shown are excess charges in the p and n regions.

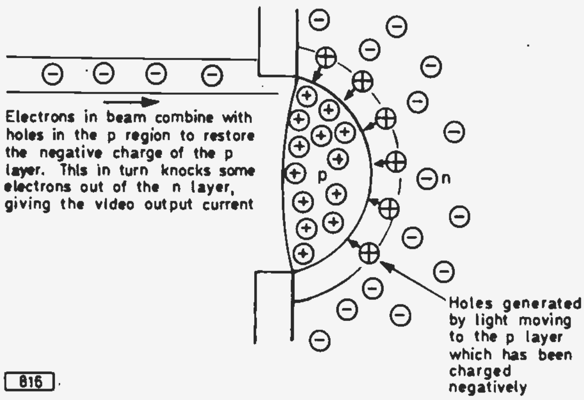


Fig. 9: Action of the beam on the photodiode array.

section of the target. Since the time between each scan is fixed, the voltage (above the cathode voltage) at each target point depends entirely on the amount of light falling on it; the current which the beam has to pass to bring the target back to cathode potential also depends on the light level. The output signal is taken from the target front face and consists of the beam current used to charge the target elements to cathode potential (see Fig. 6).

Bell Picturephone System

Bell's "Picturephone" system combines a telephone with a TV camera and receiver (both miniaturised) so that a caller can see and be seen by the person called. For the camera tube Bell needed something of vidicon size and resolution but free from the main defects of the vidicon, especially its lag at low light levels. Replacing the normal vidicon target material (antimony trisulphide) with an array of silicon photodiodes seemed an excellent way of com-

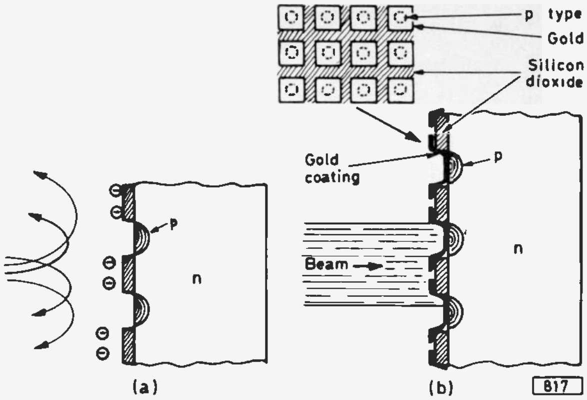


Fig. 10: In a later type of target a gold coating covered the p regions and most of the silicon dioxide.

bining the desirable properties of silicon photodiodes with the easy switching (through the electron beam) of the vidicon. Since a silicon photodiode array can be heated to 400°C without damage, a "vidicon" using such a target can be baked during pumping to ensure a low gas pressure and thus a very much longer tube life than that of a conventional vidicon.

The form of target used in the first tubes of this type is shown in Fig. 7. The individual diode elements are formed on a wafer of n-type silicon 0·05mm. thick, with an 0·1mm. thick edge of 21·5mm. diameter for reinforcement. Within a square target area (sides 12·8mm.) an array of p-type dots is formed with 660 dots along each side giving a total of about 436,000 diodes within the square. The n-type regions between the p-type dots are oxidised to silicon dioxide which being an insulator charges to cathode potential when struck by the electron beam and then stays at that potential.

The diameter of the scanning electron beam is chosen so that the beam when focused covers several diodes: this avoids the need to line up the direction of scanning with the sides of the target area.

In action the n-type layer is run at a voltage of about 10V positive to the vidicon cathode. When the electron beam scans the target it fixes the potential of the p-type areas (and the silicon dioxide layer) at around zero volts with no illumination. Thus each diode is reverse-biased to the extent of about 10V. This reverse bias results in a depletion region at the pn junction (i.e. a region with few free charge carriers) in the usual way (see Fig. 8). Since the depleted pn junctions are surrounded by layers of comparatively good conductor (remember that the charges from the depleted parts have moved into the remaining regions) the pn diodes act as capacitors—the capacitance is around 2,000pF per square cm. Because of this the voltage difference present between the n-layer and the p-islands remains after the scanning beam has passed—provided the leakage through the diodes is low enough.

Diode leakage currents of around 0·1pA (10^{-13}A) have been quoted, giving a storage time of at least one complete frame with negligible change of voltage. Surface leakage from one p island to another is smaller because the voltage difference, if it exists at all, is normally much less and the silicon dioxide layer is a good insulator. The reverse voltage which can be applied depends on the breakdown voltage of the diodes.

When the target is illuminated most of the light energy is absorbed very close to the surface, giving rise to extra free electrons and the creation of holes in this part of the target. Since the basic target material, being n-type, is already rich in electrons it is the behaviour of the holes that is of interest. These will start to move towards the p regions at the rear because of the negative voltage applied to these regions by the beam (negative that is compared to the n-layer). If the n-layer is of sufficiently good quality most of the holes will reach the pn junctions, reducing the charge across each junction. When the next scan occurs (see Fig. 9) the beam current restores the negative charge to the p region with a flow of electrons. The resultant current flow through the external load resistor when this takes place constitutes the tube's output signal.

Different Types of Target

Some difficulties are encountered with the form of diode array so far shown (Fig. 7). The silicon dioxide layer can charge up regularly in an uncontrolled way, thus repelling the electron beam and effectively switching off the tube—see Fig. 10(a). One method of reducing this effect is to cover the p region islands with gold so that the target surface becomes a layer of gold squares with fine dividing lines of silicon dioxide—see Fig. 10(b). This results in the electron beam being used more efficiently since the diodes can be charged for the whole time during which the beam scans the gold instead of during only the shorter time when it passes over the p regions themselves. This leads to a gain in resolution because smaller beam diameters can be used. Making this form of target is difficult however and does not entirely eliminate charging effects.

Another method which has been tried is to cover the *silicon dioxide* layer with a conducting material. The material can be evaporated on to the target in such a way that it lands on the silicon dioxide (see Fig. 11) only where the beam would land and does *not* land on the sloping sides where it would cause diodes to short across one to another. This extra layer has the effect of greatly increasing the capacitance to earth. Thus the response at high frequencies is poor unless this shunt capacitance is compensated either by using peaking coils in the video preamplifier or by connecting the extra layer to earth through a low-pass filter.

The use of this conducting film enables a silicon vidicon to be used in a way that is unique among camera tubes: it can provide gain at the target by a form of triode action.

Imagine two pn junctions, one with 1V on the p dot the other with 5V on the p dot (see Fig. 12)—these voltages have arisen as a result of conduction due to light. When these dots are scanned the beam current landing will be in proportion to the voltages. If we could arrange it however that a much lower proportion of the scanning beam struck the 1V region than the 5V region (the rest of the beam being reflected) we would have greatly increased the contrast between the regions, thus amplifying the signal. This can be achieved by biasing the conducting layer negatively, thereby making it act like the grid of a triode and repelling most of the beam from the least positive regions of the target. Advantage has

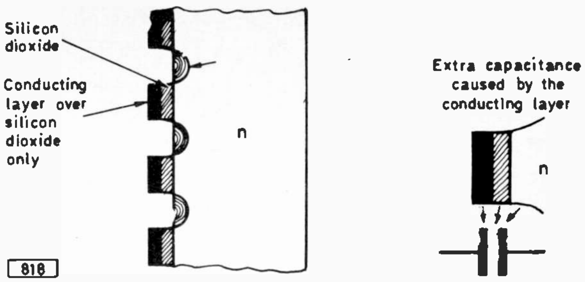


Fig. 11: In this type of target a conducting layer covers the silicon dioxide only.

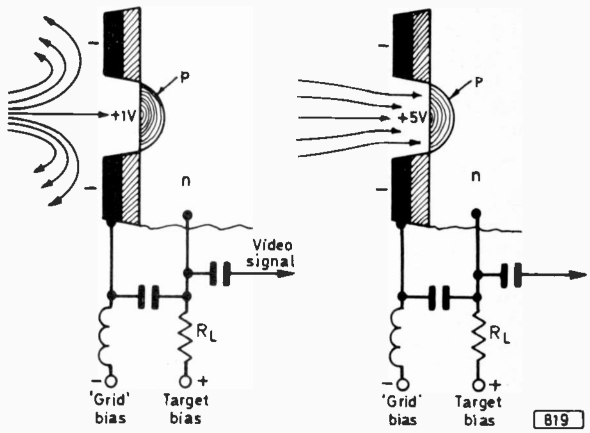
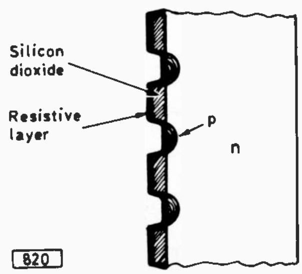


Fig. 12: Using the conducting layer as a "grid", biased negatively. This gives sharp distinction between areas with large or small charges, and consequently amplification is obtained at the target.

not been taken of this type of structure to date because of the difficulty of making a conducting film without shorts to individual diodes.

The target structure that has been most successful so far is shown in Fig. 13. It consists of an array of pn junctions as before, but with a film of high-resistance material deposited over the whole surface. This resistive film prevents excessive charging of the silicon dioxide because of the leakage which takes place along the film. This leakage must not be so high that there is a significant loss of charge by any diode during the frame period however, and the film must be thin enough to ensure that there is a fairly *low* resistance across its thickness otherwise the beam will be unable to charge the diodes adequately. Suitable materials are available but each has disadvantages. Antimony trisulphide for example gives very

Fig. 13: A more successful form of target. In this the whole photodiode array is covered with a high-resistance layer.



good results but as it cannot be baked at high temperatures one great advantage of the silicon diode target is lost. Gallium arsenide has good properties but the films are not consistent. Other materials are being investigated.

Performance

The performance of the silicon vidicon is certainly superior to that of the conventional vidicon. The sensitivity in terms of μA signal for μW of light energy is better and remains constant with illumination level changes. This corresponds to a gamma value of about 1 compared to a standard vidicon gamma of 0·6. (Gamma is a way of stating the relation between light in and signal out. It can be defined as log [signal out/signal in], unity gamma being one way of stating that the silicon vidicon's response is linear.) The response to colours is wider than that of the conventional vidicon and extends much farther into the infra red region.

The resolution obtained depends not only on the number of diodes in the array but also on the resistive film used to cover them. The resolution is adequate for 625-line use.

Diode faults cause defects in the received picture. The way in which these faults affect the picture seems to depend on the resistance of the resistive layer used to cover the target. With a comparatively low-resistance layer a defective diode appears as a white spot. With higher-resistance layers however the white spot starts to spread at high target bias voltages and will eventually blot out the complete picture. It seems that one defective diode in half a million will cause this "white-out" effect if a high-resistance layer is used with a high target voltage.

Unlike the antimony trisulphide vidicon the silicon vidicon is very stable chemically. The target can be baked at 400°C during tube processing without loss of any of its performance and this enables silicon vidicons to be pumped to a lower pressure, and with less absorbed gas present in the structure, than is the case with an antimony trisulphide vidicon. The reward for this lower gas pressure is a longer active life while the chemical stability of the target should mean that the electrical characteristics of the target do not change with time.

A valuable property is the lack of "burn-in" or permanent image due to scanning the same area for a long time. It has been customary with conventional vidicons and image orthicons to overscan the target during warm-up so as to avoid excessive scanning of the same area: in colour cameras this requires some re-registration before transmission so the practice is less common. The only change that occurs in a silicon vidicon seems to be a change in the diode back resistance at certain values of reverse voltage.

The image lag with an antimony trisulphide vidicon is due to the time taken for electrons and holes to recombine, so reducing conductivity. In a silicon vidicon this time is around 10μsec or less so that lag due to this effect is negligible. As with any camera tube some lag can be detected if the beam does not completely discharge the target: with the silicon vidicon this is very much less than the lag experienced with the conventional vidicon.

Finally, though the tube is at least as sensitive as any other vidicon it is not damaged by intense illumination: the Bell Telephone Laboratories report having focused an image of the mid-day sun on to the target of a silicon vidicon tube without damaging it.

The main impact of the silicon vidicon so far has been for low light level surveillance applications where its sensitivity is the great advantage. For the present the Plumbicon (lead-oxide target vidicon) seems to have established itself as the standard tube for modern studio colour TV cameras. Silicon vidicons have been added to the ranges of camera tubes available from several manufacturers. Mullard for example state that their silicon vidicons are direct replacements mechanically for their standard vidicons and require very little modification to the camera circuitry: the electron gun used is the same as in Mullard Plumbicon tubes.

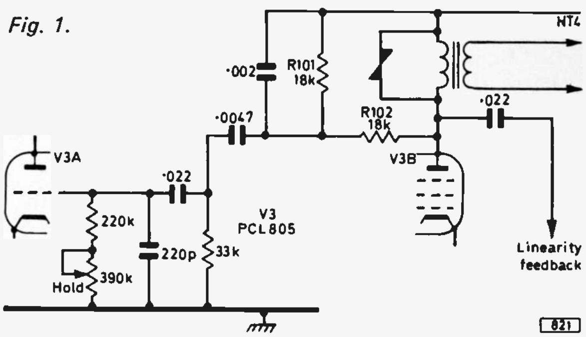
As we saw earlier the basic silicon photodiode array is the key to the next major development in TV cameras, the miniature all solid-state camera. For this purpose the array will be allied with a charge-coupled i.c. arrangement to provide the output signal. We shall be reporting on this later. Meanwhile the silicon vidicon itself is a most interesting collaboration between solid-state and vacuum techniques. ■

LETTER

Awkward Field Fault

I have just spent a considerable while trying to find the cause of a field fault in a receiver fitted with the BRC 1500 chassis. The symptoms were as follows. To start with the field scanning would appear to be correct, but with a jitter. The bottom would then start to fold up rapidly until the scan occupied only a small band across the centre of the screen. By advancing the brightness control the field blanking pulses could be seen above the folded over scan. Alteration of the height control would bring back correct scan for a short while. This looked like a height circuit fault but everything proved to be correct there. Eventually the fault was found to be the result of failure of the timebase to oscillate as R102 (see Fig. 1) in the cross-coupling network

Fig. 1.



between the anode of the pentode section of the PCL805 and the grid of the triode section had increased in value from 18kΩ to 400kΩ. To be on the safe side I replaced both this and R101 using 1W carbon film resistors and that cleared the fault.

It may help your readers to know of this possible condition.—**A. M. Levett** (*Portslade*).

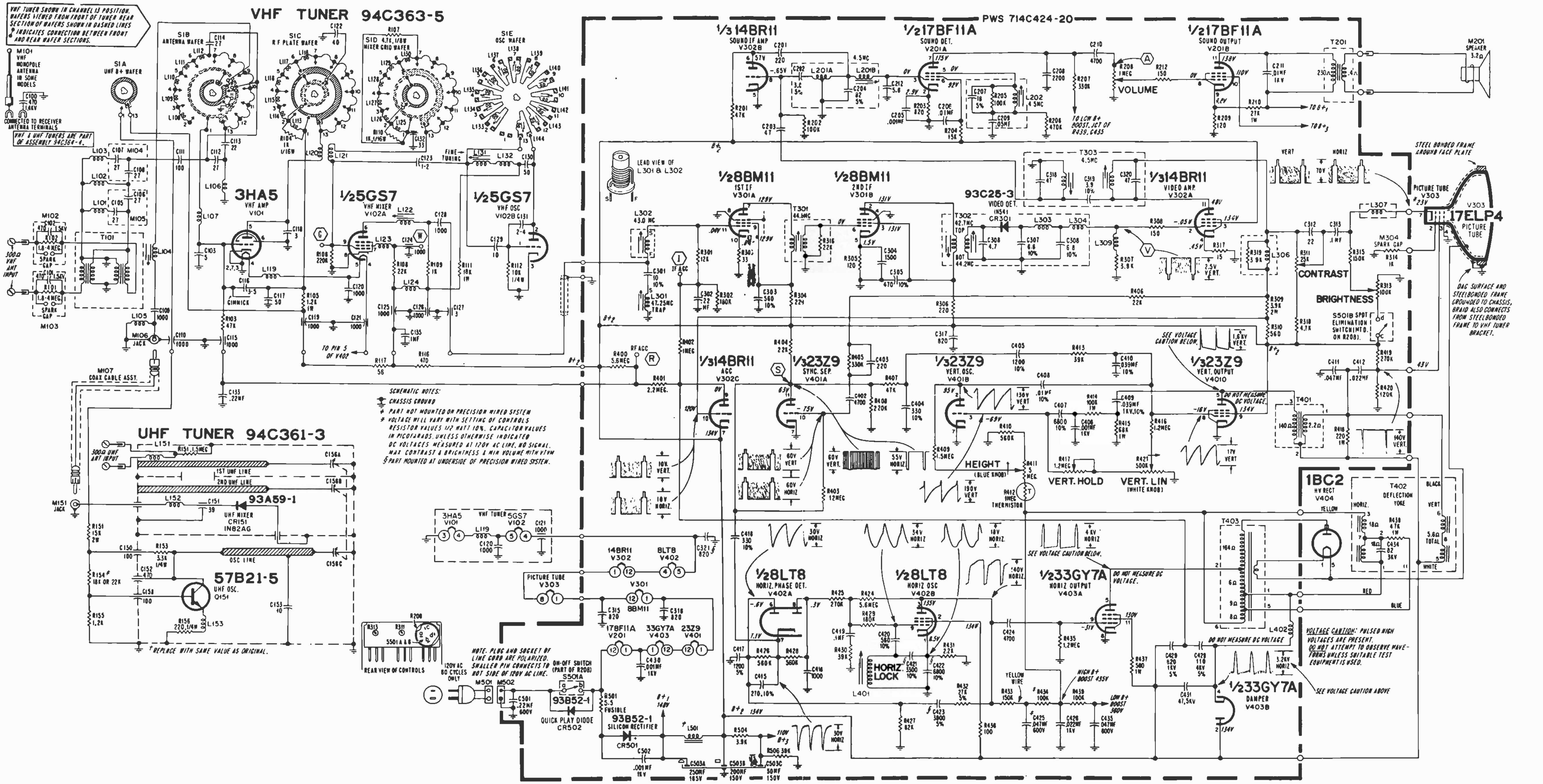


Fig. 1: Circuit of a representative US mains-only portable using compactron valves.

the modifications on the electrical side.

If the tuner unit is found to have a balanced input it is necessary to fit a balun operating in the reverse direction to convert the incoming 75Ω line to 300Ω. Baluns are not too easy to come by but once one has a conversion facility set up a balun removed from one receiver can be reinstated in another. Such "recycling" is of course very efficient!

Since the v.h.f. facility will not be used in the UK there is no need to change the v.h.f. aerial connections. In some cases however it may be convenient to remove them entirely to make room for the u.h.f. input modifications and to avoid confusing the customer.

Mains Supply

Once the aerial arrangements have been sorted out the receiver should be fed with 220V a.c. from an autotransformer or variac and have its operating current measured on the a.c. range of an Avometer. The waveform will not be sinusoidal so the Avo reading will not be accurate: this does not matter however—just note the reading. A series resistor should then be fitted (trial and error being the simplest way) so that when the receiver is fed from 240V the Avo reading is the same as before. Once the correct resistor value has been established a permanent home can be found for the component within the receiver. Remember that it will become very hot (about 20W rating may be needed): it should be positioned well clear of heat-sensitive components therefore.

Intercarrier Sound

Having completed these two operations the receiver should be examined to find the intercarrier i.f. transformers and f.m. discriminator. Switch on and if possible tune to a test card, adjusting for maximum definition. The picture will in all probability be entirely satisfactory. If there is any sound signal at all coming through however it will be accompanied by a loud roaring buzz.

The procedure which works out best is as follows.

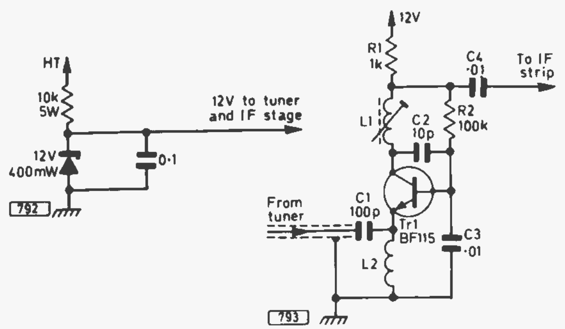


Fig. 2 (left): Obtaining a zener-stablised 12V supply from the h.t. line.

Fig. 3 (right): Simple but successful single transistor i.f. amplifier which can be added to provide extra gain.

First unscrew the cores in the f.m. discriminator can and see whether the sound improves. One core (in the secondary winding) will be found to have a point at which the sound improves and the buzz level drops dramatically. Leave this core in the minimum buzz position and adjust all the other sound i.f. cores for maximum volume. The sound will probably increase in volume as each core is moved outwards from its coil (so increasing the frequency of operation from 5·5MHz to 6·0MHz) until finally there is an abundance of volume. It is now advisable to wait until there is a break in the test card music so that the discriminator cores can be finally adjusted for minimum intercarrier buzz. The tuning of the receiver should be rechecked at this point and if a discriminator balance potentiometer is fitted this should also be adjusted for minimum background buzz.

Once this procedure has been correctly carried out the receiver can be finally reassembled.

UK/US Operation

The foregoing description represents the simplest approach to Continental receiver conversion. Before moving to the next phase I should mention the Sony TV110 UWE portable receiver which is capable of operating either in the USA or on the Continent. The 5·5MHz i.f. strip is right at the top of the receiver, being separate from the main i.f. panel, and can easily be adjusted to UK working. The receiver will then operate in both the UK and the USA but not on the Continent: this arrangement is very convenient for some regular travellers.

Adding a U H F Tuner

One sometimes comes across a 625-line receiver with 5·5MHz sound but no u.h.f. tuner. Such sets are usually of Japanese origin and are built for use in Middle Eastern countries where u.h.f. is not yet employed. When conversion of these receivers is contemplated allowance must be made—in terms of time, effort and cost—for removing the v.h.f. tuner and fitting a u.h.f. one in its place. This is quite an involved job and should not really be undertaken by anyone except an experienced engineer. A suitable type of u.h.f. tuner has to be located (usually of Japanese manufacture) and obtained ostensibly as a replacement for a UK import. Knobs and dials must also be obtained at the same time. Brackets and mountings need to be made up and the final job made presentable from the appearance point of view.

As these receivers are usually valve types the heater line has to be interrupted when the v.h.f. tuner is removed and a resistor fitted in place of the v.h.f. tuner valve heaters. It is advisable to measure the voltage and current required by the v.h.f. tuner valves prior to removing the tuner so that the value of the resistor required can be calculated using Ohm's Law.

Any a.g.c. line to the tuner can be disconnected and disregarded. Since the u.h.f. tuner will have less gain than the original v.h.f. type it will probably be necessary to add a transistor i.f. stage to make up the deficiency. The u.h.f. tuner and extra i.f. stage can be supplied by a zener diode stabiliser as shown in Fig. 2. Various i.f. amplifier circuits have been tried: one of the easiest and most successful is shown in Fig. 3. Here a grounded-base amplifier stage is employed. The r.f. choke L2 can consist of 25 turns of 38 s.w.g. enamelled copper wire wound on to a taped ferrite core. L1 consists of 15 turns of 28 s.w.g. enamelled copper wire. It is important that C3 is a small disc ceramic capacitor with its leads kept as short as possible, otherwise the common inductance in Tr1 base may result in the circuit being unstable.

This particular type of job is very expensive for the customer, and a valved receiver made in Japan is likely to include valves which are unobtainable in the UK. Where do you obtain a 17JZ8 for example? This valve is a triode pentode, performing the same basic functions as our PCL805. I have succeeded in obtaining valves from Japan but there is a delay unless they are flown in and then they are expensive. These points should always be explained to the customer. I mentioned this before but stress it again.

US Sets

We next come to the American TV ("the man in New York said it would work anywhere"), bought cheaply from a chain store and brought home to the UK. Fortunately most people realise that a transformer is needed to reduce the mains voltage to 110V. So they buy such a transformer and then find that they can obtain hardly any results from the set.

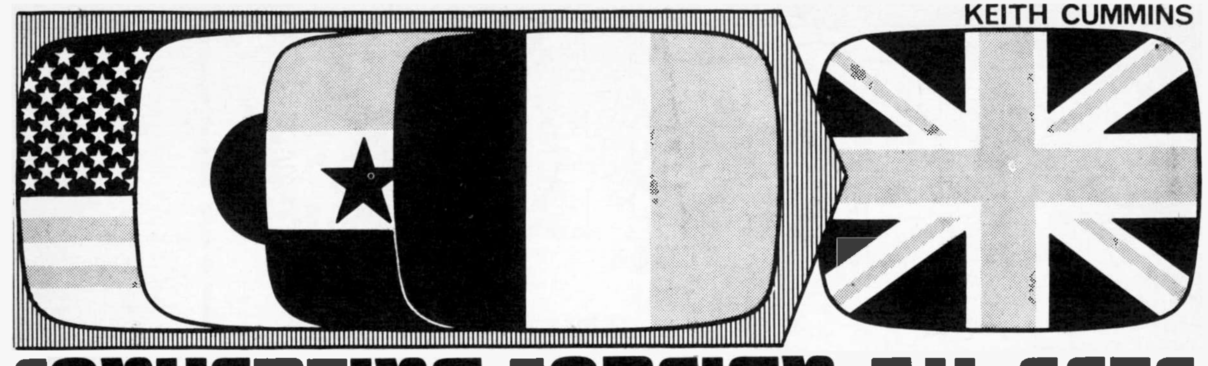
Timebases

Looking at Table 1 again, it will be seen that the US system uses a line frequency which is almost the same as ours, so there are no troubles with the line timebase. The number of fields is higher however—which results in only 525 lines instead of 625. If we slow the field scan down from 60 to 50 per second we can receive a 625-line picture to our standards. There is usually sufficient latitude on the field hold control to enable this change to be made by simple adjustment. If this is not possible increasing the value of the resistor in series with the field hold control will provide the answer.

Tuner

Fortunately it is now mandatory in the US that all receivers are fitted with a u.h.f. facility. As the US

KEITH CUMMINS



CONVERTING FOREIGN TV SETS

EVERY so often a customer will bring us a television receiver which he has purchased abroad. The customer is usually totally unaware of the differences in the TV standards used in different parts of the world. On hearing about this he is often in a state of some anxiety, having purchased the receiver and perhaps paid import duty only to find that he has a television set that will not work in the UK. It is possible as we shall see to modify foreign receivers to operate satisfactorily in the UK, but the cost of doing so varies considerably.

TV Systems in Use

Let us first consider the present broadcasting arrangement in the UK. We have the old v.h.f. 405-line monochrome transmissions and the u.h.f. 625-line colour system operating side by side. As the 405-line system with its a.m. sound carrier is peculiar to this country any conversion to this system must be considered uneconomic and pointless in the long term as the 405-line system is to be phased out during the next decade. Conversions can only sensibly be considered therefore in terms of the 625-line system. The basic parameters of the three major TV systems in use today are shown in Table 1. The features shown describe basic monochrome operation—colour will be considered later.

Continental Sets

It will be seen that the differences between the Continental and UK systems are minimal, the main difference being the intercarrier sound frequency which is set of course by the sound-vision spacing. It is the practice on the Continent to use the lower TV bands for 625-line transmissions (there is no dual-standard working except for the 819-line monochrome transmissions still used in France) and sets are fitted therefore with both v.h.f. and u.h.f. tuners. For UK working the v.h.f. tuner has to be parked in the "U" position and the intercarrier frequency changed to 6MHz. All the other parameters are compatible systemwise. The continental receiver will be fitted with two IEC type 300Ω balanced line aerial input sockets, one for v.h.f. and the other for u.h.f. It will also be designed for 220V 50Hz a.c. mains working.

We can now list the changes which need to be made to the continental receiver so that it will operate in the UK. First we have to change the aerial socket to a suitable coaxial type. Secondly we must accommodate the change in mains voltage from 220V to 240V. Thirdly the intercarrier i.f. stages have to be retuned.

Advising the Customer

Before commencing the operation the customer must be informed that the process is one way, i.e. that the set will be unsuitable for use with the original system once the modifications have been completed. If there is any chance that the set is likely to go back to its country of origin, the customer may simply decide to pack it away for the duration. Another thing that needs to be explained is the difficulty which could be experienced in obtaining spares (e.g. the line output transformer and scanning coils) in the event of breakdown. Only if the customer is prepared to accept the risk should the job be undertaken.

Aerial Connection

The aerial connection at 300Ω may well be found to terminate behind its socket in a small ferrite-cored transformer called a balun. This device converts the 300Ω balanced input to a 75Ω unbalanced coaxial feed for the tuner. If such a device is fitted it can simply be removed and the appropriate coaxial socket fitted in its place—a mains-isolating u.h.f. socket should of course be used. Often the mechanical arrangements are more difficult to engineer than

Table 1: Characteristics of TV Systems

Parameter	*UK*	*Continent*	*USA/Canada/ Japan/ S. America*
Number of lines	625	625	525
Line speed (Hz)	15,625	15,625	15,750
Number of fields per second	50	50	60
Sound System	FM	FM	FM
Sound-vision carrier spacing (MHz)	6	5.5	4.5
Bands used	IV and V	All	All
Overall channel bandwidth (MHz)	8	7 or 8	5

channels are narrower than ours the highest channel number on the tuner is 83 instead of 68. If we modify such a receiver therefore the channel numbers will not tally. Fortunately this is something most people get used to once they know where to find the programmes. The v.h.f. tuner has to be permanently parked at "U" and tuning carried out using the u.h.f. tuner only.

Alignment

The awkward part of the conversion involves changing the intercarrier frequency from 4·5MHz to 6MHz. Such a change cannot be carried out by adjusting the tuning cores alone so it will be necessary to modify the values of the tuning capacitors used in the intercarrier i.f. stages. This involves a bit of trial-and-error working. The simplest approach usually is to remove the capacitors from inside the cans and then solder new, lower value ones across the appropriate points on the printed circuit beneath the cans. Patience is needed here.

When the intercarrier frequency is finally aligned to 6MHz it may be necessary to stagger tune the main i.f. strip, using a test card, to obtain adequate definition and sound level. Certainly it will be necessary to locate and retune the co-channel sound trap (L301 in Fig. 1) at the input of the i.f. strip in order to avoid buzzing on sound and attenuation of the higher video frequencies.

Retuning the whole receiver takes time and since the bandwidth is increased there is an overall loss in sensitivity. As the video amplifier stage is designed for a 4MHz bandwidth it may not be able to do full justice to the incoming signal. It is best left alone however otherwise further loss of gain may be incurred.

Aerial & Power Supply

The aerial (or should I say "antenna"?) input in the USA is 300Ω balanced, so again modification as previously described will be needed in order to terminate a 75Ω coaxial feeder.

As an American receiver is designed to operate on a 110V a.c. mains supply it is best to use a transformer to reduce our mains voltage. Suitable transformers are included in the RS range.

"Instant-on"

Many American portables have a fast warm-up or "instant-on" facility. The circuit of this is shown in Fig. 4. Diode D1 allows every negative half-cycle of the incoming a.c. mains supply to be fed to the heater line when the mains on/off switch is turned off. This keeps the heaters in a state of semi-warm readiness. The h.t. rectifier D2 cannot conduct under these conditions since only negative pulses are applied to its anode. When the mains switch is closed D1 is short-circuited, the heaters rapidly warm to their normal operating temperature and D2 provides h.t. in the usual way.

Representative Circuit

The circuit of a US portable we have recently converted is shown in Fig. 1. It is of particular interest in being representative of a "generation" of

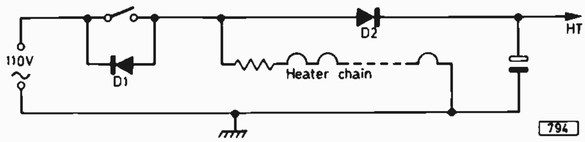


Fig. 4: Fast warm-up or "instant-on" circuit.

television receivers that never appeared in the UK—those employing 12-pin compactron valves. At first sight of the circuit the number of valves used looks normal enough—until one realises that there are only six valves on the main chassis, plus the e.h.t. rectifier and two v.h.f. tuner valves. Both vision i.f. pentodes share the same envelope (8BM11); the video amplifier pentode, gated a.g.c. triode and neutralised triode intercarrier sound amplifier share the same envelope (14BR11); the pentode quadrature sound detector and sound output valve share the same envelope (17BF11A); the sync separator triode shares the same envelope (23Z9) with the triode-pentode field timebase valve; while the line timebase consists of two compactrons, a double-diode-pentode (8LT8) consisting of the flywheel sync discriminator diodes and pentode sinewave line oscillator, and a diode-pentode (33GY7A) combining the line output valve and boost diode. So be warned what might come your way! One other crafty feature: note the way in which the field output pentode bias is derived—from the −69V established at the grid of the triode section of the timebase via the hold and linearity controls and R416 to provide −16V on the control grid of the pentode. That could cause some head scratching in the event of bottom compression!

Colour Sets

We are sometimes asked to consider converting colour receivers. A great deal of complexity is involved in this so SECAM and NTSC receivers are definitely "out". Continental PAL type receivers can be modified using the approach already described: it is necessary to retune the sound traps in both the i.f. and chrominance sections however in order to avoid objectionable sound-chroma beat patterning. As the colour subcarrier frequency is the same the colour circuits themselves need only be adjusted in the normal way.

In the case of an NTSC receiver one would not only have to replace the decoder circuit with a PAL decoder and take care of the attendant interfacing problems but would also have to replace the tuner and i.f. strip because of the narrower US channel bandwidth (with the colour subcarrier at 3·58MHz instead of 4·43MHz). In view of the critical importance of the i.f. response to a colour receiver's performance it would be quite uneconomic to try to make modifications here.

Conclusion

The purpose of this article has been to provide guidance on receiver conversions: really however these have to be played "off the cuff" as each situation arises. Nevertheless if the basic approach is understood, and the differences between the various TV systems fully appreciated, completely satisfactory conversions can be carried out. Unfortunately they will always, inevitably, be expensive. ■

FAULT FINDING GUIDE

9

John Law

BRC 1400 CHASSIS-2

Line Output Stage Faults

Timebase valves in any set are suspect and multiple ones are more prone to faults. Apart from valves a common fault which gives normal reception on 625 lines but line collapse on 405 is failure of C106 (600pF, 2kV working) or C108 (0·3μF, 150V working). In one case leakage in C106 resulted in line tearing and arcing. In another case line failure on 405 lines only was due to C55 in the line oscillator circuit being faulty—this also results in the PL504 overheating of course. The coupling capacitor C117 to the line output valve can produce varying line troubles depending on the extent of the leak. This fault also means an overheated PL504.

Line collapse on 625 only occurs when C107 goes open-circuit.

Another weak spot in the line output stage is the 8kV working capacitor C114. This tends to result in insufficient width. Lack of width has also been traced to changes of value of R140 and R141 in the PL504 grid circuit, the width control R142 track being open-circuit or the resistor R143 in series with it changing value. A low-emission line output valve also gives this symptom of course. An unusual case of low width which could be expanded by pressure on the e.h.t. tray was eventually traced to the wrong tray having been fitted: as mentioned before there are different types of trays which are not interchangeable. Leakage in C113 which feeds pulses to Z4 can damage this v.d.r. resulting in low width after C113 has been replaced. C113 by itself can cause lack of width: it can also when faulty result in damage to the e.h.t. tripler.

Absence of e.h.t. can be due to failure of the boost reservoir capacitor C105. It can also be caused by the smoothing capacitor C104 being defective (make sure it is a 1μF type, rated at 500V, rather than 0·1μF as fitted in some receivers). Failure of the boost supply after an hour's use was traced to the boost reservoir capacitor breaking down: on cooling it resealed and gave a further period of normal operation. Another cause of no e.h.t. is failure of the line output valve screen grid resistor R138: this leaves the oscillator working and the grid drive normal. If the associated decoupler C115 is suffering from loss of capacitance striations will appear on the right-hand side of the raster.

Line Oscillator Troubles

Loss of line hold with a change of note turned out to be a mechanical fault: the screened cable which feeds the grid of the line oscillator—from tags 4 to 5 on the panel—was shorting. No line oscillation has been traced to R69 in the line oscillator grid circuit changing value, the associated timing capacitor C53 being leaky and also to a faulty blocking oscillator transformer (T1). Note the fusible resistor R145: if this opens, the h.t. supply to the line output stage and line oscillator is removed. This resistor is not present in earlier versions of the chassis.

Line hold controls at the ends of their tracks can be due to the d.c. amplifier cathode voltage being incorrect: the cathode is biased by a potential divider and the trouble occurs when the upper resistor R59 changes value. The first suspects in the event of line sync troubles however should be the flywheel sync discriminator diodes W5 and W6, followed by the d.c. amplifier valve V4B.

A leak in C43 which increases as temperature rises can result in poor sync after an hour or so. In some sets it helps to add a 100pF capacitor in parallel with C43.

R59, R60, R62 and R69 can all change value intermittently to produce line drift.

Wavy Verticals

Hum on the line, i.e. wavy verticals, can be caused by loss of capacitance in the main smoothing block: it is better to replace the complete can rather than add external capacitors. This symptom is also caused by the same fault in C52 which decouples the h.t. supply to the line oscillator and d.c. amplifier.

The associated smoothing resistor R66 can increase in value: its appearance is a good guide to its condition as it generally discolours considerably as its value alters. It is located at the bottom left corner of the panel and the fault symptoms it produces include line waver and slip. When C52 dries up the general line instability is aggravated. The original resistor is a ½W type: replacing it with a 1W type will avoid the fault developing at a later date.

Fuzzy Picture

A fuzzy picture with no control of focus was caused by a break in the lead to pin 4, the focus

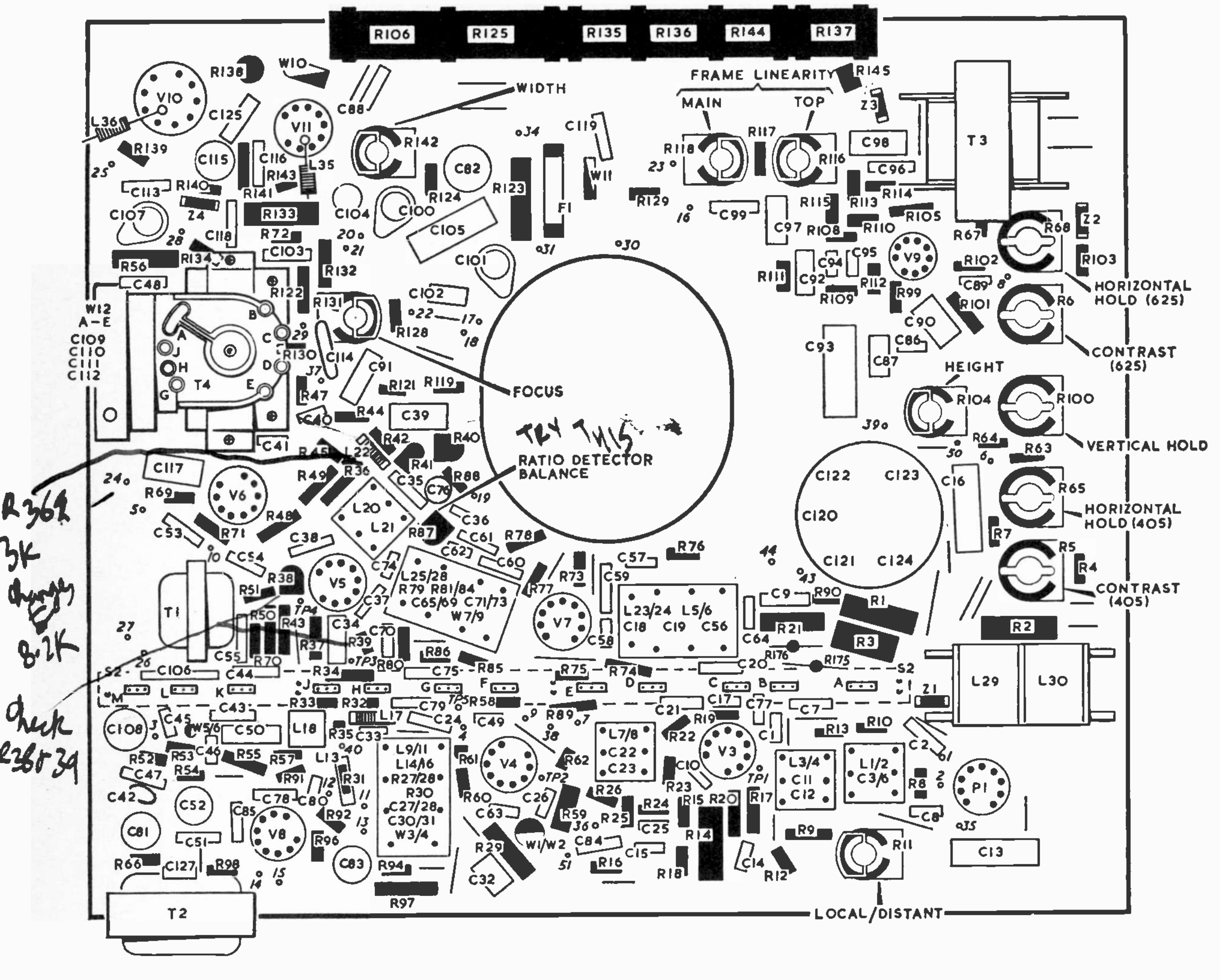


Fig. 2: Component layout, main chassis assembly.

electrode connection on the c.r.t. base. This lead comes through a sleeve with other wires and had fractured at the terminal. It was not immediately obvious and is another example of the need to make a close physical inspection before dashing for the Avo.

Unusual Fault

An invisible break in the printed panel gave the unusual symptom of no raster for a quarter of an hour followed by normal operation for the rest of the evening. The line output valve voltages were normal but there was no boost diode anode voltage until the set started operating of its own accord. The fault cleared after solder was liberally run over the PY801/U193 base connections and surrounding print.

Field Timebase

Replacing the PCL85 valve will cure many field troubles such as jitter, roll, poor interlace, field shrinkage at the top or bottom or loss of height. If a new valve does not clear the trouble further investigation is required.

The PCL85 triode anode is fed from the boost rail. No voltage at the anode but over 200V on R103 suggests a break in the height control R104 track. The field will also collapse if the smoothing capacitor C104 in this line is short-circuit (replace with a 1μF capacitor as previously mentioned)—C104 can short intermittently.

A thin white horizontal line as a result of failure to oscillate can also be caused by any of the following capacitors being defective: C87 the triode grid time-constant capacitor, C90 the field charging capacitor, or the cross-coupling capacitors C92 and C93. Check the field hold control R100 as well in case its track is open-circuit.

Normal voltage at the screen grid of the PCL85 pentode section but no voltage at its anode suggests a break in the output transformer T3 primary winding. No voltage at either electrode should draw attention to R135, the smoothing resistor for the HT3 line to the field timebase.

Loss of height over a period beyond the range of the height control is usually caused by R103 increasing in value. If it turns out to be in order check by substitution the miniature thermistor X1 in series with the field scan coils.

A heater-cathode leak in the PCL85 will tend to cancel the bias from the heater chain to the grid of the pentode section via R105. This results in bottom fold up. Leakage in the coupling capacitor C93 between the triode and pentode sections of the valve gives similar symptoms.

Field linearity faults can be caused by a break in the track of either of the linearity presets R116 or R118. If C97 is faulty the linearity will be affected according to the degree of leakage. C94 and C95 can go short-circuit to produce field cramping—this may also be experienced if R135 is 1·5kΩ instead of 1·7kΩ.

Sync Faults

Sync faults in this chassis seem to have greater effect on the field synchronisation than on the line synchronisation and to be worse on 625 lines than 405. Where the sync performance is poor check the bias stabilising resistor R38 in the video amplifier circuit: when this changes value the sync becomes very critical. Any slight leakage in C34, the coupler to the video amplifier, or C40, the coupler to the sync separator, will affect the shape of the sync pulse: when in doubt change both. The field hold adjustment becomes very critical if the sync separator screen grid voltage is incorrect. The upper resistor R45 of the potential divider feeding this electrode should be checked therefore, also the associated decoupler C41.

Tuner Troubles

The v.h.f. tuner does not give much trouble apart from valve faults and dirty switch contacts. An occasional internal fault in a valve will burn up a resistor which can usually be replaced—take care over this. The u.h.f. tuner is trouble free apart from the occasional faulty transistor which can be successfully replaced providing care is taken to copy the transistor position and the exact length of its leads.

Sound Faults

If there is normal vision but no sound the 30PL1 valve or its supplies are suspect. Sound distortion can be caused by heater-cathode leakage in this valve or leakage in the coupling capacitor C80 between its triode and pentode sections. No sound can also be the result of the sound i.f. amplifier valve V7 screen grid resistor R77 being open-circuit. If this resistor is burnt check the associated decoupling capacitor C60. An open-circuit audio output transformer or even loudspeaker coil can result in no sound.

Buzz on Sound

Buzz on sound on 625 lines is a problem which can be largely overcome by altering the value of the video amplifier screen feed resistor from 3kΩ to 8·2kΩ. Careful adjustment of L27 and R87 also helps. Pick up from the scan coils in the assembly L27/L28 also causes buzz in which case a metal shield is available for fitting over the can. This should be positioned for optimum effect—it will usually project $\frac{1}{4}$-$\frac{1}{2}$in. beyond the top of L25/L28 can. A plate which supplements this is also available: it is supplied with washers and a screw which screws into L26 (don't overtighten and inadvertently turn the coil former).

Further improvement can be obtained by ensuring that as in later production sets resistor R35 which applies reverse bias to the 405-line vision detector diode W4 on 625 lines is connected to a potential divider consisting of 180kΩ (R176) and 22kΩ (R175) between the junction of R3/R6 and chassis instead of directly to the junction of R3/Z1; also that R74 and R75 are both 10kΩ (this improves the limiting action of V7).

Modifications

A number of modifications introduced on later production chassis are worth noting (all are incorporated in our circuit diagram, Fig. 1 last month).

To reduce sound-on-vision R97 was increased in value to 1kΩ (2W).

The rating of C89 in the field timebase was increased to 400V to improve reliability.

To increase rectifier protection C88 and C119 were changed to 0·01μF 2·5kV pulse types.

To improve the a.g.c. action C13 was changed to 0·33μF, C40 to 0·015μF, R4 to 5·6MΩ, R7 to 3·9MΩ, R43 to 1MΩ and R46 (from V6A grid—pin 8—to chassis) was deleted.

In the line timebase the line output pentode screen grid decoupler C115 was changed to 0·1μF 400V to increase reliability. R70 was reduced to 33kΩ to cure line scan crushing. R71 was changed to 15kΩ $\frac{1}{2}$W to centralise the line hold control and in some receivers R141 is 1·8MΩ to centralise the width control setting. To reduce dissipation in the width control circuit the control itself (R142) was changed in value to 2·2MΩ and its series feed resistor R143 to 680kΩ.

To reduce asynchronous hum C52 was increased in value to 12μF, the d.c. feed to the line hold controls was taken from the junction R66/C52 instead of R66/C123 and all earthing straps to the u.h.f. tuner were removed.

Black Hum Bar

Finally, a black hum bar covering roughly half the screen can be present when C13 which decouples the a.g.c. feed to the v.h.f. tuner is open-circuit.

SHORT COURSES ON MICROELECTRONICS

Middlesex Polytechnic at Enfield provides short courses on microelectronics at their Microelectronics Centre which was opened in 1969. Aspects of microelectronics technology covered include monolithic, both m.o.s. and bipolar, thick-film and hybrid circuits. The emphasis is on practical experience—there are opportunities to learn about microelectronics technology by first hand processing of integrated circuit and hybrid devices. Enquiries should be addressed to Mrs. D. P. Linnell, Middlesex Polytechnic, Queensway, Enfield.

MILLER'S Miscellany

Chas. E. MILLER

AT the time of writing I have just returned from a camping holiday in Norfolk which was marred only by the vocal efforts of a misbegotten and malevolent cockerel whose pen was on one side of the camp site. It insisted on waking us at four-thirty a.m. with an obviously well-rehearsed virtuoso performance. Dear reader, have you ever tried by dawn's early light to anaesthetize a cockerel with Servisol? (Come to that, have you ever tried to spell anaesthetize?).

Ah! Nostalgia

It can hardly have escaped anyone's notice that nostalgia, in its accepted if not dictionary meaning, is the thing of the moment. Vintage films, long the province of television, are now playing to packed audiences in cinemas. There are radio and TV shows that recall famous names of the past. And fashion is busily resurrecting such thirties' styles as Oxford Bags. In *Practical Wireless* there is a fascinating series which looks at bygone radio sets. As far as I can see, however, no one ever seems to look back at television sets of the past. It cannot surely be because the subject is too recent: television in one form or another has been around since the late twenties.

Maybe the reason is that the early sets were so loathsome that they are more likely to induce neuralgia than nostalgia! Nevertheless, having realised with shock that no TV engineer under the age of thirty will have been working before the days of 13-channel slimline sets I propose to bring back from the shadows some of those models with which we used to wrestle back in the late forties and early fifties. One snag is that although most of the pioneer TV set manufacturers have long ceased production their brand names live on under the aegis of the large combines; and since any account of their wares is almost certain to be offensive if not actually libellous, it will be essential to use aliases. Therefore our subject for this month will be called by the name Buggins, though I suspect that few old hands will fail to identify it!

The earliest Buggins sets that I had to repair were of the two chassis, console cabinet type. Apart from the r.f. (50kHz) e.h.t. generator the design feature which sticks in my mind was the transformerless frame (field) output stage. The output valve was coupled to the scan coils by a 4·7kΩ high-wattage resistor and a 40μF electrolytic capacitor. The resistors would frequently burn out, and as the correct replacements were hard to come by at the time many were the improvisations!

Desperate on one occasion to get a set out for the weekend I hit on the idea of using an electric light bulb as a load resistor. I calculated that a 15W type should be all right and was delighted to find that it produced a splendid, linear frame scan. The lad who worked for me mounted it in a b.c. lampholder on the chassis, the only difficulty then being that the current through it made the bulb light up to nearly full brightness! We solved that problem by coating it with black paint, and the set went back to the owner.

Inevitably next week we had a call back.

"That set you repaired", the customer complained, "there's an awful smell of burning paint coming from it and a funny light on the wall behind".

When I called at the house I discovered that prior to fitting the back the lad had scratched a Certain Word into the paint on the bulb. In the Stygian darkness associated with TV viewing in those days the holes in the back acted as pinhole lenses. The inscription was thus projected on to the wallpaper. Thankfully it was in reverse, thus preserving the customer's sensibilities. I seem to remember getting round that one with the aid of a perforated cocoa tin!

The long awaited successor to this set was the Buggins Super 12-in. For this the R and D boys had pulled out all the stops. The chassis was wedge-shaped to fit the contours of the tube, tapering from about eight inches height at the rear to one inch at the front, a design which hit a new low for accessibility.

Despite the fact that complements of valves for either parallel (6·3V) or series (300mA) operation were available Buggins opted for a series-parallel system never seen before or since. The i.f. chassis used 6·3V valves throughout, but the sound and field output valves were 45V 0·1A types. The field oscillator, a thyratron, and the line output valve had 6·3V heaters, the sound intereference limiter a 4·0V heater and the c.r.t. a 2·0V heater. The two large rectifier valves had 52V 0·3A heaters.

Naturally to supply all these a mains transformer of staggering complexity was required. But the pièce-de-résistance was the power supply section. Buggins wished to run the line output valve with 365V on its anode, and one might well imagine that in the absence of a high boost line (it was actually 30V above h.t.) it would have been a simple matter to arrange for an h.t. overwinding on the mains transformer. But no: they used a voltage-doubling circuit to get nearly 450V direct from the a.c. mains input. This was far more than was required so they used a massive 900Ω resistor to drop it down again! The sinister byproduct of this was that the chassis was permanently live. One way round on the plug it would be the normal 240V a.c. to earth; but should you reverse the input in the usual manner the chassis would then be 450V d.c. above earth. And thereby hangs a tale.

From 1956 we were fitting Band III converters to the old BBC only sets as fast as they could be obtained. So great was the demand that I had part-time help in to speed up the work. One day I left Frank, an experienced and able engineer, wiring a 13-channel tuner into a Buggins 12-in. whilst I intended going on a service call. Before I could open the van door I heard an agonised shout and a crash from within the workshop. I dashed back to find Frank lying flat on his back on the floor with the television set on his chest. He was suffering from severe shock

—continued on page 178

LONG-DISTANCE TELEVISION

ROGER BUNNEY

NOVEMBER is usually a very active month for Meteor Shower (MS) reception. Not so this year however. Both the Taurids and Leonids showers appeared to be very inactive—indeed the "peak activity" days produced less activity than a normal day! The highlights of the month were provided by tropospheric reception, particularly on the 9th, 18th and 21/22nd. Hugh Cocks (Mayfield, Sussex) received both ORF (Austria) Pfänder transmitters on chs. E5/E24 on the 9th. Since no other transmitters along the reception path were being received at the time this would indicate a tropospheric duct and indeed a check on the prevailing high-pressure systems on this day indicates an isobar pattern in this direction. The 18th was another classic for tropospheric propagation. A cold front tracked slowly southwards over the UK, arriving at the south coast around 1500-2000. From around 1500 this front (which ran East West) produced enhanced reception along the axis of the front. The Lille-2 signal on ch. E21 lifted considerably above its usual level here and in due course there was severe co-channel interference with CLT-Luxembourg. Conditions were such that Band III and u.h.f. signals from West Germany were received in the Hampshire area. They reached a peak at approximately 1800 and then slowly declined with the passage of the cold front away across the Channel. The weather map provided by the Meterological Office clearly shows this cold front at its 0600 position on November 19th (see Fig. 1).

Conditions lifted again a few days later with a minor tropospheric opening. Indicative of the improvement was a communication from Bob Leggett (Leighton Buzzard) who whilst at Stewkley, Bucks received strong signals from NOS (Holland) and BRT/RTB (Belgium) in colour on an indoor Antiference log-periodic aerial plus preampifier! Sweden on Band III was also received during the 22nd.

A number of minor SpE (Sporadic E) openings have also been reported during the month and I feel that this could be an indication that the December period may give us a lift in such activity: a lift can often occur during a period of improved SpE such as we are going through now. Even during the dark days of November, 1973 I feel it can be predicted that the 1974 season will be an improvement on that of 1973.

My log for the November period is as follows:

1/11/74 DFF (East Germany) ch. E4; CST (Czechoslovakia) R1—both MS.
2/11/74 SR (Sweden) E2; NRK (Norway) E4; ORF (Austria) E2a; CST R1—all MS.
3/11/74 DR (Denmark) E4; WG (West Germany) E2, 4—all MS; TVE (Spain) E2—SpE.
4/11/74 SR E2; WG E2—both MS.
5/11/74 DR E4; SR E4—both MS.
6/11/74 DR E4—MS.
7/11/74 DR E3; SR E3; ORF E2a—all MS.
8/11/74 TVP (Poland) R1; ORF E2a—both MS.
10/11/74 TVP R1—MS.
12/11/74 DR E4; DFF E4—both MS.
15/11/74 CST R1—MS.
16/11/74 SR E2; NRK E2—both MS.
17/11/74 DFF E4; SR E2; NRK E2; ORF E2a; CST R1; TVP R1—all MS.
18/11/74 Good trop. opening this day—see above—various NOS (Holland), BRT (Belgium), ORTF (France) and WG (West Germany) stations at v.h.f./u.h.f., also the great rarity CLT (Luxembourg) ch. E7!
19/11/74 SR E4—MS.
20/11/74 DR E3,4; SR E2—all MS.
21/11/74 DR E3; CST R1; TVP R1; SR E2—all MS; also improved trops—u.h.f.
22/11/74 Improved trops, mainly ORTF u.h.f.
23/11/74 CST R1; ORF E2a—both MS.
25/11/74 SR E2—MS.
27/11/74 DR E4; SR E2,E4—all MS.
28/11/74 DR E3; SR E2,4—all MS.
29/11/74 SR E2; NRK E2; ORF E2a; TVP R1—all MS.

I have discontinued logging NOS E4, ORTF E22 (Paris), BRT E25 and E28 since these are now received virtually daily.

Keith Hamer (Derby) posed an interesting reception query recently. At 0100 one morning he noted colour

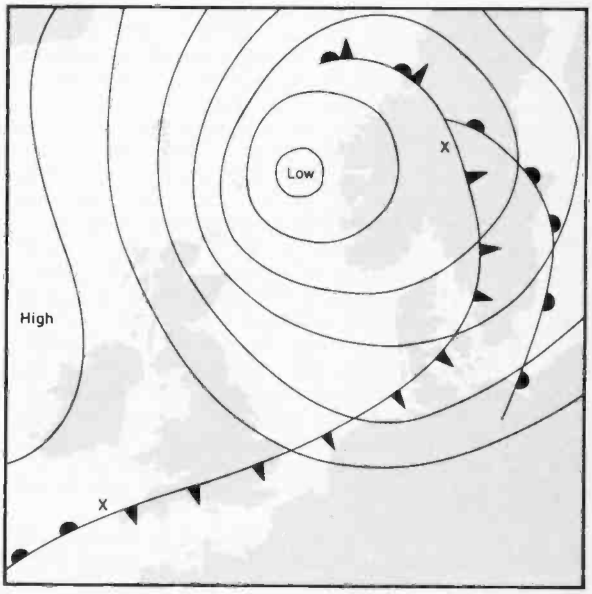


Fig. 1: Weather situation at 0600 on November 19th. X-X indicates the cold front. A large temperature inversion or decrease in humidity with height—or both—extending through an atmospheric layer near the earth's surface gives rise to enhanced long-distance signal propagation. The map above is based on the official Meteorological Office one and is reproduced by permission of the Controller of Her Majesty's Stationery Office.

bars on chs.E23/E39 with the identification "KRS 3." The signal was described as strong from an easterly direction. It has been identified as a line test/ident signal from King's Reach, London Weekend Television. Normally the signal passes over GPO lines between programme originating sources, studio centres and transmitters and is not transmitted! It seems however that this one was transmitted and despite the early hour was received by a vigilant DX enthusiast.

EBU Listings

France

Marseille-Grande Etoile.	ORTF-3 ch. E26 1000kW.
Metz-Luttange.	ORTF-3 ch. E31 1000kW.
Avignon-Mt. Ventuox.	ORTF-3 ch. E39 300kW.
Amiens St. Just.	ORTF-3 ch. E44 500kW.

Sweden

Oeverkalix.	TV2 ch. E45 1000kW.

(NE of Boden near the Finnish border).
The polarisation in each case is horizontal.

News

Hungary: Good news. MT has been noted using the PM5544 card recently but with an identification—"MT" in the upper black rectangle and "B'pest" in the lower black rectangle (thanks Hugh Cocks).

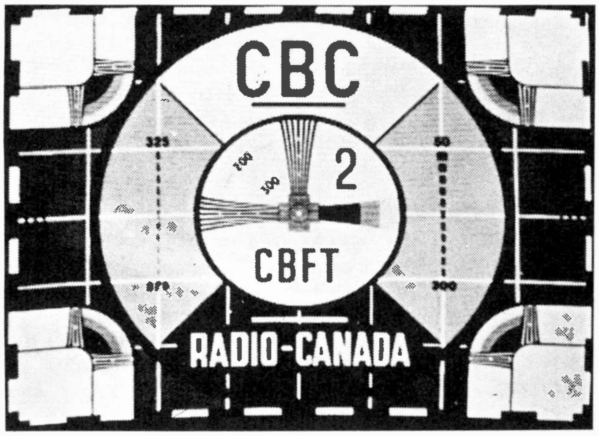
Switzerland: The three Band I transmitters—Bantiger, Utilieberg and La Dôle on chs.E2, 3, 4 respectively—are to have new transmitters installed! These have been ordered from a UK manufacturer and will operate in "main reserve configuration with automatic change-over facilities." The transmitters—two 10kW pairs for each site—will be installed during 1974.

Yugoslavia: We mentioned recently that a new transmitter was operating from Mt. Pellister in Macedonia, Yugoslavia. This is a Band I unit and operates on ch. E4. The transmitter is a 5kW type but the e.r.p. isn't yet known. It is expected to be around 40-50kW e.r.p. Consequently this must be well received during good Sporadic E conditions. As it only came into operation in late August it may not have been (knowingly) received at long distance.

Jordan: In addition to the expansion of PAL colour in this country's television system new transmitters are being planned. A south-bound radio link is being constructed to Aqaba. This will serve three transmitters. To the North of Amman a 10kW e.r.p. transmitter is being constructed at Irbid (channel not known) and will provide dual-language programmes. Negotiations are also in hand with Iraq and Syria concerning programme exchange.

Holland: As from January 1st, 1974 the PM5544 card will be used by NOS. This will carry the identification "Nederland 1" (or "2") in the lower black rectangle. On weekdays it will be radiated between 0915-20 minutes before programme. Between 0900-0915 transmitter news will be radiated and from 20 minutes to zero programme start the PM5544 will be interspersed with the PM5522 colour blockboard (times local/CET). In passing, Dieter Scheiba notes that NOS have been seen to use the 12 vertical stripes (as used extensively by TVE) at times.

Belgium: With the introduction of BRT-1 and BRT-2 services the following information has come to hand: BRT-1 radiates from: Aalter E2; Antwerp E2; Wavre E10; Brussels E11; Genk E44; Oostvleteren E49.



Canadian Broadcasting Corporation (CBC) CBFT Montreal (French network) test card. Courtesy CBC.

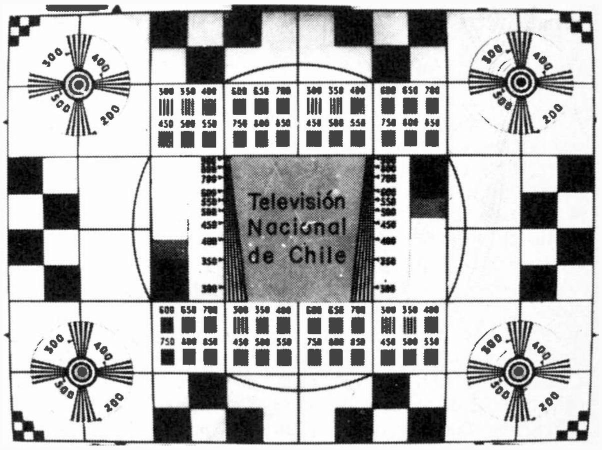
BRT-2 radiates from: Wavre E25; Egem E43; Brussels E48; Schoten E62.

BRT-1 is still in monochrome. The PM5544 test cards have for the most part remained the same as before although occasionally alternative patterns have been noted with "TV1" or "TV2" on. The RTB (French) service isn't likely to start a second network before 1975.

West Germany: WDR-1 has now largely dropped the Telefunken T05 test card and uses the FUBK electronic type instead. This may present identification problems.

Pirate TV

Attempts have been made from time to time to transmit TV programmes from international waters (and indeed international air space!). The following news has just come in from the Europese Testbeeld-jagers. A Belgian millionaire involved with Radio Atlantis is reported to be about to start a television service from the North Sea. This will be a commercial venture—a sales company at Zwijndrecht, Holland is trying to sell air time for the pirate. It is rumoured that the transmissions are to start in approximately mid-December from an old Japanese war vessel. A



Television Nacional De Chile, Santiago, test card. Note the similarity to the French (ORTF) test card. Courtesy Keith Hamer.

radio station is also to be carried aboard this ship which cost one million Dutch Guilders. The information is rather vague at this stage and one cannot be sure whether anything will come to fruition. Should the situation develop further and detailed information come to hand it will be pased on at once!

Signal Logging

Since October 1st, I have been using a new system of signal logging. This has been done to simplify the log and save space while at the same time providing a more objective appraisal of the signals received. The system adopted is a variation of the VAFI one (as used by the WTFDA) but with some additions. An example:

28/11/73—Dull
0715 M355 M E3 Denmark 5544 tc

The first line is obvious—date and local weather. The second line gives the local time, signal duration, vision strength, fading, interference, propagation mode, channel, country of origin and signal content (in this case the PM5544 test card). With repeated signals the letter R would appear after "M355." The codes for each section are as follows:

Vision	*Fading*	*Interference*
0 No signal	0 Auroral flutter	0 Loss of signal
1 Just detectable	1 Deep to fast	1 Extreme
2 Heavy snow	2 Slow fade	2 Heavy
3 Moderate snow	3 Moderate fade	3 Moderate
4 Light snow	4 Light	4 Light
5 Snow free	5 None	5 None

Propogation Modes	*Signal Duration*
A Auroral	S Short/Burst/Ping
E Sporadic E	M Medium (at least 5 seconds)
F F2 Layer	
TE Trans-equatorial	L Long (at least 15 seconds)
T Tropospheric	
M Meteor Shower/Scatter	R Repeated short bursts

Another example:

17/11/73—Clear skies
0809 M255R ME2 Sweden tc
0819 M355R ME2 Norway Fubk tc

I have discontinued the practice of noting local air pressure and temperature since apart from tropospheric signals these have no relevance.

From Our Correspondents . . .

A long letter from Clive Athowe (Norwich) describes reception over the October period in his area. It is a most inspiring log, showing that most types of signal have arrived in East Anglia (where most signals seem to go!). Apart from tropospheric and MS signals, SpE seems to have been very active during the 17th (with Arabic music)—22nd period including Albania. A photograph was included of the Albanian clock. This has the numerals 12, 3, 6 and 9, there being just markings for the other hours. These are white (with white hands, including the seconds hand) on a black/dark background. Other points of interest are: an identification for SWF-3 Marienberg ch. E44—"S3 STGT3"; and the DFF second chain has been noted with the test pattern carrying the identification "DDR-F 2".

To conclude this month we give further details from the letter received from D. Minns, Bahrain, Arabian Gulf (see also last month).

Damman, Saudi Arabia ch. E8 has a very strong signal into Bahrain with mainly Arabic programmes but also at times English programmes with Arabic subtitles or Arabic dubbed sound. The test card used is the "Indian Head" but with the Indian Head deleted and crossed swords with a palm tree above inserted. At times a form of grey scale is radiated but with frequency-response gratings.

A regular long-distance service is received from Kuwait on chs. E9/E11: the virtually permanent temperature inversion layer over the Gulf provides an almost consistent signal. Reception tends to vary according to temperature and humidity however, fading rather during the cooler winter months. The Indian Head card is again used. English programmes are often radiated with dubbed Arabic sound.

Doha (Qatar) ch. E9 and Abu Dhabi chs. E5/6 are regularly received with some fading after dark. The latter uses a version of the PM5540 test card. Of some importance is the existence of a ch. E2 Iranian transmitter received regularly during the mornings—this has also been received in Malta. Dubai transmits in monochrome at the l.f. end of Band III (colour expected soon).

The receivers used are mostly Japanese, basically for the 525-line, 4.5MHz system M but with convertors for 5.5MHz system B sound.

That concludes the very interesting letter from D. Minns: we hope his excellent reception will continue. We are always pleased to hear from enthusiasts in distant countries about reception conditions in their areas.

MILLER'S MISCELLANY

—continued from page 175

in both senses of the word. It transpired that having completed wiring in the tuner he'd switched the set on and in a moment of temporary aberration had taken hold of the aerial lead in one hand and the set's chassis with the other, thereby receiving the 450V d.c. straight across his body. Unable to let go with either hand he'd luckily fallen away from the bench, dragging the set with him. I say luckily because this pulled the mains lead out. The miracle was that the c.r.t. hadn't gone off in his face when the set crashed on to him. What was that about nostalgia?

Now, Voyeur!

In lighter vein, a friend told me recently of a discovery he made when on a service call to a set fitted with the Thorn 850 chassis. Crouching behind the set he removed the (v.h.f.) tuner and found that the hole in the cabinet afforded a splendid view of the mini-skirted owner's anatomy. It would appear that ever since on each call to the set whether for low width, lack of sync or whatever removal and cleaning of the tuner has been necessary . . .

We had one, but the wheel came off!

I read that a manufacturer now offers a device "designed to interface with t.t.l. or I.B.M. level buses, enabling high speed mainframes to feed the slower t.t.l. peripheral equipment". It's called a dual bus driver. Does the Transport and General Workers' Union know about this? Seems to me, what with semiconductors and bus drivers, we could be heading for a demarcation dispute . . .

THE 'TELEVISION' COLOUR RECEIVER FORUM

THE purpose of this feature is to co-ordinate the experiences reported to us by readers who have successfully completed the colour receiver project started in our April 1972 issue and to pass on all information likely to be of help to others. Reports to date indicate that we have already covered in this feature (see the November, December and January issues) all the recurrent problems encountered. We would nevertheless like to continue to hear from constructors of their experiences with the set. Any hints that might save others' time are particularly welcome. Contributions published in this feature will be paid for at our normal rates: contributors' addresses will not be divulged. We regret that it is not possible for us to answer telephone enquiries regarding this feature or the set itself. The Fault Finding Advisory Service will continue—application forms were provided in the August, September and October 1973 issues.

Dear Sir,

TUNER CONTROL UNITS

Some of the push-button tuner control units supplied contain a fixed resistor in series with the earth connection 8D. This is worth noting since the resistor restricts the tuning range—channels 25 down may not be obtained. If this situation is experienced there is a simple solution—reverse the connections to 8C and 8D.

W. C. Clark.

Dear Sir,

VOLUME CONTROL

The range of adjustment provided by the volume control when this is incorporated in the audio feedback circuit is rather limited. Placing the volume control at the input to the audio module increases the range considerably. This can be done as follows. Connect a fixed 3kΩ resistor (value suggested by the i.c. manufacturer, General Electric, New York, USA) in the circuit position originally used for the volume control (across 9C and 9J). Feed the audio module input (9B) from the slider of a log. potentiometer connected between the i.f. strip audio output (2C) and chassis (9J). The original potentiometer works all right in this position but the value is not important—anything from about 25kΩ to 250kΩ will do.

R. Windhurst.

Dear Sir,

GREY-SCALE ADJUSTMENTS

I am not too enthusiastic about the method you suggested last month for setting up the c.r.t. background (first anode) controls: setting them all to maxiumum even briefly results in rather a hefty beam current. Whilst working with the set I have evolved the following grey-scale tracking procedure which has proved entirely satisfactory.

Turn the contrast control to maximum, the brightness control half way and the colour (saturation) control to minimum (no colour). Switch off the blue and green guns and adjust the red background control R437 until a picture is just visible. Repeat this procedure with the other guns (R435 and R436). Then switch all three guns on, turn up the brightness and tweak the background controls if necessary for correct reproduction of dark grey. Finally adjust the drive controls R401-3 for best reproduction of flesh tones with normal user control settings.

T. Shanks.

Dear Sir,

LOUDSPEAKER SCREENING

Interference to the picture caused by the loudspeaker can be almost entirely eliminated by adding extra steel screening around the loudspeaker on the c.r.t. side. A suitable piece of mild steel can be formed into a U bend and held in place by means of double-sided Sellotape.

E. Davidson.

Dear Sir,

REMOTE CONTROL

The remote channel change circuit I have devised for use with the colour receiver has been successfully tried out and may be of interest to other constructors. The circuit of the channel selection system, also the varicap tuner connections, is shown in Fig. 1. There are four stages in the selector circuit (additional stages for further channels could be added if required), each stage using a pair of transistors which together perform the same function as a silicon controlled switch. When the set is

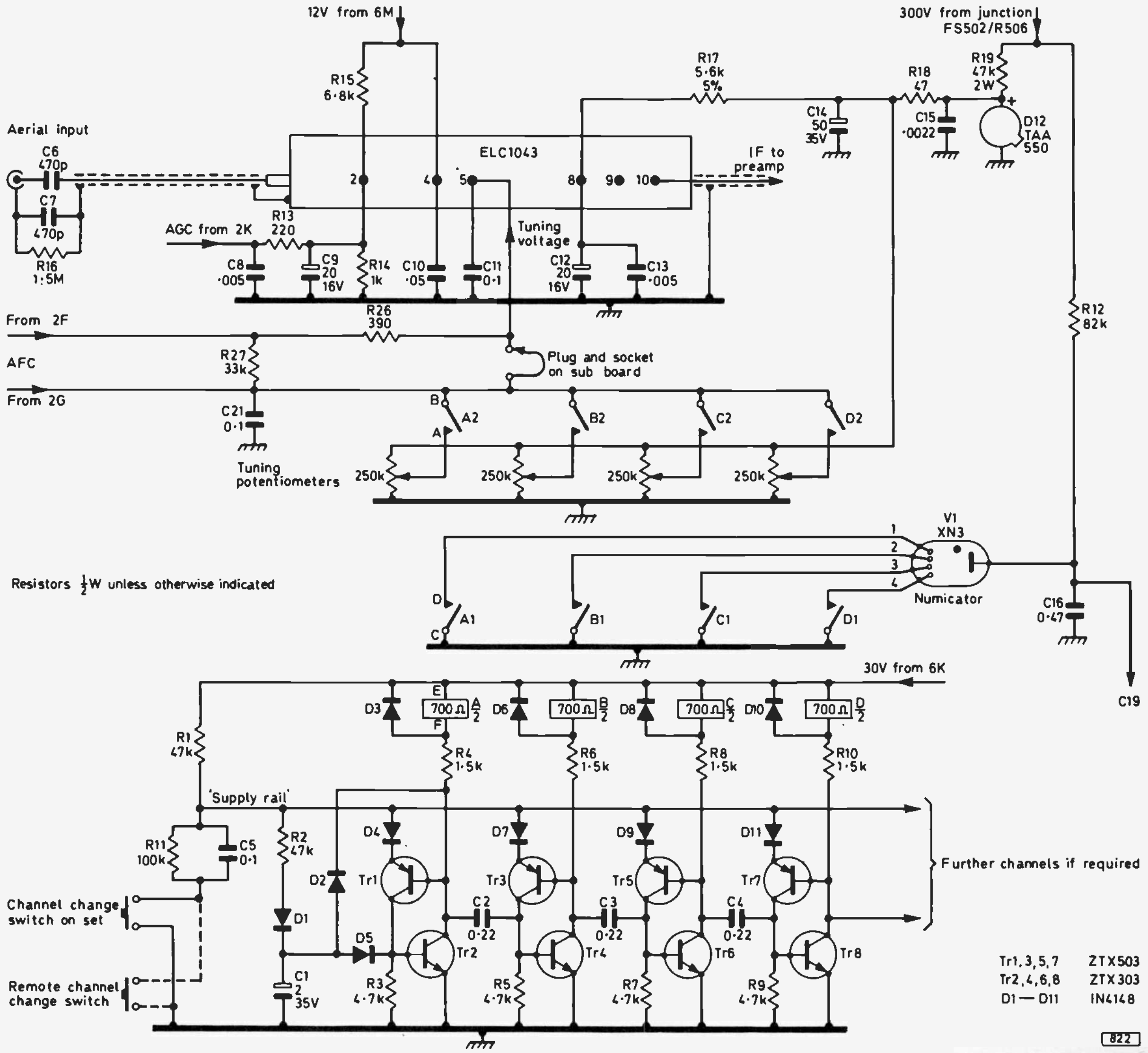


Fig. 1: Remote control and varicap tuner circuitry used by B. C. James.

switched on the voltage on the "supply rail" (junction R1/R2) is 30V. As a result C1 charges via R2 and D1 and eventually sufficient current is passed by D5 for Tr2 to conduct. Tr1 and Tr2 then lock on, relay A operates, the supply rail voltage drops to 1V and C1 discharges via D2. On operating the channel change switch—there is one on the set and another at the cable-connected remote unit—C5 momentarily shorts the supply rail to earth as it charges, Tr1 cuts off so that Tr1 and Tr2 release, and the supply rail returns to 30V. Relay A also releases of course. As the collector of Tr2 goes positive a positive voltage appears at Tr4 base so that Tr4 and Tr3 lock on and relay B operates, the supply rail falling to 1V again. Each subsequent operation of either channel change switch steps the operating stage on one until the last stage switches off. The supply rail then returns to and stays at 30V, C1 charges as at initial switch on and relay A operates once again. R11 discharges C5 between switch operations. If it is found that channel 1 does not automatically appear on first switching on, one

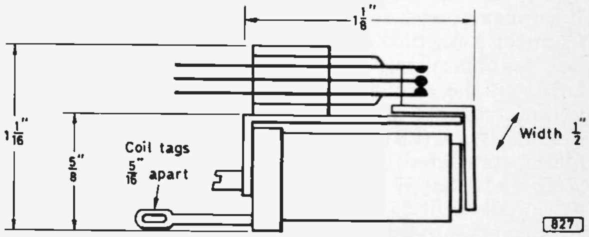


Fig. 2: Outline and dimensions of the relay used for channel selection and numicator switching. The relay is a standard PO type.

of the other channels coming on instead, an 0·5μF capacitor can be added from Tr2 base to the 30V line (junction R1/D3) to ensure that channel 1 always comes on first. One relay contact switches the appropriate channel tuning potentiometer into circuit; the other connects the appropriate numicator cathode into circuit to give channel indication.

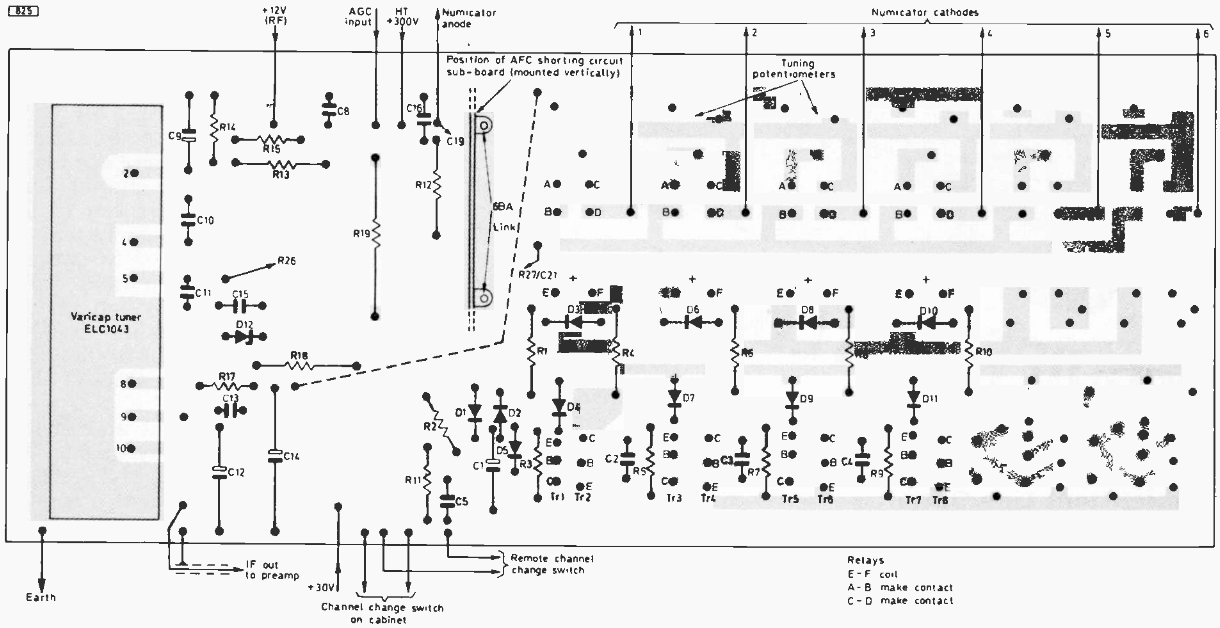


Fig. 3: Printed board layout for the circuitry shown in Fig. 1, viewed from the component side. The actual size of the board is 10⅜ x 4¼ in. The a.f.c. shorting circuit sub-board is mounted vertically in the position shown using 6BA nuts and bolts and metal brackets.

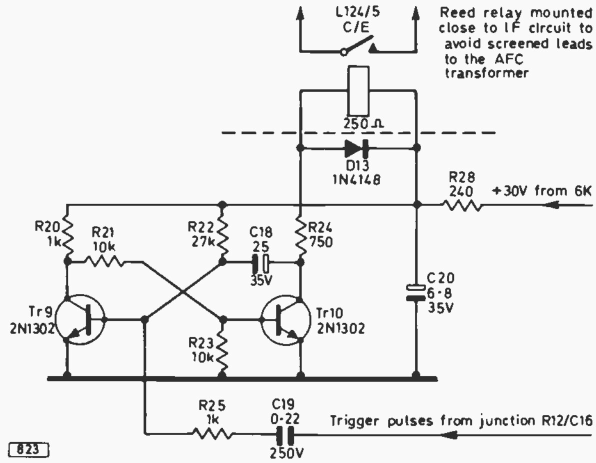


Fig. 4: A.F.C. shorting circuit used by B. C. James. The 1 in. reed relay is a standard PO type.

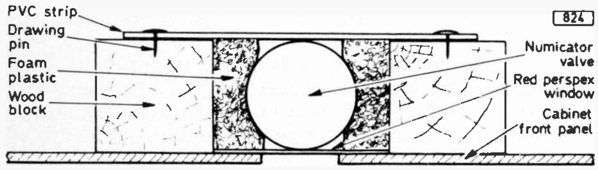


Fig. 5: Method of mounting the numicator valve.

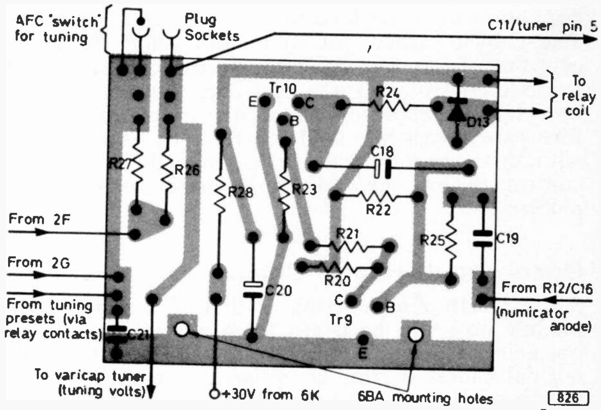


Fig. 6: Printed board layout for the a.f.c. shorting circuit, viewed from the component side. Size 2½ x 2 in.

The circuit is arranged along with the varicap tuner and its associated components on a printed board as shown in Fig. 3. The board is 10⅜ x 4¼ in. and fits in the convergence drawer, on the loudspeaker side, with the tuner at the back in the cool air. The tuning presets then appear at the right-hand side of the drawer, giving easy adjustment. The i.f. preamplifier was built on a separate board, keeping to your layout.

The numicator mounting is shown in Fig. 5. It is held between two foam plastic pads glued to two wooden blocks which are glued to the front of the cabinet. The valve is held by a strip of p.v.c. plastic pinned across the blocks at the rear. A red Perspex window eliminates neon glare in the valve.

The tuning potentiometers used are standard 0·15W vertical mounting presets.

The selector circuit requires approximately 30V and draws 15mA. I have taken this supply from 6K on the power board (across C508). The suggested

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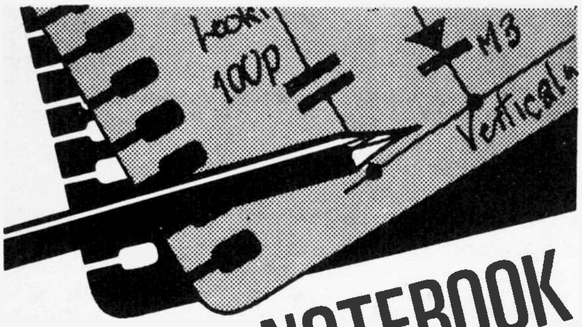


SERVICE NOTEBOOK

G. R. WILDING

Intermittent Line Output

The fault on a Pye single-standard colour receiver was intermittent line output due to an intermittent fault in the PCF802 line oscillator circuit. A new PCF802 failed to cure the trouble and on checking their front-to-back resistance both discriminator diodes in the flywheel sync circuit were found to be OK. We next made a close but fruitless inspection for dry-joints, then decided to change the three electrolytics used. The intermittency persisted however. It is our experience that capacitors rather than resistors are the most common causes of intermittent oscillation so we decided to continue replacing them. The culprit turned out to be the 320pF feedback capacitor from the oscillator tuned circuit to the pentode control grid. On replacing this we found it necessary to reposition the oscillator coil core which forms the preset line hold control. The drill as usual with this type of circuit is to place the main hold control midway then adjust the preset for optimum picture lock.

Open-circuit Heater Chain

A tip worth remembering is that if a slight high-pitched note can be heard from a receiver with an open-circuit heater chain you will find that the normal causes of this condition—open-circuit fuses, switch contacts or dropper resistor sections—are not to blame. The cause is an open-circuit valve or c.r.t. heater: the resulting high-voltage strain across the heater-cathode insulation of the boost rectifier—which is usually the first valve in the chain—often results in it producing this high-pitched vibration. Whenever a break exists in the heater chain below the supply point from the thermistor or dropper resistor the set should be disconnected from the supply immediately to prevent damaging the heater-cathode insulation of the valves above the break.

Low Boost/LT Supplies

The complaint reported on a Bush Model TV166U was "set working on v.h.f. only." This naturally gave the impression that the u.h.f. tuner or the system switch was at fault. On switching on however it became apparent that this was not the case, for while there was a lockable picture on 405 lines together with sound the raster was only about half the normal height—the width was near normal. On switching to 625 the height decreased still further, the raster became blank and noise-free and there was no sound.

In these models the 22V supply for the transistor i.f. stages and the u.h.f./v.h.f. tuner assembly is obtained from a low-voltage winding on the line output transformer. As all symptoms had developed simultaneously it appeared that the line output stage was at fault, the height being reduced due to low boost voltage while the reduced l.t. supply was insufficient to enable the u.h.f. oscillator to operate. The disturbing feature was the near normal width, since a drastic reduction in the boost and l.t. rail voltages would if caused by a low-emission line output valve or high-resistance feed resistor in the width circuit be accompanied by a comparable width reduction.

A heavy leak across the boost rail and chassis would reduce the boost voltage and by loading the output transformer reduce the 22V supply. A heavy leak across the l.t. supply would have a similar effect. Voltage tests confirmed that both the boost and the l.t. voltages were low, the former 400V instead of 780V and the latter about 12V. Although little hope was held out the line timebase valves were changed since all simple possibles must be tried first when tackling a difficult fault. We have on occasions come across a line oscillator which is able to provide near normal line width but as a result of the end of its switching pulse output being rounded the line output pentode is not cut off as cleanly as it should be, resulting in reduced flyback voltages and boost rail potential.

The capacitors in the output stage associated with the boost voltage were next checked or replaced, then the line output valve anode d.c. feed coil checked by substitution. As the trouble persisted we next considered the possibility that there was a c.r.t. first anode leak—such a leak sometimes develops, imposing a sufficiently high load to reduce the height to well below normal even with the height control at maximum. Removing the first anode supply to the tube base failed to produce any noticeable improvement in the boost voltage however and as there was no heavy leak across the l.t. circuit we were left with the conclusion that the line output transformer was faulty. A replacement restored normal results on both systems. It is always best when confronted with the possibility of a faulty line output transformer to eliminate all other likelihoods first.

No Results: Pye 368 Chassis

No results on a model fitted with the Pye 368 chassis was due to the mains fuse F1 being blown. Our first move after replacing the fuse was naturally to check that no short existed across the mains plug connections. The low resistance reading obtained with the test prods either way suggested that the h.t. rectifier might have developed a short as a result of which pure a.c. was being applied to the electrolytics causing one or more to break down. There is however a complication which must be taken into account on this chassis. System changeover is effected by a microswitch linked to the tuner: when this is operated mains a.c. is applied via a fuse and low-value resistor (R69, Fig. 1) to one or other of a pair of solenoids L22/L23. The energised solenoid then pulls the system switch in the appropriate direction.

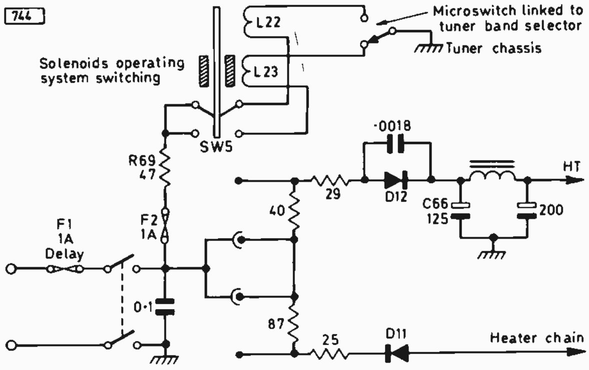


Fig. 1: The mains input circuit of the Pye 368 dual-standard chassis: note the presence of the solenoids which operate the system switching. In later versions R69 and F2 are replaced by a single 22 Ω resistor.

It also operates SW5 which breaks the circuit and enables the other solenoid to be operated when the microswitch is again changed over by tuner rotation. If SW5 jams or is slow in moving over F2 will blow. The point to remember however is that if the system switch is changed over from the position when the set was last used while the supply is disconnected one of the solenoids plus R69 will be connected across the mains input. In these circumstances to check that a short-circuit reading is not due to the solenoid plus R69 resistance it is necessary to turn the tuner knob again to a channel on the other system, thereby changing over the microswitch, or to move the slider system switch directly. When we did the latter the "short" caused by the solenoid disappeared leaving the usual heater chain plus dropper resistance which of course became a complete open-circuit when the c.r.t. base connector was removed.

On reversing the meter leads however a low resistance reading was obtained, clearly the result of conduction through the h.t. rectifier D12 as a result of an h.t. short-circuit. This was found to be due to a short in the reservoir capacitor (C66) which is part of a multiple electrolytic can. As one end cap was slightly swollen the complete unit was replaced. Excellent results on both systems were obtained following this.

Although the very compact transistorised i.f. strip mounted at the back of the tuner unit on this chassis looks as if it could be troublesome we have in practice found it to be extremely reliable, the only faults we have encountered being dry-joints. The same cannot be said unfortunately of the line output transformer used. This is particularly prone to breakdown. The one compensating feature is that the transformer is fitted with flying leads and connectors which only need to be pushed on to about eight square-sided pins on the main chassis.

Unusual Symptoms

The symptoms on a set fitted with the BRC 950 chassis were very unusual: on test card a normal picture was obtained but peak white outlines terminated in a distinct blob with a totally black streak continuing to the raster edge. There were also accompanying light crackles from the loudspeaker. If the brilliance level was reduced so that peak white was never reached the symptoms disappeared.

As this chassis is fitted with an e.h.t. multiplier this was the first suspect—since when faulty these can cause unusual effects. A replacement unit failed to improve matters however, nor did replacing the line output stage valves (PL504 and PY801) and the video valve (PFL200). There was no suggestion that the line output transformer insulation might be breaking down (this is always accentuated on *dark* scenes, when the e.h.t. current is at minimum and the e.h.t voltage at maximum therefore)—and in any case this would have resulted in random spots rather than the unusual symptom described. A 220pF 8kV capacitor is connected to chassis from the BK choke in the cathode lead of the PY801 boost diode in these models (Mk. II version) and frequently develops a heavy leak, rapidly reducing the picture width after switch on. As this is a suspect component and appeared to be the original one we replaced it in case minute sparking was occurring inside. Again there was no improvement.

After checking all soldered connections in the grid circuit of the line output valve, particularly around the width stabilising v.d.r., we came to the conclusion that the fault was caused by miniature sparking in the c.r.t. A replacement was accordingly connected up and proved the point by clearing the trouble.

COLOUR RECEIVER FORUM

—continued from page 181

R534 has not been added in the power supply circuit since as shown in Fig. 1 the 30V stabiliser (D12) circuit is fed from the h.t. line (from the junction FS502/R506). The anode of the numicator valve is fed from the same point, via R12.

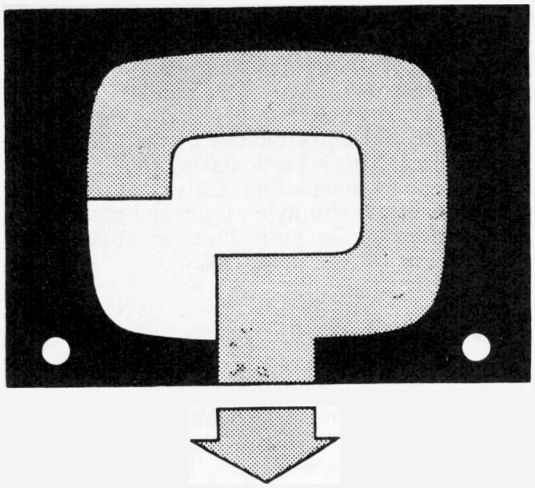
The circuit shown in Fig. 4 (layout in Fig. 6) is used for a.f.c. shorting when changing channels. Tr9 and Tr10 form a monostable multivibrator. When the channel selector circuit operates the numicator changes to a different number. As it restrikes its anode voltage drops from 250V to approximately 90V. This provides a negative pulse which is fed via C19 to the base of Tr9, switching it off. Tr10 then switches on for a period determined by the time-constant of C18 and R22. The reed relay contacts close until Tr9 switches on again and Tr10 cuts off. When changing across several channels the relay will stay operated until after the final channel is selected.

The a.f.c. shorting relay is mounted next to the i.f. panel, with very short leads between the reed and the a.f.c. transformer L123/5: this avoids the need to use screened leads. A 1in. reed is used, with 42 s.w.g. wire scramble wound on the coil former.

B. C. James

AN ACKNOWLEDGEMENT

Manor Supplies have drawn to our attention the fact that the flyback blanking arrangements shown in Fig. 2 in the December "Forum" were devised by them for their version of the "Television" Colour Receiver.



YOUR PROBLEMS SOLVED

★ **Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 185 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone. We cannot provide modifications to circuits published nor comment on alternative ways of using them.**

FERGUSON 3646

The problem with this set is that the 220pF 8kV capacitor C114 from the boost diode cathode to chassis keeps burning out. This occurs when the set is switched to u.h.f., and happens about every three weeks. The boost diode and line output transformer have been replaced but the fault persists.—J. Garner (Portsmouth).

You are not alone in having trouble with this capacitor and the fact that it breaks down frequently does not usually indicate that there is a fault condition, though spark overs in the PL500 line output valve do not help. We suggest you obtain a different type and wire it as far as possible from the PL500 which operates at a high temperature—even small temperature rises have a drastic effect on capacitor and insulation resistances. It is unfortunate therefore that C114 is situated in a warm spot. We take it that the width control is not over advanced so that the PL500 is over-run, and that it operates normally. If not, check R141 (1·8MΩ) and R140 (2·2MΩ) which are in series with its slider. It could help to replace the pulse feedback capacitor C113 (100pF) to the width circuit. Make sure that all dropper and smoothing resistors are of the correct value so that the h.t. line is at the correct voltage. Also check that the PL500 screen feed resistor R138 (2·2kΩ) is within tolerance. (BRC 1400 chassis.)

DEFIANT 9A52

The problem is complete lack of v.h.f. signal and I associate this with the large negative signal at the anode of the a.g.c. valve (PCL84 triode section). The PCL84 pentode section cathode voltage also seems high on v.h.f., at about 12V. The contrast is non-existent, the contrast control having no effect at all. Extensive component checks in the a.g.c. circuit have failed to put matters right. The v.h.f. sound and vision can be restored however by earthing the a.g.c. triode anode to chassis. The picture then has excessive contrast, the contrast control no effect and there is a tendency to pulling on whites.—I. Ball (Acton).

The pentode cathode voltage is certainly much too high. It should be about 5V on v.h.f. This suggests that the fault is basically due to incorrect biasing in this section of the PCL84. On v.h.f. a bias stabilising network (10kΩ plus 8·2kΩ) is switched between the screen grid and cathode of this stage: these resistors tend to change value—they should be not less than 18kΩ in total. Also check the value of the cathode resistor R122 (220Ω). In the a.g.c. circuit it is worth checking the triode's grid return resistor (R127, 100kΩ), the 10M resistor (R132) in series with the contrast control slider and the 68kΩ resistor (R125) to chassis from the earthy end of the contrast control. An extra 100kΩ resistor in parallel with R127 may help. (Early Plessey dual-standard chassis.)

KB SV149

The fault with this set is that the picture rolls and cannot be locked by operating the field hold control. Setting the field hold control to its limit results in the picture rolling slowly but still without lock.—T. Minor (Salford).

We would have thought that a new PCL805 field timebase valve would cure the trouble. If not the fault seems to be loss of lock because the field hold control can't reach it rather than lack of sync. Check R86 and R82 which are in series with each end of the hold control therefore, also C75 which is across the whole network (PCL805 triode section grid/cathode circuit). If one of the cross-coupling capacitors C73, C74 or C78 is faulty the hold position could be shifted out of the range of the control. Make sure that the PCL805 pentode section cathode decoupling electrolytic C82 is in order, especially if there is any tendency to cramping at the bottom of the picture, by temporarily connecting a substitute in parallel with it. (ITT/KB VC200 chassis.)

ULTRA V1770

I wish to replace the vision detector and a.g.c. clamp diodes in this set but the types originally fitted appear to be obsolete.—L. Watson (Egham).

We suggest the use of an OA70 or OA90 as the vision detector and a general purpose silicon diode such as the BA148 as the clamp.

HMV 2609

The a.g.c. line seems faulty since when the contrast control is turned up there is a really dark picture and a lot of tearing. Otherwise the picture is reasonable but when there is a foreign film with subtitles quite a buzz occurs momentarily when the subtitles appear. The a.g.c. clamp and the overload diode are type M3 rectifiers: is there a substitute for this?—A. Swinson (Leatherhead).

The buzz is probably due to the local/distant preset control R7 being advanced too far. Try turning it down (top left preset, on i.f. panel). This may also help the action of the main contrast control. The M3 diode is not all that reliable and replacement will probably stop the pulling at high contrast. A nip with a pair of pliers sometimes improves the internal contact. It can be replaced with an OA81 or similar diode with a high reverse resistance. (BRC 850 chassis.)

SOBELL 1002

The picture creeps up from the bottom by about two inches after the set has been on for approximately an hour. The PFL200 video/sync valve became faulty with a smell of burning but after fitting a replacement the picture is just a shadow. There is also excessive height and narrowing at the sides.—H. Gaunt (Derby).

The cause of the picture creeping up at the bottom is either that the field output pentode cathode decoupler C97 (200μF) has lost capacitance or that the valve itself has lost emission. The weak vision could be the result of the video amplifier anode load resistor R46 (3kΩ) changing value, possibly when the PFL200 failed. The narrow picture with excessive height is probably caused by either the line output pentode (PL500) being low-emission or the v.d.r. (VDR3) in the width circuit being faulty.

TEST CASE

134

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.

? *Although vision troubles appear to predominate there are times when in both monochrome and colour receivers the sound channel exhibits distress. Such was the case with a set in the GEC/Sobell 2020/1020 series. The symptom was very distorted sound increasing in severity with time.*

This chassis uses an EH90 and the pentode section of a PCL84 in the audio channel. The EH90 serves as the sound detector, providing sufficient output to drive the pentode. A large proportion of sound distortion faults in receivers using this valve line up are due to one or other of the valves or to a change in value (usually a value decrease) of a resistor in the EH90 circuit.

In this case however all the smaller components in the audio stages appeared to be in order. The valves were checked by substitution and during this operation it was noticed that the PCL84 was running at an abnormally high temperature. Changing the EH90 made no difference. The new PCL84 gave a little less distortion but continued to run at an excessive temperature, the distortion again rising as the valve got hotter.

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

SOLUTION TO TEST CASE 133

Page 138 (last month)

Although more powerful, the line output circuits used in colour receivers often differ only mildly from their monochrome counterparts. Thus a very hot boost diode would indicate an excessive load on its cathode. This would almost certainly blow the fuse, of course, as was the case (colour receivers seem to be endowed with more fuses than monochrome models—which is not a bad thing!).

The best way of tackling the symptom is to remove the mains supply and trace the cathode leak through the line output transformer. The most vulnerable component is the boost reservoir capacitor (C436, 0·33μF). As the scan return circuit is via the deflection coils and convergence circuits a mild change in leakage resistance (at the boost diode cathode feed point) is sometimes observed when these circuits are disconnected (unplugged) if the boost reservoir capacitor is in trouble.

To save time it is best to go straight to this capacitor with an ohmmeter and measure its leakage resistance. In a large proportion of cases it will be found to be the culprit, as it was in the case cited.

If the reservoir capacitor proves to be all right leakage between windings of the line output transformer is a possibility. Modern transformers are troubled in this way less than earlier ones however.

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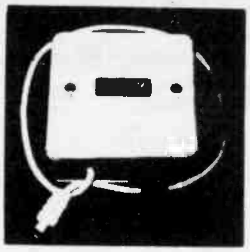

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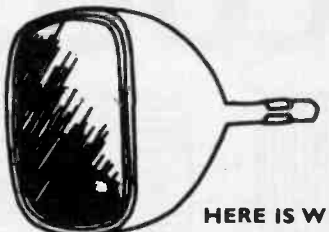

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