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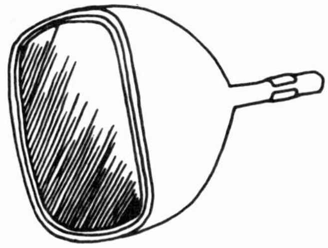

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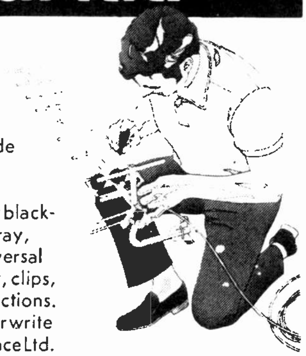

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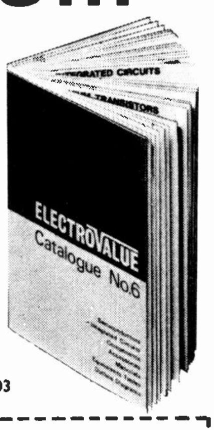

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6F14	·40	50CD6G	·68	ECH83	·40	LN329	·72	PL504	·63	UY85	·25
6F23	·68	AC/VP2	·77	ECH84	·36	LN339	·63	PM84	·33	VP4B	·77
6F25	·53	B349	·65	ECL80	·35	N78	·87	PX25	·95	W77	·43
6J7G	·24	B729	·62	ECL82	·31	P61	·40	PY32	·52	Z77	·22
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6SN7GT	·30	DAF96	·36	EF80	·23	PC96	·42	PY83	·26	AD140	·37
6V6G	·28	DF91	·16	EF85	·28	PC97	·36	PY88	·33	AF115	·20
6V6GT	·28	DF96	·36	EF86	·30	PC900	·29	PY800	·34	AF116	·20
6X4	·23	DH77	·20	EF89	·26	PCC84	·29	PY801	·34	AF117	·20
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25U4GT	·57	DY802	·33	EL90	·26	PCF802	·40	U251	·64	OC82	·12
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TELEVISION

VOL 22 No 11
ISSUE 263

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

SEPTEMBER 1972

ODE TO A CONSTRUCTOR!

We are still trying to recover after being very severely taken to task by a number of followers of our colour receiver project over the question of component shortages. Our failure to "second source" and as one reader put it our "unprofessionalism" leads us to ask quite frankly how far our responsibility could reasonably be expected to extend?

Our main responsibility is to publish information of use and interest to our readers and to ensure that it is accurate. When we publish a constructional feature we have also of course to bear in mind the availability of the components used. But we can come up against problems here—ones which in fact are shared by the industry generally.

TV set makers in practice are assemblers of sets from parts bought in: capacitors, resistors, semiconductor devices, wound components, tuners and so on are all mostly bought in. This in fact is one reason why things can go haywire. For if you don't actually control your suppliers all sorts of things in addition to simple shortages can occur: the component manufacturer can just stop making a particular part, or change its specification, or introduce a new but different version—all of which can lead to difficulties.

We mention all this because those readers who have complained so insistently don't seem to realise that what they are actually on about is the way the industry is structured! The large demand caused by some 2000 colour set constructors has put our suppliers in the position of being industrial buyers. With most projects this situation does not arise: where demand is limited stocks can usually be found somewhere. But if you try to place an order for several thousands of something the position is different. Nor would second sourcing have helped much: it would probably have tended only to increase prices since our suppliers have in many cases been able to pass on discounts arising from the bulk orders they have had to place.

We have ensured that everything used in the project is standard and found a dealer prepared to supply every item. Thus everything can be got though it may take time. That it seems is in all fairness as far as our responsibility can be expected to go.

W. N. STEVENS—*Editor*

THIS MONTH

THE NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED SEPTEMBER 18

Errors: Several small errors for which we apologise got through in the August issue. In the colour receiver audio module C803 is shown incorrectly as C308 in Fig. 1 and as C804 in Fig. 2 (left-hand side), page 443. In Fig. 5, page 453, V4A cathode voltage should be 2.5V not 25V. On page 457 in the text the rectifier should be W8 not D8.

TELETOPICS

SYNCHRONOUS VISION DEMODULATION

There are now three UK produced TV chassis—two colour (BRC 8000/8500 chassis and GEC C2110 series) and one monochrome (Decca Gypsy portable)—employing synchronous vision signal demodulation. So it seems time to get clear what the process involves. In Fig. 1 we have illustrated in block diagram form the process as carried out in the BRC 8000/8500 chassis. This chassis and the Decca Gypsy use a Motorola type MC1330P i.c. for the purpose: the GEC C2110 series uses a Mullard TCA270 which operates in a similar manner. As can be seen the i.f. signal at about 40mV peak-peak is fed into the MC1330P at pin 7. Within the i.c. it is fed to a differential amplifier which produces antiphase outputs which are then applied to two gates. The input signal is also applied to a limiter amplifier which strips the modulation from the signal to leave just the 39·5MHz i.f. carrier. This is then used to drive a stage which in conjunction with an external *LC* circuit produces antiphase 39·5MHz squarewave signals. These are used to switch the gates on and off alternately. Thus if say gate 2—see inset waveforms—is switched on first it will conduct and pass the negative-going half cycle of the input signal while on the following half cycle of the input signal gate 2 will be switched off but gate 1 will switch on again passing a negative-going half cycle of input signal. In this way the signal is demodulated, the video preamplifier being fed with a series of unidirectional pulses at twice the carrier frequency. All that is then required to recover the original modulation is filtering. The video output developed across an external load resistor at pin 4 is negative-going and is fed via a 6MHz trap to reject the intercarrier signal to the chrominance and luminance channels. A positive-going video output is available at pin 5 and in the BRC 8000/8500 chassis the intercarrier signal is taken from this point. In comparison to conventional envelope detection this technique provides improved linearity with less cross-modulation: with the increased use of i.c.s it is likely to become the general practice.

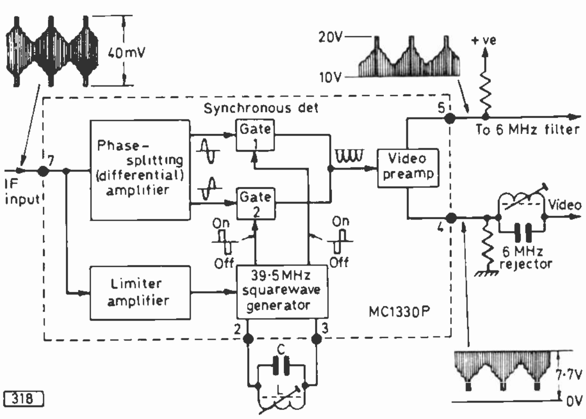


Fig. 1: Synchronous vision signal demodulation as carried out in the BRC 8000/8500 chassis using a Motorola MC1330P integrated circuit.

COLOUR TUBE DEVELOPMENTS

"Even in the latest form it is doubtful if the shadowmask tube has yet attained a desirable brightness level; that is to say sufficient to use in areas of high ambient lighting or in daylight conditions. When operated in such locations the tube suffers a loss of performance as the picture washes out in both contrast and colour saturation." The quote is from W. W. Wright, Chief Engineer, Thorn Colour Tubes Ltd., writing in *The Royal Television Society Journal* last August and is repeated here because the problem couldn't be put better. The modern, much developed shadowmask tube is a superb device but it is nevertheless clear that we are not yet at the end of the road. In fact a number of further developments seem likely to be with us before long. We mentioned last month the technique of darkening the areas between the phosphor dots on the screen to reduce light reflection. As in all modern c.r.t.s the screen has an aluminised backing and in fact approximately 10% of the screen has only this highly reflective backing visible: thus covering some or all of the non light emitting area of the screen with black non-reflecting material provides a significant improvement in contrast. The technique is already being used by some US tube manufacturers and most others seem to be on the point of adopting it. The term black matrix tube is coming into use to describe such tubes which are inevitably rather more expensive than conventional types. We don't suppose it will be long before someone introduces the idea here.

There is intriguing news from RCA who developed the original shadowmask tube and who are now about to introduce a new colour tube which they believe will become the standard tube for 19in. and smaller colour sets. The new tube retains the shadowmask principle but uses slits in place of holes in the mask, has the phosphors arranged on the screen in parallel lines and uses a three side-by-side gun system. Advantages claimed are the elimination of the need for dynamic convergence and reduction of purity (beam to phosphor register) problems. It also gives increased brightness and a sharper picture. The deflection and neck components are permanently attached to the tube, simplifying installation, set production and servicing. The first such tubes to be available will be 15in. ones: 17, 19 and 13in. types are planned to follow. RCA claim that for the first time colour set adjustments will be comparable to those of black-and-white sets.

STATION OPENINGS

The following relay services are now in operation:

Betws-y-Coed BBC-2 channel 27 (aerial group A).
Conway BBC-2 channel 46 (aerial group B).
Newton BBC-1 channel 33 (aerial group A).
Newhaven BBC-1 channel 39 and BBC-2 channel 45 (aerial group B).
Lancaster Granada channel 24 (aerial group A).
Malvern ATV channel 66 (aerial group D).
Todmorden Granada channel 49 (aerial group B).

All these transmissions are vertically polarised.

JAP BLITZ

We all know by now that the demand for TV sets has been so great in recent months that UK setmakers have been unable to produce enough sets—in spite of a remarkable expansion in production. It has been a piece of extraordinary economic mismanagement and a field day for imports. The Japanese approach to the UK market however seems to go a lot deeper than merely making good what UK manufacturers cannot supply. In fact a report from the Radio Industry Council to John Davis, Minister for Trade and Industry, describes the Japanese approach to the UK market as "a blitzkrieg launched by the integrated action of Japanese firms and their government". Backing this up with statistics the report points out that nearly five million radio sets either made in Japan or assembled elsewhere from Japanese components flooded the UK market last year, driving UK setmakers' share of the market down to 14%, while monochrome TV imports have risen from 4,000 to 111,000 in three years. Japanese colour sets have now taken well over 7% of the market. Mr. Davis had the report with him during his recent visit to Japan to discuss TV etc. imports. It looks suspiciously as if since the US market turned sour Japanese firms have decided that the UK is the next best bet. The thing that has to be borne in mind is the way trade is organised in Japan, with a few large firms acting hand in hand and with active government support both at home and in export markets. From the UK point of view the combination of Japanese trading practices, a wide open market and excessive demand spells danger.

TV FIRES

While acknowledging the fact that the incidence of fires caused by TV sets is as BREMA points out extremely low nevertheless it is also a fact that there has been a significant increase in recent times, especially in colour sets, as the Fire Research Station reports. It is worth emphasising once again therefore that viewers should be urged to switch off at the wall socket outlet at the end of their viewing. Dealer A. Leeson-Magery wrote recently in *Electrical and Radio Trader* of his investigations into the causes of TV set fires. He found that the most common cause was as one would expect the line output transformer. Two other causes he encountered were vases and paper labels. Vases are often placed on top of a set and may eventually split, soaking the set. He found that the owner usually switched off to let the set dry out but that on switching on again evaporation could lead to arcing. Sets over two years old he found tended to shed their paper labels which could come to rest on or close to components that run hot. It seems worthwhile keeping an eye open for the latter possibility—and warning owners about the former.

DIGITAL VIDEOPLAYER SYSTEM

If you are going to have a videoplayer system why not adopt the very latest technology and encode the video information digitally? That at any rate seems a logical approach and a couple of US companies are working on just such a development, with the video signals stored on photographic film. The system enables a 30-minute colour programme to be stored on a small card which is inserted in the videoplayer. The firms concerned are the Digital Communications Corporation of Encino, California and Battelle Development Corporation of Colombus, Ohio.

EHT MEASUREMENT

Correct e.h.t. adjustment on colour sets is most important and BRC have published in the latest edition of the *BRC Bulletin* a simple circuit which enables the e.h.t. to be adjusted on any of their colour chassis using an Avo Model 8. The circuit is reproduced in Fig. 2 and the adjustment procedure

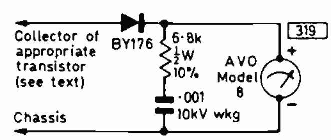


Fig. 2: BRC recommended circuit for e.h.t. measurement on their colour chassis.

is as follows. Switch the receiver on and allow to warm up for 15 minutes. Switch off the receiver and connect test circuit. Switch receiver on again and set brightness to minimum (all other controls for normal operation). With 2000 series receivers the Avo meter is set to its 250V range, the BY176 is connected to the collector of the e.h.t. generator transistor (VT7) and the set e.h.t. control adjusted for a reading of 155V. With 3000/3500 series receivers the Avo meter is set to its 1kV range, the BY176 is connected to the collector of the line output transistor (VT504) and the set e.h.t. control adjusted for a reading of 490V. With 8000/8500 series receivers the Avo meter is set to its 2·5kV range, the BY176 is connected to the collector of the line output transistor (VT401) and the set e.h.t. control set for 1·325kV (8000 chassis) or 1·4kV (8500 chassis). Switch the set off before disconnecting the meter circuit.

ITA BECOMES IBA

The Independent Television Authority officially became the Independent Broadcasting Authority on July 12th.

PAL LICENCE LIBERALISATION

AEG-Telefunken, holders of the PAL patents, have now signed an agreement with a second Japanese company—Matshushita (National Panasonic)—to produce PAL colour receivers and it is expected that further Japanese firms will obtain licenses before long. Telefunken say that the aim behind the liberalisation of their policy is the maintenance of the overall quality of the PAL system: they say that attempts by foreign setmakers to get round the PAL protective rights are endangering this aim.

TUBE-SCREEN SIZES

Another successful prosecution has been brought against TV firms under the Trade Descriptions Act: a ticket in the window of a Currys store described a Hitachi receiver as having a 15in. screen but when the display area was measured by a Weights and Measures Inspector it was found to have a diagonal measurement of "about 13⅞in." Both firms were fined £200. You have been warned.

BATC CONVENTION

This year's British Amateur Television Club Convention will be held on September 16th at the ITA Headquarters (70 Brompton Road, Knightsbridge, London) from 10.30 a.m. to 6.30 p.m. There will be an exhibition, presentation of papers and general meeting. Further details can be obtained from D. S. Reid, 58 Weald Road, Brentwood, Essex.

NEW SETS AND AERIALS

BRC have now announced their first models fitted with varicap tuners. These are the **Ferguson** Model 3820, **Ultra** Model 6820 and **HMV** Model 2815. All these models use the 1500 chassis, are fitted with 24in. tubes and feature slider controls and a push-button on-off switch. The varicap tuner is a three-transistor type with external i.c. voltage regulator. Also announced are two further models fitted with the new 8500 colour chassis, the Ferguson 3713 and Ultra 6713—both are fitted with 19in. tubes.

A new wideband set-top log-periodic aerial designed to eliminate ghosting has been introduced by J Beam. Called the Top-Log, the aerial has a recommended retail price of £2.50. Aerialite have introduced a new multiple-director range, the Superb 6, Selector 9 and Supreme 18. These aerials are supplied flat packed and to make this possible the dipole has been redesigned: the new design is inductively compensated and feed matched, not requiring a balun. There are two other new aerial ranges from Aerialite, the Silver Gain range of 6, 10 and 18 element models which has been engineered to eliminate ageing problems and a new range for loft mounting.

HI FI TV SOUND PROBE

Celestion are marketing a device called the Telefi comprising a probe which is placed near or outside a TV set to pick up the 6MHz sound signal for feeding to an external hi fi system. Further details can be obtained from Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich.

SIMPLE CROSSHATCH & DOT GENERATOR

CALEB BRADLEY B.Sc.

WHEN ONE begins servicing colour television receivers there are a dozen or so controls that on every set can seem formidable—the "convergence" controls. Each control needs critical adjustment and many of them are exasperatingly interdependent. Yet they must all be set properly before a decent picture can be obtained. Ironically, maladjustment shows up worst on monochrome pictures. Colour sets bought ex-rental are certain to need some convergence adjustment and a pattern generator that makes the job of convergence easy is a great help in dealing with them. The instrument to be described is however cheap enough to be of interest to any colour TV set owner since all sets benefit from occasional reconvergence. The generator is so compact it could even be built into a receiver. It has a further use, for very precise checking of picture linearity on any 625-line receiver.

Static Convergence

All colour sets with the notable exception of Sony models use the shadowmask colour cathode-ray tube (c.r.t.). This tube differs from monochrome c.r.t.s in having three separate electron guns aimed at the screen—see Fig. 1. The shadowmask itself is a metal sheet of tiny "peepholes" which ensure that each gun "sees" only the phosphor dots on the screen of one colour, i.e. red, green or blue.

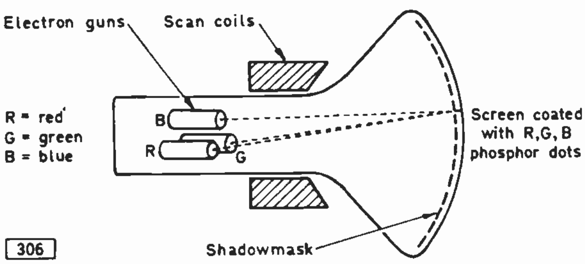


Fig. 1: Principle of the shadowmask colour tube. Since the three electron guns are in different positions each "sees" only one colour of phosphor through the holes in the shadowmask.

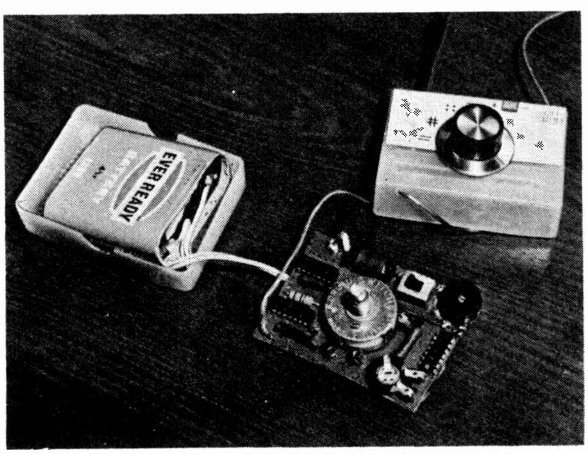
A single set of scan coils on the c.r.t. neck deflects all three beams to scan out an overall raster in the usual manner. The individual rasters produced by the three guns must coincide of course if a properly registered picture is to be obtained (at the moment we need consider only monochrome where all three guns produce the same pictures). The initial attempt to register the three rasters is done by moving each one bodily on the screen. This is generally done by rotating the four small magnets on the *main* and *blue lateral* convergence assemblies mounted on the c.r.t. neck—see Fig. 2: pole pieces inside the assemblies bring the field from each magnet to bear on one particular beam only (a few imported sets however use potentiometers). This adjustment is called *static convergence*. The reason why four static controls are needed to converge the three rasters is shown in Fig. 3(a) which indicates the directions of shift given by the three magnets on the main assembly. There are three points where two colours can be converged but it is not possible to converge all three colours until an extra static control is provided for one colour, always blue in practice, as shown in Fig. 3(b).

The static convergence procedure is simple and consists of first converging the red and green pictures together (giving yellow), then using the two blue controls to complete the convergence (giving white). A mirror should be used to view the *centre* of the screen while doing this.

The utmost care must be taken in making static adjustments since one's fingers are near several high voltage points. Note particularly the focus supply on the c.r.t. base panel (about 5kV) although all the c.r.t. base connections and the dynamic coil connections should be studiously avoided. Some sets are quite unpleasant to work on in this respect since one has to penetrate a tangle of wires to reach the red and green static magnets. So please take care, for the sake of both our circulations!

Dynamic Convergence

With good static convergence obtained at the centre of the picture you may be dismayed to find that other parts of the picture do not register. This is because of the raster distortions that arise as a result of the guns being in different positions. The resultant distortions are shown in exaggerated form in Fig. 4. This situation is corrected by feeding special current waveforms through coils inside each



Internal view of the crosshatch and dot generator.

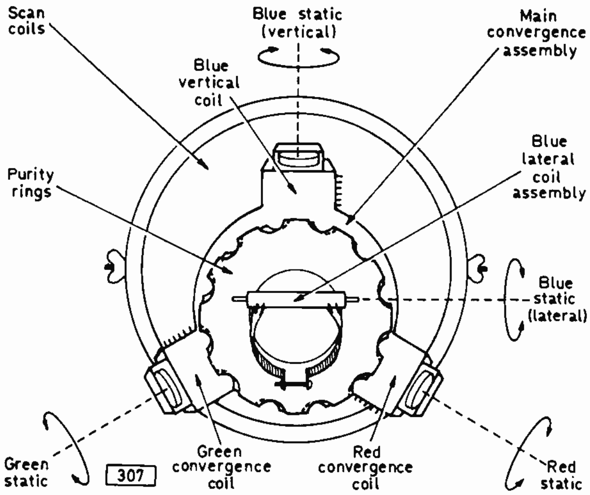


Fig. 2: The usual static convergence adjustments, viewed from the rear of the set.

convergence assembly to "counter-distort" each raster back to rectangular shape so that they register over the whole screen area. This process is known as *dynamic convergence* and involves setting a large number of preset controls for the right degrees of counter-distortion.

A full description of dynamic convergence circuits would take more room than we have here. One reason for their complexity is the need to make the controls easy to use. The controls preset the amplitudes and shapes of the various line and field frequency current waveforms fed through the convergence coils—a mixture of parabolic and sawtooth current waveforms is needed to produce the required raster correction. As a simple example Fig. 5 shows how a parabolic line-frequency current in the blue vertical coil can improve the shape of the blue raster. Further correction, generally including pincushion correction which is obtained by coupling line and field waveforms in a device called a transductor, is needed for full raster correction.

For the red and green rasters the situation is even more complicated since the respective convergence coils act at 45° to the vertical. A matrix control arrangement for these rasters is almost always used so that the result of adjusting each control is almost entirely a vertical or a horizontal movement of the rasters. This makes adjustment easier since one can make separate adjustments for good convergence of the vertical and horizontal lines of a crosshatch

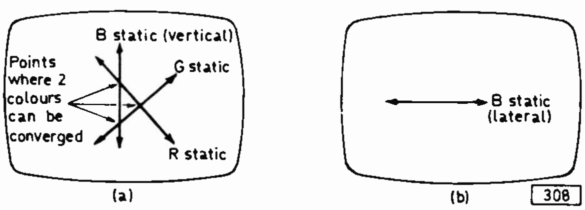
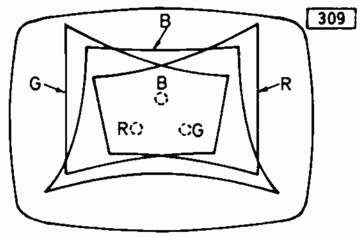


Fig. 3: (a) The R, G and B picture shifts produced by the static adjuster magnets on the main convergence assembly. (b) The shift produced by the blue lateral magnet which is necessary for complete convergence of the B with the R and G pictures.

Fig. 4: With static convergence only, the R, G and B rasters are distorted as shown here (exaggerated). Dynamic convergence is the process of counter-distorting each raster back to its ideal rectangular shape.



pattern. Another aim of dynamic convergence circuit design is that none of the controls should affect the static convergence at the centre of the picture. In fact neither of these two conditions is fully met in practical designs and because of this it is necessary to go through the sequence of static and then dynamic adjustments several times to get a good result.

The type of correction given by each convergence control is clearly stated either by the control or in the receiver service manual and as they are easier to use than to describe we shall not linger on them.

Crosshatch Pattern

It is imprudent to attempt static convergence and utter folly to adjust the dynamic controls on a normal programme picture. What is needed is a stationary picture which shows up any convergence errors. The ideal is a crosshatch pattern of thin vertical and horizontal white lines as shown on the cover. The set photographed had good convergence along the horizontal lines but was way out on the verticals. The dynamic convergence controls on this model can be seen on the fold-up panel at the top rear of the set: by viewing the pattern while making adjustments excellent overall convergence was obtained within a minute of the photograph being taken.

Dot Pattern

Another useful pattern is a regular matrix of white dots. This is of no use for dynamic adjustments but is useful for static adjustment where one aims for good convergence on a single dot at the centre of the picture.

While the transmitted test card can be used at a pinch for convergence adjustments it is a poor sub-

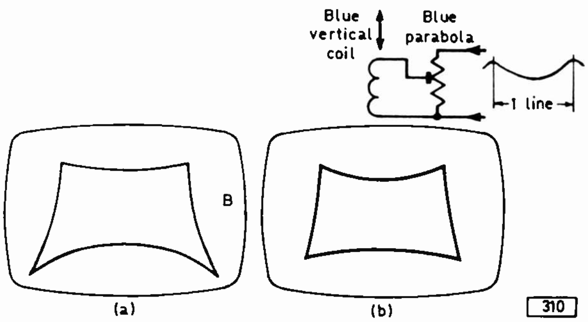
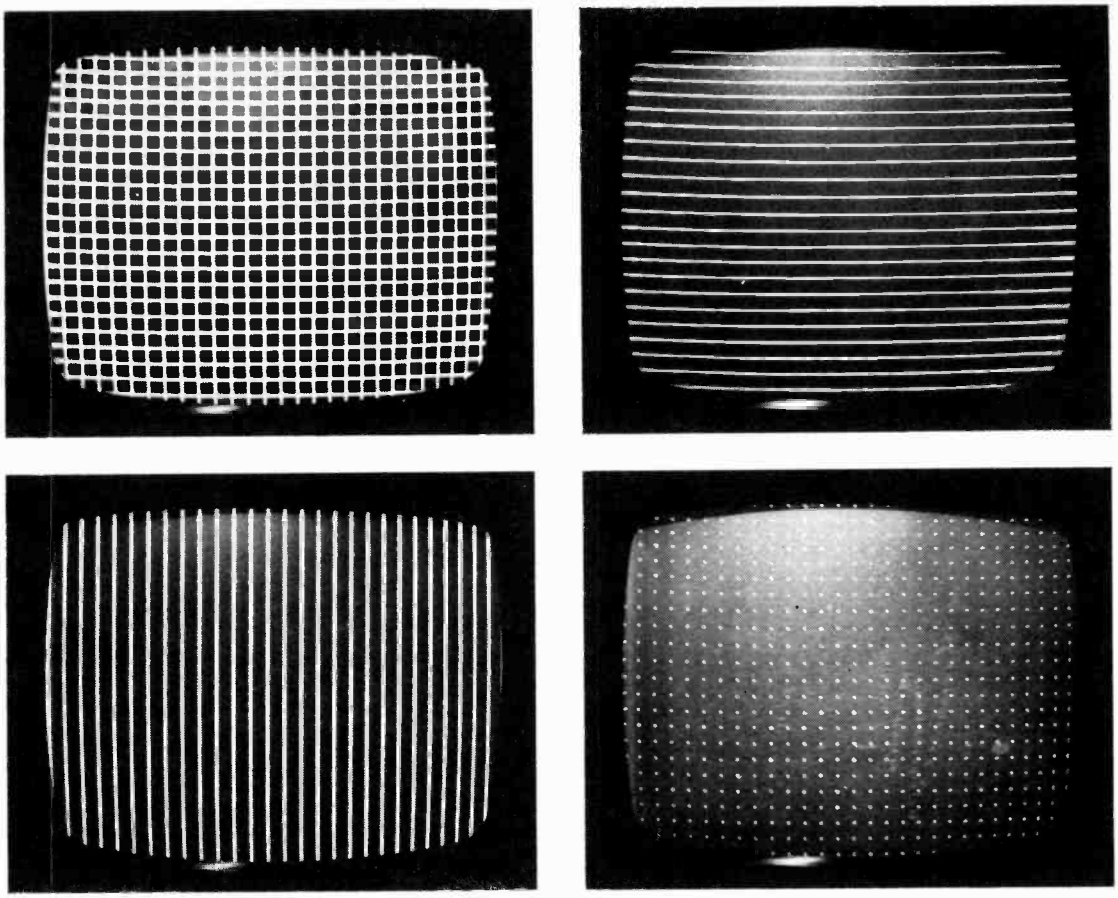


Fig. 5: (a) Exaggeration of the basic B raster distortion. (b) The distortion can be partially corrected by feeding a parabolic line frequency waveform into the blue vertical convergence coil.



Set of four off-screen photographs of the patterns provided by the generator.

stitute for these patterns which can be provided inexpensively by the generator to be described.

Generator Requirements

After experience of using both commercial and home-constructed pattern generators for convergence adjustments I have come to the following conclusions:

(1) Generators which provide an r.f. output suitable for feeding into the aerial socket or i.f. strip of the receiver are best but are necessarily complex and expensive.

(2) A generator which merely produces a video signal for injection at some point after the receiver vision detector can be made very cheaply since it need not generate any sync pulses, the set being synchronised by an off-air transmission. It should be noted that the receiver line and field oscillators must be synchronised during convergence adjustment since there are several time-constants involved in the dynamic circuits.

(3) Previously published designs often suffer from a rather unstable display—excessively so with some makes of set. This can be the result of (a) poor synchronisation between the pattern generator and the receiver or (b) the pattern signal getting into the set's sync separator and upsetting the line or field lock.

(4) A generator for servicing should be compact, portable, self-powered, usable with any set and robust enough to take its chances in a tool kit.

(5) Two patterns in addition to the crosshatch and dot patterns so far mentioned would be useful, namely horizontal lines and vertical lines separately. Although these are merely the two components of the crosshatch pattern it is psychologically helpful to have them when adjusting certain dynamic convergence controls. The range of four patterns is shown in the accompanying off-screen photographs.

(6) It was found possible to satisfy all these points and yet use a minimum of components in the generator by making use of MSI (medium-scale integration) TTL (transistor-transistor coupled logic) i.c.s. The prices of these have tumbled to rock bottom in the past few years.

The full circuit of the generator is shown in Fig. 8 where the three areas within broken lines represent the three digital i.c.s. used.

Circuit Description

The generator picks up line frequency pulses from the receiver by means of a pickup wire placed near the line output stage. No actual connection is necessary since there is considerable stray electrostatic field (alternatively the lead may be connected to a source of positive line frequency pulses in the set —such as may be used for burst gating, blanking, clamping or PAL bistable driving—but it must never

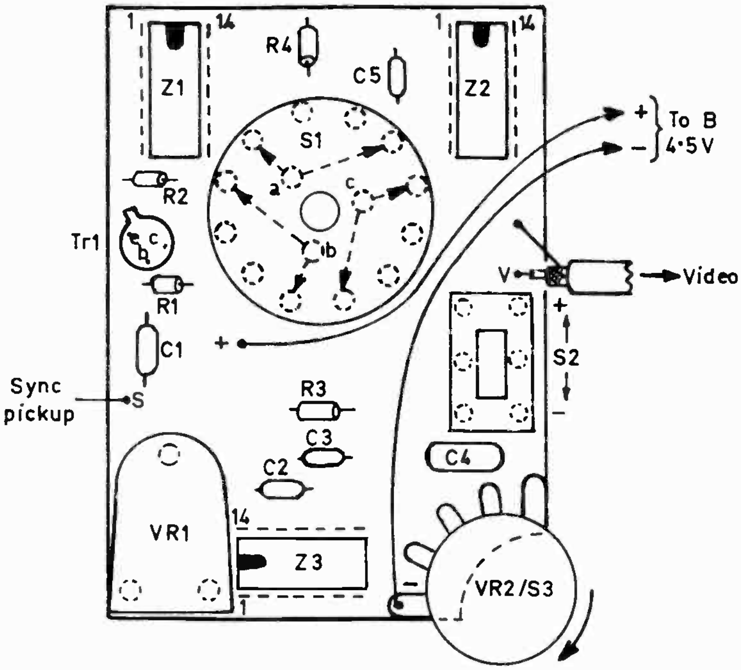


Fig. 6: Component layout and drilling guide.

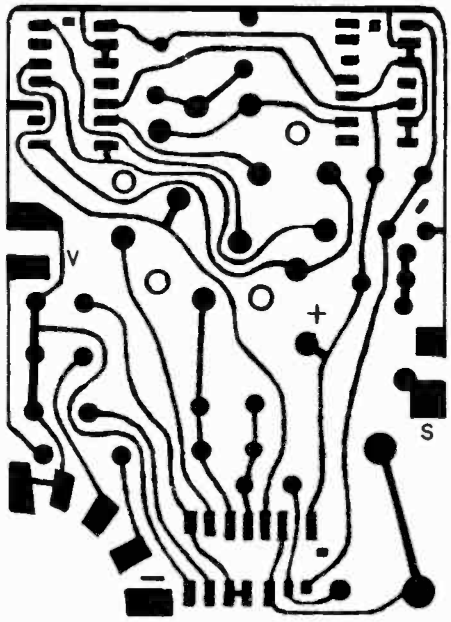


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Fig. 7: Printed board layout, actual size.

COMPONENTS

Capacitors:
C1 33pF disc ceramic
C2 5kpF disc ceramic
C3 100pF or 120pF disc ceramic
C4 0.1μF miniature, e.g. Mullard wasp type
C5 5kpF disc ceramic

Resistors:
R1 1MΩ
R2 1kΩ
R3 4.7kΩ
R4 56Ω
All ¼W, 10% carbon

Potentiometers:
VR1 250Ω preset, e.g. "miniature" skeleton type (horizontal) from LST Components
VR2 5kΩ edgewise volume control with switch (Eagle K416)

Semiconductors:
Tr1 BC109 (other high-gain silicon planar npn types acceptable)
Z1, Z2 SN7490 decade counter (Texas, Siemens, etc.)
Z3 SN7400 quad two-input NAND gate (Texas, Siemens, etc.)

Miscellaneous:
S1 3-pole, 4-way wavechange switch
S2 Small changeover slide switch (one pole of d.p. type used)
B Ever Ready 1289
S3 on VR2
Printed board

Kit: A kit of components, box and printed circuit board is available from Bi-Pre-Pack Ltd., 222 West Road, Westcliff-on-Sea, Essex, at £3.50 including post and packing (battery not included). Note that the board supplied with the kit differs from that shown in Fig. 7, having been optimised to suit the box and components in the kit. Component reference numbers are printed on the board to assist assembly.

be connected to any high-voltage point around the line output transformer or valve/transistor). The waveform picked up normally shows the ringing in the line output transformer and is also likely to contain lower field and mains frequency components. Since these would cause ragged synchronisation of the generator they are removed by the steep differentiator formed by C1 and Tr1 base resistance. Slight forward bias by R1 helps Tr1 give good clean line pulses at its collector. The slight ripple visible in the waveform in Fig. 8 is caused by feedback from the verticals oscillator.

TTL Integrated Circuits

A few notes on TTL i.c.s are needed here. The inputs and outputs of these devices are normally at "0" or "1" where 0 is about 1V (or earth) and 1 is about 4V. Intermediate levels are not considered in describing the characteristics of such devices. By

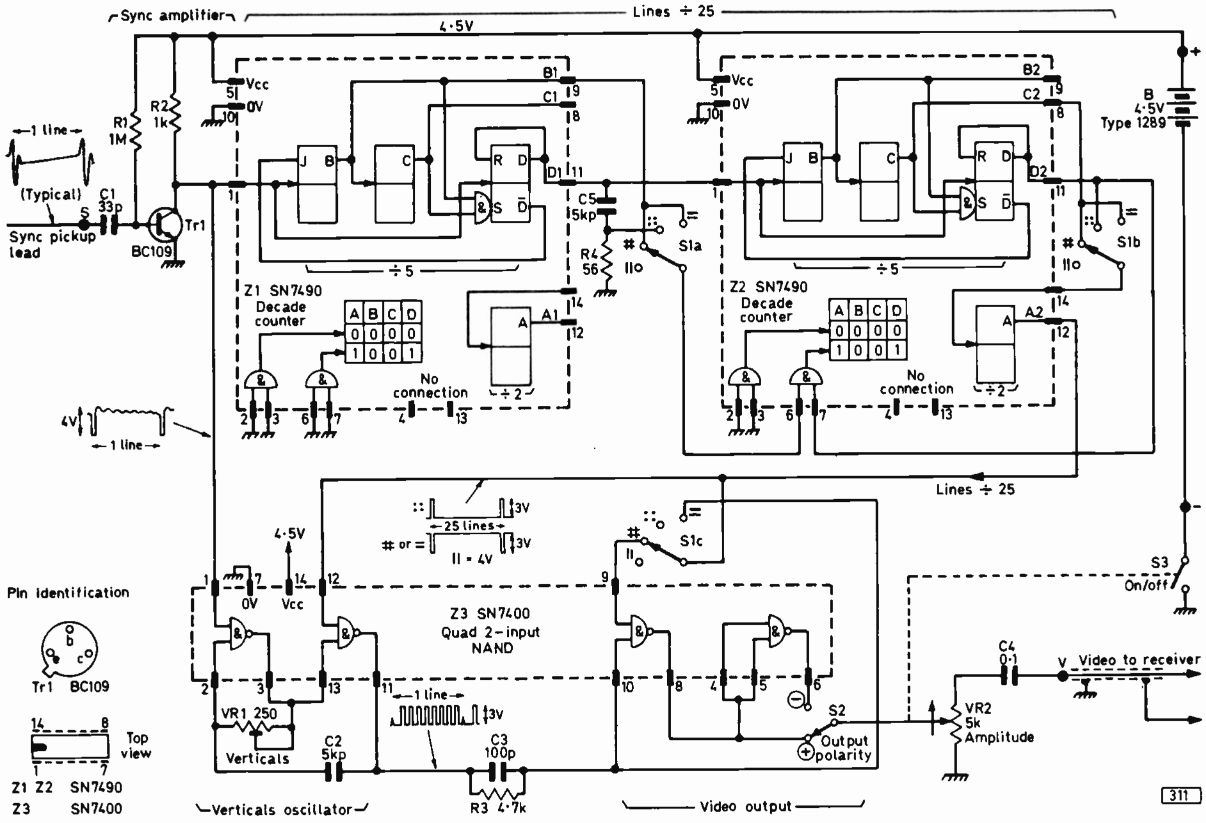


Fig. 8: Circuit diagram of the crosshatch and dot generator. S1a/b/c are the sections of the pattern selection switch.

making the output of such a device switch repeatedly between the 0 and 1 states therefore one can generate a rectangular wave of about 3V peak-to-peak.

A truth table is shown in Fig. 9 for a two-input NAND gate and shows the output states for all possible combinations of input states. An SSI (small-scale integration) TTL i.c. containing four such gates is used in the circuit.

Frequency Division

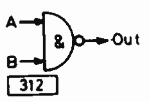
The lines ÷25 part of the circuit produces the pattern of horizontal lines by driving one in every 25 scanning lines white. This number was chosen to give a stable display on a 625-line raster since $625 = 25 \times 25$, i.e. the same 25 lines in each frame are brightened. Two other factors are involved but have no practical consequence.

First as each frame is scanned in two interlaced fields each of 312½ lines, 20ms duration the lines of the pattern have a 50Hz flicker. This is hardly noticeable. Secondly at least one line of the pattern will be lost in the field blanking period. Thus only 24 pattern lines are displayed.

Two MSI decade counter i.c.s Z1 and Z2 are used to do the frequency dividing. Each of these contains a divide by 5 counter and a separate divide by 2 stage. The line frequency pulses are fed to the ÷5 counter in Z1 and produce at the D1 output a 1 on every fifth line (Fig. 10). The action of the ÷5 counter need not be explained since it either gives the right B, C and D output waveforms or it doesn't —and you can't repair an i.c.! The ÷2 stage in Z1 is not used. The D1 output signal is fed to the ÷5 circuit in Z2. The D2 output from this is a 1 for five lines every 25 lines. The problem now is to get from this a one-line wide pulse every 25 lines. Differentiation is one possibility; another is the use of additional gates to combine the inputs and outputs of the counters and this is a common technique used by logic circuit designers. The arrangement chosen by the author is rather unusual but has the features of providing either a 0 or a 1 pulse and of using no extra logic elements. The process is a little complicated since it makes use of the ÷2 stage and the setting inputs of Z2: you will be forgiven if you prefer to skip the next four paragraphs!

The A2 output of Z2 simply changes its state every time a *low-going* edge, i.e. 1 to 0, is fed to pin 14. Also, if 1 is fed to *both* pins 6 and 7 of Z2 (and only then) the current state of the ÷5 and ÷2 counters is overidden and A2, B2, C2, D2 are set to 1 0 0 1 respectively. There is also a pair of pins which similarly sets to 0 0 0 0 but we don't use these.

Suppose the pattern selector switch S1 is set to the dot pattern for which a 1 pulse is needed from A2. Assume (Fig. 10) that A2 is at 0 at line 1. Up to line 20 nothing causes it to change. On line 21 the



A	B	Out
1	1	0
0	1	1
1	0	1
0	0	1

Fig. 9: NAND gate symbol and truth table which summarises the possible input and output conditions.

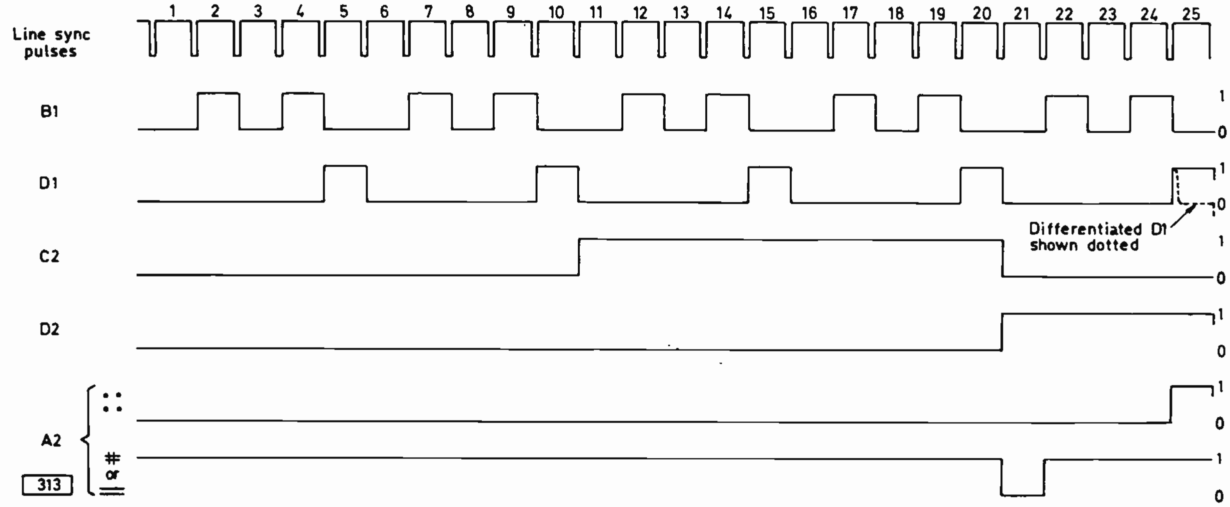


Fig. 10: Waveforms of the lines divided by 25 circuit.

D2 signal which is returned to one of the set 1 0 0 1 pins goes to 1 but this has no effect as the other pin is connected to 0 (earth) via R4. On line 25 however the high-going edge at D1 is differentiated by C5 and passes to the other set 1 0 0 1 pin. Since B2, C2, D2 happen to be in states 0 0 1 anyway (B2 is not shown in Fig. 10) the ÷5 counter is unaffected by this. But A2 is set to 1. On the next line the low-going edge of D2 from S1b causes A2 to change back to 0 where it remains for the next 24 lines. The reason the D1 output is differentiated before going to Z2 pin 6 is that it is necessary to remove at least one of the set 1 0 0 1 inputs some time before a low edge to pin 14 can change A2.

For crosshatch or horizontal line patterns a 0 pulse is needed from A2. Assume that A2 is at 1 on line 1. On line 21 the low-going edge of C2 from S1b causes A2 to change to 0. Also on this line the D2 signal to pin 7 goes high but this has no effect until the following line 22 when the B1 signal to pin 6 also goes high. This activates the set 1 0 0 1 and again only A2 is affected, being put back to 1 where it remains for the next 24 lines.

For a vertical lines pattern a continuous 1 is required from A2. Pin 6 of Z2 is left open-circuit by S1a, which with TTL i.c.s is equivalent to fixing it at 1 (hence the need to earth all unused set inputs of Z1 and Z2). When D2 next goes to 1, A2 will be set to 1 at which it remains indefinitely since no signal is fed to pin 14. The ÷5 counters go on working but their outputs are not used.

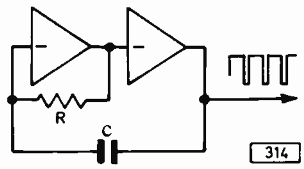
Complex as this sequence may seem it is all performed by just four components and a switch so there is no complexity in the construction.

Verticals Oscillator

The verticals oscillator circuit produces the vertical lines pattern, i.e. it produces a narrow "white" pulse a number of times during each scanning line. This it must do at the same points on every line or the pattern lines will slope.

The oscillator is very simple, using only two NAND gates (half of Z3) and two other components. For the moment assume that pins 1 and 12 of Z3 are both fixed at 1. Inspection of the NAND truth table (Fig. 9) shows that when the A input say is fixed at 1 the gate output is always the *opposite* of the B input. In fact the gate can be regarded as a high-gain inverting amplifier. Thus the verticals oscillator uses the arrangement shown in Fig. 11 where

Fig. 11: Simplified block diagram of the verticals oscillator which uses two of the NAND gates in Z3.



the two amplifiers in series yield a positive loop gain with feedback by C. The oscillator produces an approximate squarewave of frequency set by the *CR* time-constant. In the full circuit (Fig. 8) VR1 is preset to give the number of vertical lines required which can be anything between about 4 and 35, i.e. the oscillator runs at this many times the line frequency. A point about this oscillator is that it is a certain first-time starter, unlike multivibrator arrangements. The oscillator output waveform has a slightly longer 1 period than 0 period due to Z3 pin 2 loading the time-constant. Its leading edges are differentiated to narrow spikes by C3 and the loading effect of the following gate (Z3 pin 10) is such that only the 0-going spikes affect it. The value of C3 is chosen for a reasonable vertical line width—for wider lines increase C3 and vice versa.

The oscillator can be halted by a 0 to Z3 pin 1 since this forces pin 3 to 1. This allows it to be synchronised to the line pulses from Tr1 so that the oscillation starts at the same point at the beginning of each line, giving stable verticals. The sync interruptions can be seen on the waveform for Z3 pin 11 in Fig. 8.

The oscillator can also be halted by a 0 fed to Z3 pin 12 since this drives pin 11 to 1. For a simple vertical lines pattern A2 is always at 1 as described above and the oscillator runs on every line. For a dot pattern, A2 only permits the oscillator to run on one line in every 25. For the crosshatch and horizontal lines patterns the effect of A2 on the verticals oscillator can be ignored.

Video Output

Of the remaining two NAND gates in Z3 one performs appropriate combination of the horizontal and vertical line signals to give the four different patterns while the other has its input pins strapped together to act as an inverter in case a negative-going signal is required by the receiver. For vertical lines or dots Z3 pin 9 is left open-circuit and therefore effectively at 1, the gate simply inverting the negative spikes from C3. The difference between these two patterns lies simply in whether A2 enables the verticals oscillator continuously or only on 1-in-25 lines. For horizontal lines Z3 pin 9 is also at 1 but the 0-going A2 signal fed to pin 10 swamps any signal from the verticals oscillator. For crosshatch the gate combines the 0-going horizontal lines at pin 9 with the 0-going vertical lines at pin 10. All outputs at pin 8 are positive-going and about 3V peak-to-peak, which is more than enough video for most receivers. The slide switch S2 selects either polarity output, though positive-going is nearly always suitable.

Output Amplitude Control

The output amplitude control requires some explanation. One is injecting artificial sync-less video into the receiver at a point after the detector and possibly before the sync separator. If the generator output impedance is too low any sync signal present in the receiver will be swamped and the set will lose lock. If the generator output level is too high the receiver a.g.c. may be sufficiently upset to lose the off-air signal or even cause latch-up. The arrangement of VR2 allows both the amplitude and impedance of the generator output to be varied and makes it easy to use the generator with any set. In practice as VR2 is rotated clockwise the contrast of the off-air picture goes down and the contrast of the pattern comes up until only the pattern is visible. D.C. isolation by C4 avoids upsetting bias arrangements in the receiver and its capacitance is sufficiently large to suit the lowest likely load impedance.

Purists may object to the apparent possibility of a gate output being shortened to earth when VR2 is at minimum. In fact this does not happen since the on/off switch S3 opens before VR2 reaches this extreme, and most TTL i.c.s can tolerate such a short briefly anyway.

Battery Level

TTL circuits are designed to operate from a 5V supply but the generator works satisfactorily from 4.5V which is available in a convenient battery size (Ever Ready 1289, as used in various doorbells, lamps and toys). The effect of a failing battery was investigated: down to 3.8V everything works well; below this the verticals oscillator becomes intermittent resulting in ragged (but usable) vertical lines. If the number of verticals is disregarded VR1 can be set to about 200Ω which gives optimum weak-battery performance. The horizontal lines remain all right until they cease abruptly at 3.4V. Thus the vertical lines give a useful early warning of a failing battery.

Construction

Arrangements have been made with the supplier given in the parts list to supply a suitable box and printed circuit board together with a kit of all the components. Alternatively the board can be home made but care must be taken in view of the narrow track spacings. Also note that alternative components may have different lead spacings. The amplitude control VR2 should be fitted first. This is a common transistor radio edgewise volume control with switch and is best mounted with the solder tags against the component side of the board, soldered to stout wires (cut up a paperclip) which pass through the board to the tracks. This avoids the possibility of the tracks lifting if the control is used roughly. The corner of the board should be cut away to avoid fouling the on/off switch on the control. The rest of the components can now be mounted as shown in Fig. 6. Take special care in positioning the transistor and i.c.s. Use a miniature solder pencil and flow only just enough solder on each joint. For the pattern selector switch S1 the board is designed to take the common cheap 3-pole 4-way "wavechange" type switch which sometimes carries the name Lorlin or Norman. It is worth checking that the "a, b and c" wipers do move as shown in Fig. 6.

Clip short the terminal blades of the Ever Ready 1289 battery so that they cannot touch, then solder the connecting wires to them. The battery should last many months even with regular use in servicing.

The completed board can be mounted in any kind of box by means of the threaded bush of S1 which requires a $\frac{3}{8}$ in. hole. There should be room in any television set to mount the generator permanently, in which case the supply can be derived from the receiver (never allow it to exceed 5V). The prototype was fitted in a two-piece polythene soap box which is available from all chemists. The box was fastened shut by the simple means of a drawing pin driven in at each end. A label can be drawn up on card showing the four patterns in simplified form.

Sync Connection

The sync pickup lead need only be brought within a few inches of the line output stage of any 625-line receiver for the generator to work. The lead should not be bared at the end and must not touch any high-voltage points. With valve timebases it is convenient to loop the lead around the boost diode (PY500). If insufficient sync is picked up the lines ÷5 stage will not work and there will be only a random display of dots (because the verticals oscillator is free running) in place of the crosshatch and vertical line patterns.

Video Connection

The best point to connect the video lead depends on the receiver. Any point between the vision detector and the base/grid of the luminance output transistor/valve (often PL802) should do. Convenient points on some common dual-standard colour sets are as follows.

Philips G25K500 (G6 chassis): To the positive (left hand) end of diode X2152 which is at the centre of the i.f. panel immediately above the system switch.

Decca CTV19 and CTV25 (see the last two issues): To the contrast control slider tag.

Bush Murphy CTV25, CTV2510: The luminance output valve grid is easily accessible at a test point alongside the valve.

BRC 2000 (Ferguson, HMV, Ultra, Marconiphone etc.): To the right-hand rear pin on the luminance delay line, found on the video board at bottom left of the frame.

In fact when in doubt the best course is to feed the signal in at the output end of the luminance delay line.

As the amplitude control is brought up the contrast of the pattern increases until on some receivers it upsets the interlace and then the field lock. If the crosshatch or horizontal lines patterns cannot be brought up to usable contrast before this happens it is probably because a horizontal line is occurring at a critical point in the field sync waveform. The cure is to switch the generator off and on again.

Secrets of Good Convergence

The following adjustments on a colour set all have an effect on convergence and should therefore be done *before* convergence adjustment: height; width; linearity; focus; e.h.t.; purity.

The purity adjustment is simply a matter of adjusting the purity ring magnets, shown in Fig. 2, for pure R, G and B pictures from the respective guns, i.e. no gun should "see" phosphor dots of the wrong colour through any part of the shadowmask. The adjustment is usually performed on a plain red raster, obtained by switching off the blue and green guns and turning down the contrast, since when this is free of off-colour blemishes the other two are usually all right as well. If necessary the scan coils can also be moved to achieve optimum purity by loosening the wing nuts shown in Fig. 2. If good purity cannot be obtained it is probably because the shadowmask needs demagnetising. Purity adjustments have a great effect on convergence: they should not be done casually therefore.

Contrast, brightness, grey-scale, tuning and decoder adjustments have no effect on convergence and can be done at any time.

When going through the dynamic convergence adjustments the final few times plan each new adjustment before making it—since by then the effect of each control should be known—and move the control slightly *less* than seems necessary. Thus the amount of adjustment on each run through should then decrease to zero. If the control for converging the blue verticals goes to one end of its range the wires to the blue lateral coil may need interchanging. If the track of a potentiometer has burnt out it will usually be obvious from the abrupt change in convergence when the control is rotated. Every dynamic control should have a visible effect on the crosshatch pattern: if one doesn't, suspect it and the associated components.

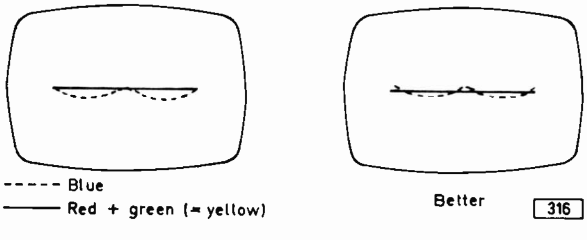


Fig. 12: If two colours cannot be converged together perfectly it is better to distribute the errors, without much attention to the edges of the screen, than to insist on perfect convergence at the centre.

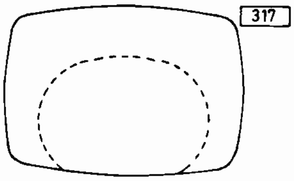


Fig. 13: The viewer is much more likely to notice convergence errors inside the area indicated here than outside it. This is fortunate as it is usually impossible to achieve perfect convergence at the corners of the screen.

It is rarely possible to achieve perfect convergence over the entire screen including the corners and the real skill lies in distributing the remaining errors so they are not noticeable to the viewer. Figs. 12 and 13 should be helpful here. Once converged as finely as possible a colour set should ideally not be moved since merely turning the set through 90° can have a minute upsetting effect on convergence due to the changed relationship of the set to the earth's magnetic field.

Last Month's Puzzler (Page 472)

A diode and a resistor fell out of a colour set but on switching on both picture and sound seemed perfect: where had the components come from? The answer is that the PAL bistable phasing (or "ident comparison") diode and its bias resistor had come unstuck from the decoder board.

The majority of decoder circuits employ a bistable multivibrator to drive the PAL switch which is in one of the feeds to the R−Y demodulator. The purpose of the switch is to compensate for the phase inversion of the transmitted R−Y signal on alternate lines. For correct operation the switch must change state at the same rate as the transmitted R−Y signal phase alternations, i.e. once per scanning line: this is done by triggering the bistable with a flyback, i.e. line frequency, pulse. The switch must also operate in synchronism with the phase alternations of the transmitted R−Y signal—otherwise the output from the R−Y demodulator will be inverted, making red things turquoise and vice versa! To synchronise the bistable multivibrator use is made of the $\pm 45°$ line-by-line phase swings of the transmitted bursts. An ident signal is derived from the bursts and is used to correct the bistable if it is driving the PAL switch in incorrect phase.

If the bistable starts off correctly there will of course be no picture fault—regardless of whether the ident diode is present or not. This is what happened with the set in question. Switching on and off several times would eventually have revealed the fault however—since the bistable is bound to fall into the wrong phase sooner or later. In the actual case it was not necessary to do this as a commercial suddenly came up with greenish flesh tones, a characteristic of reversed R−Y.

Next month we return to Renovating Rentals!

television NOISE figures

GORDON J. KING

One important television receiver parameter is the noise figure which relates essentially to the front-end or tuner. It is particularly important since it determines the aerial signal strength required on a particular channel to produce a picture and sound with subjectively acceptable noise content. Thus if the noise figure is known it is possible to determine from a signal strength contour map of the kind published by the BBC and IBA the type of aerial required.

Thermal Noise

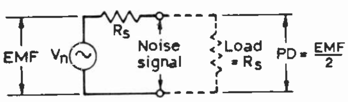
What then is meant by the noise figure? As a result of the random thermal motion of electrons in a resistor minute electrical fluctuations occur across it. This is responsible for one form of noise, thermal noise: the electrical fluctuations represent the noise signal. The resistance concerned could be that of a true resistor, a conductor or be an "apparent resistance" such as the radiation resistance of an aerial.

The expression commonly adopted for determining the magnitude of the noise signal produced across a resistance is:

$$Vn=\sqrt{(4kTBR)} \qquad (1)$$

where Vn is the noise voltage, k Boltzmann's constant (equal to $1{\cdot}38 \times 10^{-23}$ J/deg.), T the temperature in degrees Kelvin (where 0°K is equal to −273°C), B the circuit bandwidth in Hz and R the resistance in ohms. Thus the noise power is proportional to the resistance, the functional bandwidth and the absolute temperature.

Let us consider this in practical terms. Suppose that the resistance is 75Ω (corresponding to an aerial



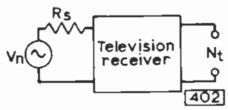


Fig. 1 (left): Definition of e.m.f. and p.d. Rs forms with the input load resistance a signal potential divider so that when Rs and the load are matched the input signal voltage p.d. equals e.m.f./2.

Fig. 2 (right): Vn the aerial source resistance noise is present along with the noise generated by the receiver itself in the total output noise Nt. This is the basis on which the noise figure is determined.

input), the bandwidth 5MHz and the room temperature 20°C (i.e. 293°K). Then we have:

$$Vn=\sqrt{(4 \times 1{\cdot}38 \times 10^{-23} \times 293 \times 5 \times 10^{6} \times 75)}$$

which works out to 2·5μV. Similarly, 7μV of noise would be produced by a 1kΩ resistor in a 3MHz circuit at 17°C. When the temperature is about 17°C (290°K) expression (1) simplifies to

$$Vn=\sqrt{(1{\cdot}6 \times 10^{-20}BR)}. \qquad (2)$$

The noise signal is e.m.f. in series with the resistance responsible for it as shown in Fig. 1.

Noise Figure

The front-end or r.f. amplifier of a television receiver produces at its output more noise than that generated by the effective signal source resistance since noise is also contributed by the valves or transistors and the passive components present in the circuit. To avoid detailed calculation of the various noise sources and to make it easy to compare the noise yield of one front-end or r.f. amplifier with that of another a kind of "figure of merit" is used. This *noise figure* or *noise factor* is defined as the ratio of the total mean square output noise e.m.f. to that part of it which is thermally generated by the source resistance. In other words

$$NF=\frac{\text{Noise at output due to amplifier and source}}{\text{Noise resulting from source}} \qquad (3)$$

With a television receiver Vn is the noise voltage generated by the radiation resistance Rs of the aerial (see Fig. 2). Sometimes in noise-figure calculations the load across which the source is connected is assumed to be noise free (i.e. at 0 K), the noise figure then being the ratio of the input signal-to-noise ratio (S/N in) to the output signal-to-noise ratio (S/N out). That is:

$$NF=(S/N\text{ in})/(S/N\text{ out}). \qquad (4)$$

This expression is best considered in connection with an r.f. amplifier (e.g. an aerial booster amplifier) where the input and output impedances are equal to the characteristic impedance of the feeder cable from the aerial and to the receiver—75Ω in the UK.

Let us suppose that the signal e.m.f. delivered by the aerial is 1,000μV r.m.s. on peak picture voltage and that the aerial radiation resistance is 75Ω. The noise as we have seen would at normal temperature be at a level of 2·5μV, which is r.m.s. e.m.f. Now both the signal and the noise will be correctly terminated at 75Ω by the input load of the amplifier, which is assumed to be noise-free. Thus the potential difference (p.d.) across the 75Ω perfect load will be 500μV signal and 1·25μV source noise, giving an input signal-to-noise ratio of 500/1·25 or 400:1.

If the amplifier has a 20dB gain the output signal will be 5,000μV and the source noise will have been amplified by a similar amount. But the total noise at the output will be greater than 12·5μV owing to the noise generated by the active and passive components in the amplifier. If the total noise at the output is 50μV, which is fairly typical, then the output signal-to-noise ratio will be 5,000/50 or 100:1 and the noise figure 400/100 or 4:1. Since we are working in voltages this could be expressed as 12dB (i.e. 20 $\log_{10}$ 4=12dB).

Because the signal and the source noise are amplified equally there is no need to take the gain of the amplifier into account. For example in the above case S/N in is 500/1·25 or 400:1 while S/N out could be 500/5 or 100:1 giving the 4:1 noise figure as before. We are dealing in ratios and in both cases we find that the amplifier contributes noise to the extent which makes S/N out four times less than the idealised S/N in.

It will also be apparent that the noise figure takes no heed of the signal strength since when S changes on one side of the noise figure ratio it changes correspondingly on the other side—see also expression (3). Thus the noise figure is determined entirely by the noise characteristics of the aerial and r.f. amplifier or front-end, the ratio diminishing (i.e. the dB value becomes smaller) as the noise contributed by the amplifier falls. Some of the latest transistor r.f. amplifiers have noise figures of 2:1 or slightly less, the figure for tuners being somewhat higher owing to the converter stage noise. For valve television amplifiers and tuners the figure sometimes rises to 8:1 depending on channel and band.

Although signal and noise *voltages* have so far been considered it is sometimes convenient to work in power ratios since the calculations need not then take account of impedances. Noise voltages can of course be added only by taking their squares (i.e. noise adds in quadrature). It is also worth remembering that while a signal strength meter may be scaled in e.m.f. volts, the signal from the source (such as the aerial) corresponds to the potential across the load: when the source and load are of the same value (matched) this potential (p.d.) equals e.m.f./2 (see Fig. 1). The same may apply to a television r.f. signal generator: the attenuator calibration is commonly in e.m.f. volts from a 75Ω source while the signal across the input load of a receiver connected in circuit is the potential across its input circuit.

Signal-to-Noise Ratio

Amplification increases the gain of a receiver but the *usable sensitivity* is dictated by the noise figure. At a given sensitivity the lower the noise figure the lower the aerial signal required for a given sound/vision noise performance. Obviously a realistic sensitivity value must be sought, and as amplification is introduced to secure this so the noise figure tends to rise. The aim is for the highest possible sensitivity consistent with the lowest attainable noise figure.

Signal-to-noise ratio on the vision side is sometimes expressed as the r.m.s. voltage on peak picture signal to the r.m.s. voltage of the noise (unweighted). Subjectively the noise shows up on picture as background "grain" and on sound as background hiss. Vision noise is more troublesome than sound noise because the vision channel has a wider bandwidth and because the eyes are more sensitive to the effect of noise than the ears. Signal-to-noise ratio is thus commonly taken as relating to the vision signal.

Original estimates put the least acceptable signal-to-noise ratio at around 25dB. In practice however viewers are prepared to accept a poorer ratio than this in fringe areas of particularly poor signal field and manufacturers tend to design down to about 10dB signal-to-noise ratio. When the ratio is some 42dB the picture noise is barely noticeable on monochrome (the equivalent is about 46dB on colour). Obviously a higher ratio than this "threshold" value is desirable.

It is possible to calculate S/N out for a given aerial input when the noise figure of the amplifier or receiver is known. One expression for this is:

$$S/N\,\text{out} = S/N\,\text{in} + Va - NF \qquad (5)$$

where S/N in is the idealised ratio (i.e. with a noise-free load) in dB at 1mV p.d. input, Va the actual aerial input p.d. across the load referred to 1mV and NF the noise figure also in dB.

At normal temperature (say 17°C) the noise p.d. will be 1·25μV so that at 1mV p.d. input the S/N in will be 1,000/1·25 or 800:1 which is close to 58dB. Suppose that the aerial signal is 500μV e.m.f. from a 75Ω source and that this is correctly terminated by a 75Ω noise-free load: the available p.d. across the load will be 250μV and Va will be 250/1,000, which is −12dB. If the noise figure is say 5dB we get:

$$S/N\,\text{out} = 58 + (-12) - 5 = 41\text{dB}.$$

As the level of the noise is fixed the S/N performance can only be enhanced by increasing the aerial signal. For example if the aerial signal voltage is doubled then S/N out will improve by 6dB while if it is halved it will deteriorate by 6dB.

Measuring the Noise Figure

There are various ways of measuring the noise figure of a receiver or amplifier but all require specialised equipment. For the sake of completeness however one method will be explained. This requires the use of a noise generator and a receiver which has previously had its noise figure established by a separate test. The set up is shown in Fig. 3.

The idea is first to establish the noise figure of the standard receiver by connecting the noise generator directly to it, ensuring that the termination is accurate. A reference readout with the −3dB attenuator switched off and the noise generator at zero is then obtained. The −3dB attenuator is next switched in and the noise generator output turned up until the reference readout is again obtained. The noise figure of the test receiver is then given by the noise generator attenuator setting. If this is given in a dB ratio a direct ratio conversion can be made.

The item under test is then interposed between the noise generator and the standard receiver and the procedure repeated to obtain the noise figure of the test item and the standard receiver together. The following expression is then used to find the noise figure of the test item:

$$NF = NF\,\text{tot} - (NF\,\text{r} - 1/G) \qquad (6)$$

where NF is the noise figure of the test item, NF tot

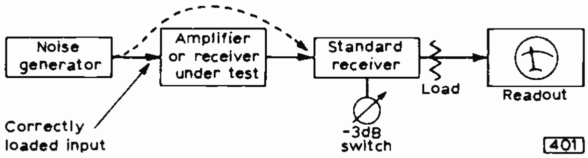


Fig. 3: One method of measuring the noise figure.

is the total noise figure, NF r the noise figure of the standard receiver and G the gain of the test item.

It is essential that direct *power ratios*, not dB ratios, are used in the above expression. The receiver must of course be tuned to the same frequency as the test item and the readout can be an electronic testmeter (e.g. valve or transistor voltmeter). The r.m.s. value of the noise should really be read but as true r.m.s. reading meters are scarce rectified average-reading meters are often adopted; although these are calibrated in r.m s. values for sinewave signals they read 1·05dB low on noise signals.

Other Noise Sources

It is as well to know the noise sources other than thermal noise that contribute to the noise figure. First there is aerial noise. Then with valves there are two other noise sources—usually considered together—shot noise and partition noise. The former results from the random arrival of electrons at the anode and the latter from the irregularity of the partition of the electron stream between the anode and screen grid (or other electrodes) of multi-electrode valves. When a valve is operated at high frequency the electron transit time also assumes an importance owing to additional random fluctuations between the grid and cathode. This is called induced grid noise, the effect being to damp the input so that from the noise point of view it looks like a resistor. A valve in fact is often given an equivalent noise resistance which is a figure of merit noisewise —the higher the R eq the greater the noise contribution. In a television set there is also the frequency changer stage to consider: this adds further noise which is greater than that produced by a straight amplifier.

Transistor Noise

Noise in transistors includes thermal noise generated by the base resistance, shot noise associated with the movement of carriers across the emitter-base junction, shot noise due to Icbo, partition noise due to the partition of carriers between the base and collector and excess noise resulting from the collector-base junction. This noise has a $1/f$ spectrum while all the other noises are white (i.e. have even spectrum distribution). While valves are given an equivalent noise resistance transistors are often given a noise figure which makes it easy to select a suitable type for low-noise applications.

The noise performance of a transistor television set front-end is superior to that of a valve front-end, especially at u.h.f., so that for a given signal-to-noise ratio a transistor front-end requires less aerial signal than its valve counterpart.

Cosmic Noise

There is also cosmic noise, which appears to come from the general direction of the constellations Satittarius and Cygnus. This noise is indistinguishable from that produced by the aerial source resistance. It has been estimated to represent a power up to 80 times maximum in ratio to the noise power expected from the aerial source resistance and varies continually. Its effect is greatest on the low Band I channels, falling off significantly at u.h.f.

Aerial Choice

For a 75Ω television aerial the terminal voltage (i.e. that across the terminating load) is equal to

$$V=\frac{\lambda\sqrt{G}}{2\pi}E \qquad (7)$$

where V is the terminal voltage (i.e. p.d.), G the gain of the aerial relative to a half-wave dipole, λ the signal wavelength and E the signal strength in V/m. The field strength contour maps issued by the BBC and IBA give us E so that it is possible to calculate the aerial signal that will be obtained. The signal e.m.f. indicated by a signal strength meter would be double the value obtained from this calculation for the reasons previously mentioned.

Given the noise figure of the receiver on the channel concerned we can use expression (5) to determine S/N out along the lines already described. Alternatively we can use expressions (5) and (7) to find the aerial gain required for use in a given signal field to provide an acceptable signal-to-noise ratio.

At u.h.f. the signal extracted from a given field is much less owing to the smaller signal wavelength. This however is significantly balanced by the higher powers used by u.h.f. stations and by the greater gain that can be achieved with u.h.f. aerials of given size.

Signal Boosting

Nevertheless there are often situations, particularly on the u.h.f. channels, where the aerial system has been fully optimised yet the noise figure of the receiver is too great to give an acceptable signal-to-noise performance. We have seen that the noise of the receiver is fixed and that there is very little that can be done in that area to reduce the noise figure. By interposing a low-noise amplifier between the aerial and the receiver input however the overall noise figure can sometimes be improved quite significantly, particularly when the tuner is of the valve variety.

The overall NF of a number of cascaded stages can be calculated as shown below:

$$NF\text{o} = NF_1 + \frac{NF_2 - 1}{G_1} + \frac{NF_3 - 1}{G_1 \times G_2} + \text{ etc.} \qquad (8)$$

where NFo is the overall noise figure, NF_1, NF_2, NF_3 etc. are the noise figures of the first, second, third etc. stages and G_1, G_2 etc. are the power gains of the first, second, third etc. stages.

Since the first stage is more important than the subsequent stages from the noise point of view this stage should always have the lowest possible noise figure and the highest gain. On this basis expression (8) can be simplified to:

$$NF\text{o} = NF_1 + \frac{NF_2 - 1}{G_1} \qquad (9)$$

where NF_1 and G_1 are the noise figure and the power gain of the first stage.

Using this simple expression we can discover the improvement possible to the overall noise figure by adding a low-noise booster amplifier. Suppose for example that the receiver has a Band V noise figure of 14dB—typical of early valve tuners—and the booster amplifier a noise figure in the same channel of 6dB with 10dB power gain. Then

$$NFo = 4 + \frac{25 - 1}{10}$$
$$= 6{\cdot}4:1, \text{ or about 8dB.}$$

This reveals a noise figure improvement of 6dB which means a much cleaner picture. Notice incidentally that the dB ratios have been converted to direct power ratios for substitution in the expression (i.e. 6dB $\simeq$ 4 power ratio and 14dB $\simeq$ 25, refer to any standard decibel table such as for example page 77, *Newnes Radio Engineer's Pocket Book*, latest 14th edition).

We have seen then that there is a great deal more to the simple signal-to-noise ratio expression than is commonly thought. At the conclusion of the u.h.f. coverage quite a few viewers will almost certainly find that the noise on their pictures is barely acceptable and this will be aggravated with colour reception. For such enthusiasts as well as for the DX disciples of Roger Bunney it is hoped that these notes will be of assistance. ■

Servicing the Channel Change Switch on the Sobell-GEC 1038-2038 Series

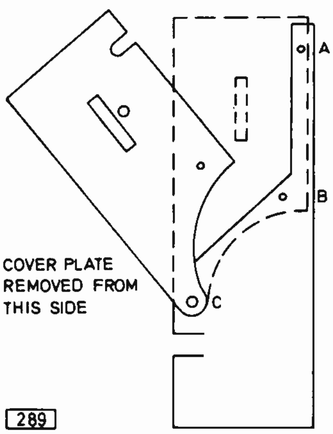
by Robert Bernard

THE five-position permeability tuner unit used in the GEC/Sobell 2038/1038 series is also incorporated in the GEC 2018/22/43/64 series and the Sobell 1018/22/43/64 series of television receivers which have proved to be as popular and reliable a range of models as any during the last few years. As with many turret tuners however the channel change switch contacts require attention from time to time.

Anyone who is not acquainted with the unit and who attempts to dismantle it for the first time may well be deterred by what appears to be a formidable task. Yet it is quite simple if the following procedure is adopted.

Having pulled the control knobs off and released the system switch link carefully note the connecting points for all leads on the tuner and i.f. panel. The aerial lead and the u.h.f. i.f. input lead should be unsoldered. Unplug the connections to the i.f. panel and remove the tuner from the cabinet.

Remove the forked lever which actuates the slider switch by unscrewing the large-headed screw and its 6BA locking nut. Then remove the two-pronged damping spring as well as the pivot screw in the projecting part of the slider.



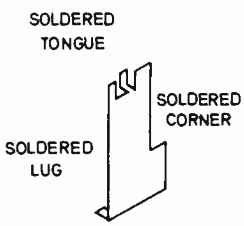


Fig. 1 (left): Identifying the front face of the tuner unit.

Fig. 2 (right): The screening plate.

Next take off the large cover plate by unscrewing the two 6BA fixing screws. Remove from the front and rear face of the tuner the 8BA screws (some earlier versions use No. 2 self-tapping screws) at B in Fig. 1. The screws at A may only require to be loosened as the tuner body is conveniently slotted at this point.

The two sections can now be hinged apart—they pivot on the screws at C as indicated in Fig. 1—to give access to the switch slider. Take care not to kink the core support wires during this process!

Before the slider can be taken out it is necessary to remove the screening plate (shown in Fig. 2) which is fixed vertically under the r.f. valve socket. The plate is soldered in position at three points and you will probably also have to ease the tongue and lug away with the tip of a small screwdriver. Next take off the slider bearing brackets which are held in by the small screw near each end of the slider.

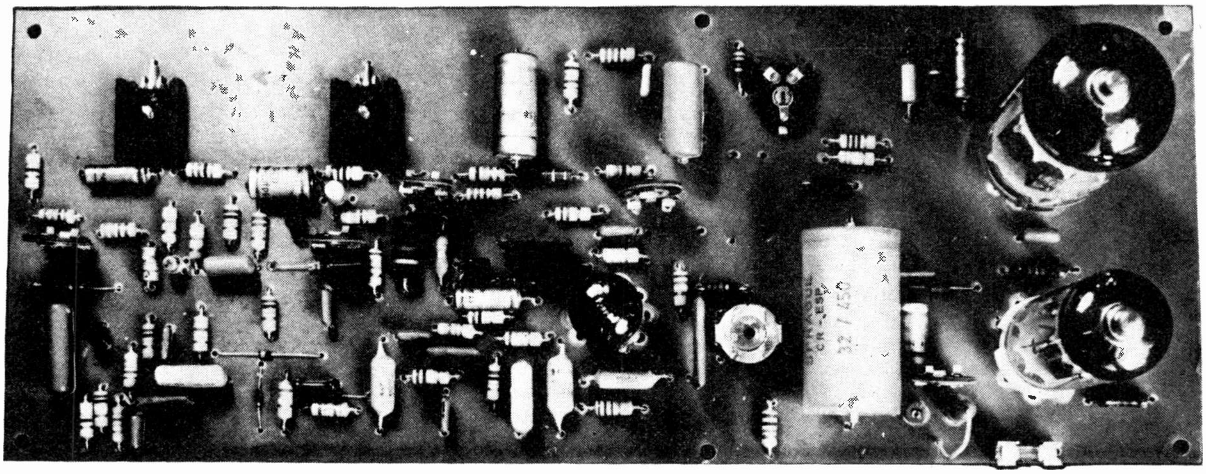
The slider must first be pulled out at the pivot screw end in order to release the opposite end. It should then be extracted by that end which is now free. Take care not to damage the springy contacts as the slider rises.

The exposed switch contacts can now be adjusted as required. Clean them with a piece of impregnated wadding such as Duraglit then polish with a rag and finally lightly smear over them a little silicone grease or Electrolube 2GX.

After service the slider should be carefully replaced and the unit reassembled in the reverse order to that detailed above, replacing the slider brackets, resoldering the screen and so on.

If the screws at C on which the tuner hinges need to be loosened the one on the front face is easily accessible but in order to adjust the other screw (on the rear face) it is necessary to take off the cam end plate as well as the cam assembly. Before removing this item note the position of the 4BA grub screws so that the system switch coupling and the wavy plates can be correctly aligned when the tuner is installed in the cabinet. If it is necessary for the screws at C to be completely removed note that they are only ⅛in. long. To avoid fouling any part of the mechanism they must not be replaced with longer screws. For the same reason any washers etc. which have been removed must be replaced. ■

THE 'TELEVISION' COLOUR RECEIVER PART 6
TIMEBASE BOARD



THE timebase module of our receiver contains the sync separator, flywheel discriminator, line oscillator and output and the field oscillator and output stages. The line output transformer itself and its ancillaries are mounted in the cabinet and do not form part of the timebase printed circuit board. The full circuit of the module is shown in Fig. 3.

Sync Separator

The 4V negative-going video signal (i.e. with positive-going sync pulses) present at point 2N on the i.f. strip is passed to input point 4D on the timebase board. The d.c. conditions of the waveform are established by the d.c. restoration circuit consisting of the input coupling capacitor C301, resistor R302 and the diode junction comprising the base and emitter of Tr301. The long time-constant of C301/R302 keeps the d.c. restored level of the sync tips quite constant despite short-term fluctuations in picture content or as a result of noise. The base bias voltage set by the ratio of R301 to R302 ensures that Tr301 conducts on only the very positive tip of the sync pulses but that the transistor then fully bottoms.

Diode D301 in the emitter circuit of Tr301 gives some protection to the base-emitter junction of the transistor which is operating in a very high gain condition. The collector load R303 is decoupled at its h.t. end by C302, the sync pulses at the collector being of course negative-going. Operation from the 220V rail ensures that the sync separator can provide sufficient pulse amplitude to directly drive the line oscillator.

The feed capacitor C313 taking pulses from the collector of Tr301 to the line flywheel discriminator is of small size (120pF) so that in combination with the conduction resistance of D307 there is a small time-constant differentiator circuit—the standard method of separating the line sync pulses from the field content. The time-constant chosen is not as low as it might have been, giving protection against too great a distortion of the field blanking pulses and thus preventing line shift particularly over the first few lines of each new scan.

Flywheel Sync Circuit

The reference signal for the flywheel discriminator is applied to the circuit at 4G from the line output transformer. The negative-going flyback pulse amplitude at 4G is about 750V peak. R335 is connected in series with the feed as a current limiting resistor in the event of large voltage flashovers that might occur on the line output transformer. C315 acts only as a coupling capacitor to give d.c. isolation. The 750V flyback pulse is integrated by R334 and C317 to produce a sawtooth reference waveform of about 25V pk-pk at the junction of D306 and C315, being effectively developed across C317. The simple phase detector D306/D307/R332/R333 produces voltage changes across C317 in accordance with the phase difference between the reference sawtooth and the incoming sync pulses.

The d.c. voltage corresponding to the correct phasing of the two signals should be zero but in the absence of incoming sync pulses there is a tendency

Table 1: Components List

Component—Pack 10

Tr301 BC147	R301 4·7MΩ	R316 25kΩ	R329 47Ω	R345 56kΩ
Tr302 BC148	R302 100kΩ	(preset)	R330 560Ω	R346 1kΩ
Tr303 AC128	R303 82kΩ	R317 18kΩ	R331 220Ω	R347 330kΩ
Tr304 2N5492	R304 6·8kΩ	R318 470Ω	R332 270kΩ	R348 1·5MΩ
or BD131	R305 15kΩ	R319 22Ω	R333 270kΩ	R349 5MΩ
Tr305 2N5492	R306 820kΩ	R320 15Ω	R334 47kΩ	(preset)
or BD131	R307 15kΩ	R321 500Ω	R335 10kΩ	R350 3·3MΩ
SCS301 3N83	R308 3·3kΩ	(preset)	R336 100kΩ	R351 2·7kΩ
D301 BA154	R309 500Ω	R322 1kΩ, 2W	R337 10kΩ	(wire-wound)
D302 BA154	(preset)	R323 3·3Ω	R338 18kΩ	R352 10Ω, 1W
D303 OA47	R310 680Ω	R324 VA1034	R339 1kΩ	R353 330Ω
D304 BA148	R311 10kΩ	R325 5·6Ω	R340 120kΩ	(wire-wound)
D305 BA148	R312 470kΩ	R326 2·7Ω	R341 150Ω	R354 100Ω
D306 BA155	R313 470kΩ	R327 220Ω	R342 120kΩ	(preset)
D307 BA155	R314 22kΩ	R328 500Ω	R343 2·2kΩ	R355 1·5kΩ
D308 BA148	R315 47Ω	(preset)	R344 33kΩ	VDR301 E298ZZ/06

All resistors ½W, 5% except where otherwise indicated above. All presets are 0·3W vertical mounting.

C301 1μF	C308 50μF, 40V	C314 150pF	C320 10μF, 64V	C326 10nF
C302 100nF	C309 25μF, 25V	C315 10nF	C321 1nF	C327 200pF, 6kV
C303 10nF	C310 250μF, 25V	C316 220pF	C322 3·3nF	C328 100nF
C304 470nF	C311 47nF	C317 4·7nF	C323 470pF	C329 100μF, 6·4V
C305 22nF	C312 2·2μF	C318 10nF	C324 32μF, 350V	C330 47pF
C306 4·7μF, 64V	C313 120pF	C319 470nF	C325 390pF	C331 200μF, 10V
C307 220nF				

Electrolytics are indicated in this list by working voltage; C327 is a pulse ceramic; 1 and 2·2μF are non-electrolytics; C321 is type C296 polyester; all others are 10% miniature foil, polyester, polystyrene or mica types. C322 must be a 5% type.

IEC values of 47μF, 22μF and 220μF may be supplied in place of 50μF, 25μF and 250μF.

2 off heatsinks ¾in. × 1in. Wire for L301.

Siferrit N22/250A pot core with adjusting screw, single section bobbin and 4-pin p-c mounting assembly, Siemens pot core adjusting tool.

Component—Pack 11

V301 PCF802
V302 PL509
V303 PY500

Component—Pack 12

B9A printed-circuit valve base
2 off printed-circuit B9D valve bases

Component—Pack 13

3 off "00" printed-circuit fuseholders
2 off 500mA "00" fuselinks
2 off test-point sockets (printed-circuit mounting)
1 off test-point plug

Miscellaneous

Printed circuit board

Component—Pack Suppliers

No. 10 A. Marshall & Son Ltd., 28 Cricklewood Broadway, London, NW2.
Cost: £7·15 including postage.

No. 11 R-B Television Services, 82 North Lane, East Preston, Sussex.
Cost: £2.55 including postage.
(Either BVA or Toshiba valves will be supplied.)

No. 12 Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk.
Cost: £0.44 including postage.

No. 13 East Cornwall Components, PO Box No. 4, Saltash, Cornwall, PL12 4AL.
Cost: £0.76 including postage.

Printed Circuit Board (TV TB 1)
E. J. Papworth & Son Ltd., 80 Merton High Street, London SW19.
Cost: £2.00 including postage.

Readers should order components from the suppliers as "Component-Pack No. . . ." for the TELEVISION Colour Receiver Project. Note that Pack No. 13 contains a spare fuse for this module and two fuse holders to be used later in the power supply module of the receiver. Any enquiries regarding the supply of individual components should be addressed directly to the suppliers.

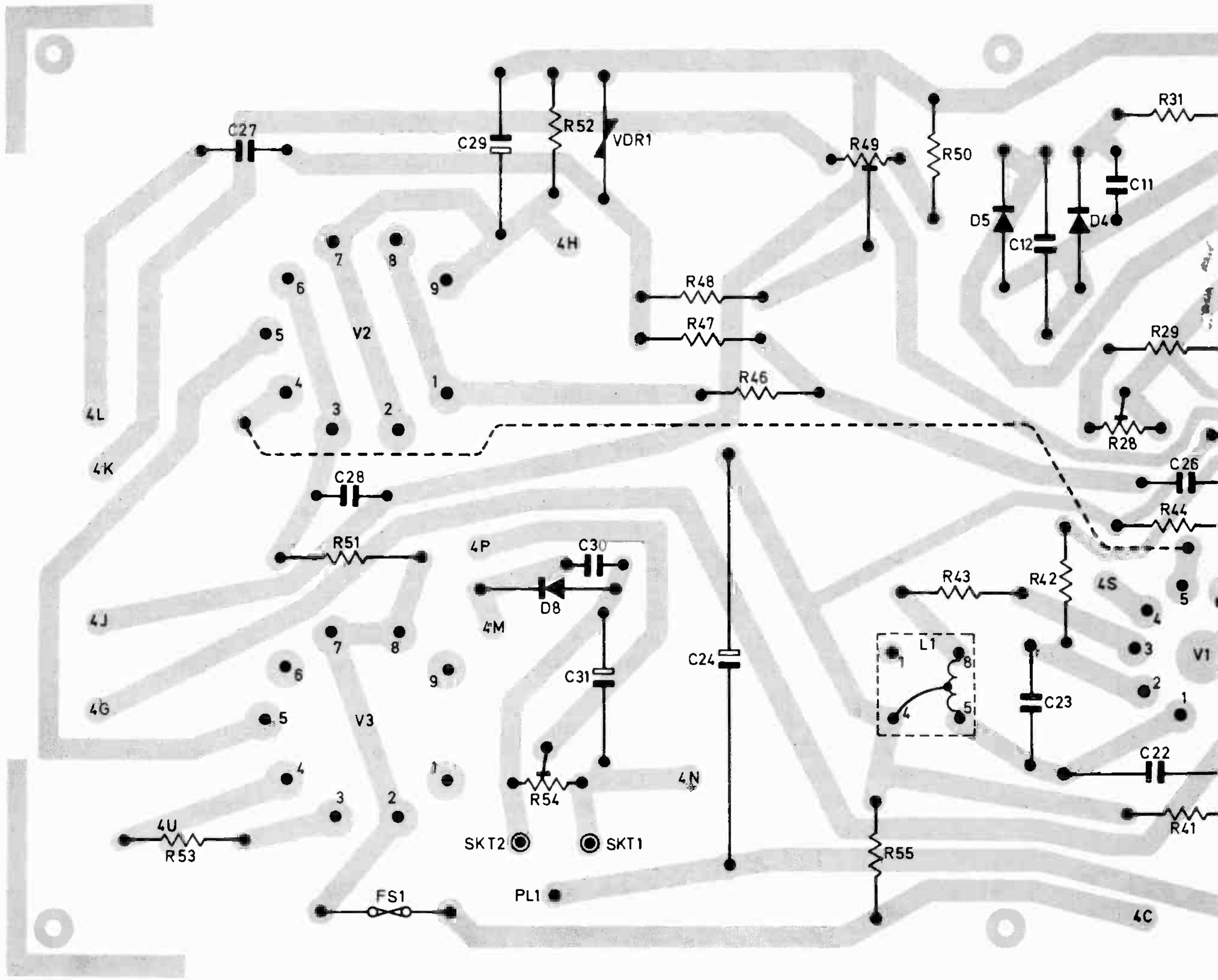


Fig. 1: Layout of the timebase board, viewed from the copper print side (all components are mounted on the other side of have been omitted from the component reference numbers, i.e. C1 above is C301 in the circuit diagram, C10 above is C31

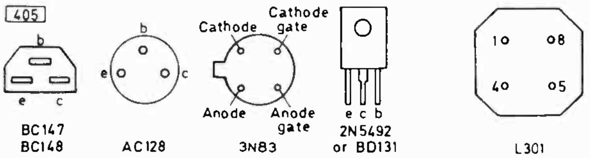


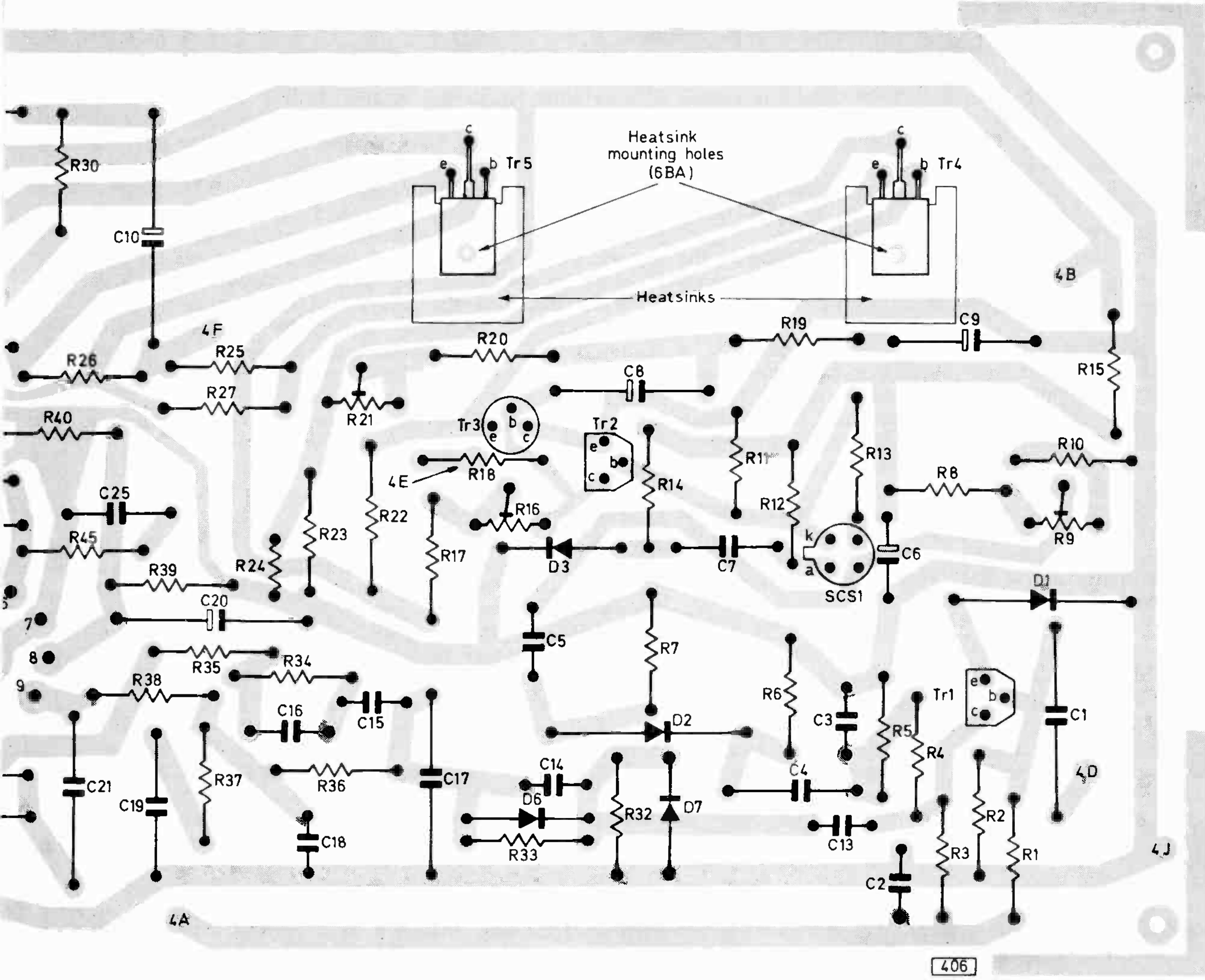
Fig. 2. Base connections, viewed from below except for the 2N5492 (or BD131) which is viewed from the side with the device number on it. In the case of the Siferrit pot core (L301) note that pin 4 is the centre tap.

for D306 to conduct through C313 on the tips of the reference sawtooth. The charge set up on C313 due to this small current creates—through R333—an error voltage on the correction line. There would be a tendency therefore for the line oscillator to drift in frequency when for example channel changing takes place. The effect can be at least partially cancelled out by providing through C314 a separate conduction path for the reference sawtooth. The charge on C314 is thus effectively subtracted from that on C313, the effect of C313 being balanced out depending on the comparative capacitance values of the two components.

Smoothing and integration by means of R336/C318/R337 and C319 are applied to the control voltage before it is fed via the grid stopper resistor R338 to the control grid of the triode section of the line oscillator stage.

Interlace Diode

The second path from the sync separator output is to the field oscillator. The feed employs a series-connected clipper diode (D302) so that in combination with the integrator R304/C303 and the differentiator of C304/R306 residual line pulses and noise are removed. The resistance ratio of R304 to R305 slightly reduces the level to the diode while the combination of R304 and R305 dictates to a large extent the highest voltage to which the collector of Tr301 will rise outside the bottoming instants. The return d.c. path for the clipper diode is provided through



the board). Actual size of the board is 13¾in. x 5⅜in. To make the lettering as clear as possible the board code prefixes 0 elsewhere and so on.

R307. The field sync pulses are then coupled through C305 to the field oscillator stage.

Line Oscillator

For the home constructor a valve line output stage is less hazardous both in construction and setting up. But to get sufficient drive level for a valve output stage and to give warm-up protection it is desirable that the line oscillator is also controlled and constructed using a valve.

The oscillator circuit used is in Hartley form (split inductor) and is connected in the classic manner. The oscillator proper consists of the pentode section of V301, with L301 and C322 forming the Hartley tuned circuit. The PCF802 is of course the usual valve for this application, with the triode section used as the reactance control stage.

For reactance operation the triode section must be coupled across the main tuned circuit in such a way that changes at the grid of the triode cause changes in the oscillator frequency. The oscillator signal must be present in the triode stage in order to achieve this. At one time this was achieved by using a common, undecoupled cathode resistor for both sections of the triode-pentode valve. In the case shown here the quadrature signal required by the triode is developed across R341, which is connected in series with the oscillator tuning capacitance, and fed to the control grid of the triode through C321.

The only other control signal at the grid of the triode is the d.c. signal from the flywheel discriminator, and as a result of the relatively long time-constant integration this is almost pure d.c. This d.c. signal adjusts the amplification given by the triode to the quadrature signal fed to it via C321 and the different degree of matrixing of the two signals present in different phases at its anode causes the frequency changes required. Matrixing takes place because the anode current path of the triode is through the oscillator coil.

C323 operates as the d.c. block in the oscillator feedback path from the screen to the control grid of the pentode.

The stability of the oscillator should be such that it requires no adjustment after the initial setting-up. To allow for tuning capacitor tolerances and to a lesser extent circuit strays some variation must be possible and this is provided by making the tuning inductor L301 variable. We are using a pot core for L301 with an adjusting screw that gives a 20% possible variation in inductance.

With C322 3·3nF the inductance value of L301 should be 31·4mH for oscillation at 15·625kHz. Allowing for circuit strays and the tolerance of C322 the value for L301 decided on was 29mH: the increase in inductance of 20% given by the screw adjuster provides a possible range of up to about 34·8mH.

The Hartley oscillator is of course basically a sinewave generator and the output must be shaped so as to provide a switching signal to control the line output valve V302. The required waveform is produced by R345 and C325 whose values are chosen so that the boost diode (V303) is just conducting at the end of the line scan.

For convenience the line oscillator is run from the same 295V h.t. rail as the line output stage. R355 reduces the h.t. voltage to a level more suitable for the oscillator and C324 is fitted to decouple this dropper.

Line Output Stage

The line output stage operates in a fairly conventional manner, the shaped drive waveform from the oscillator switching the output valve directly. A standard form of boost/width control circuit is used with v.d.r. stabilisation of the feedback voltage, the absolute level and therefore the switching time of the output valve being set up by R349. Very large resistance values in the feedback circuit have been avoided. This has been done to avoid the problems that arise when large-value resistors change value with age (as they do!). The time-constant of the feedback loop is designed to be long at 50Hz so that 50Hz modulation of the line output stage at low beam currents is reduced: this modulation can arise as a result of the use of a transductor for pincushion distortion correction.

The line output transformer is operated with fifth harmonic tuning and a low overwind voltage so that the e.h.t. pulse produced for the e.h.t. tripler is quite flat-topped and no separate regulation of the e.h.t. supply is necessary (see *Line Output Stage Harmonic Tuning*—PRACTICAL TELEVISION February 1970). The focus voltage is also derived from the e.h.t. tripler and variations required in the e.h.t. voltage are set up by using subtractive or additive taps on the line output transformer.

An unusual feature compared to monochrome practice is the presence of a decoupled resistor in the cathode circuit of the line output valve. This is used to provide an output—at point 4H—consisting of a d.c. signal proportional to the current flowing through the PL509—a measure therefore of the tube beam current. This output feed is used for beam current limiting. With an average anode current of about 250mA the voltage at 4H will be about 2·5V. This corresponds to the maximum beam current drain of about 1·3mA. At very low or zero beam current the voltage at 4H will dip to a little over 1V.

The line output stage is separately protected by a 500mA fuse (FS301) in its h.t. feed.

It is a requirement in colour receivers that the whole raster can be shifted both horizontally and vertically using purely electrical methods. To achieve line shift requires a change in the average or d.c. current through the line scan coils. A voltage of up to about 80V to feed the d.c. shift facility is made available on one of the secondary windings of the line output transformer (points 9 and 10). The signal across this winding is rectified by D308 (with C330 providing rectifier protection), smoothed by C331 and taken to the output point 4P through the d.c. shift potentiometer R354. To achieve line shift in either direction the polarity of the voltage must be changeable. This could be done by using a potentiometer with a fixed centre tap connected to chassis or, more readily available, a plug and socket arrangement.

The feeds to the line convergence circuits etc. will be described when we deal with these sections of the receiver.

Field Generator

A silicon controlled switch (SCS) is used as the field oscillator. For a field oscillator we require a stage which not only provides a suitable output waveform but also has good interlace. A multivibrator is relatively poor in this respect, the triggering points being dependent on the noise present with the input pulses. There is also a tendency for a multivibrator to act as an amplifier of noise.

The best interlace is obtained with an oscillator which is *off* during the scanning period. This happens with both the blocking oscillator and the SCS oscillator, both of which are capable of extremely good interlace performance. The blocking oscillator is best avoided however—particularly at field frequency—because of the wound component required.

To run briefly over the operation of the SCS field oscillator we will assume to start with that C307 is uncharged and that the SCS (SCS301) is cut off. The current through R314 will forward bias D303 so that the junction of R314 and C307 is effectively at chassis potential. C307 therefore charges through R312 until the point is reached where the voltage at the junction of R312 and C307 (the anode of the SCS) is greater than the voltage at its anode gate connection which is determined by the potential divider network R308, R309 (field frequency) and R310. When this situation is reached the SCS switches on, presenting a low impedance. C307 then discharges through the SCS and a certain amount of current is also taken through R308 and the top part of R309. The resultant current flow through R311 raises the voltage at the base of Tr302 so that it turns on. This is the flyback period.

As the charge on C307 steadily falls during the flyback period and then tries to reverse (note that R314 is of much smaller value than R312, so after discharging C307 will try to charge towards the rail potential via R314) diode D303 suddenly starts to conduct again and current is taken through R312 and C307. The current through the SCS falls rapidly once C307 has discharged and in fact falls below the holding current for the device, turning it off. This reduces Tr302 base voltage so that it also cuts off rapidly. The whole process then repeats itself to give the next scan and flyback period.

The duration of the scan period is determined by

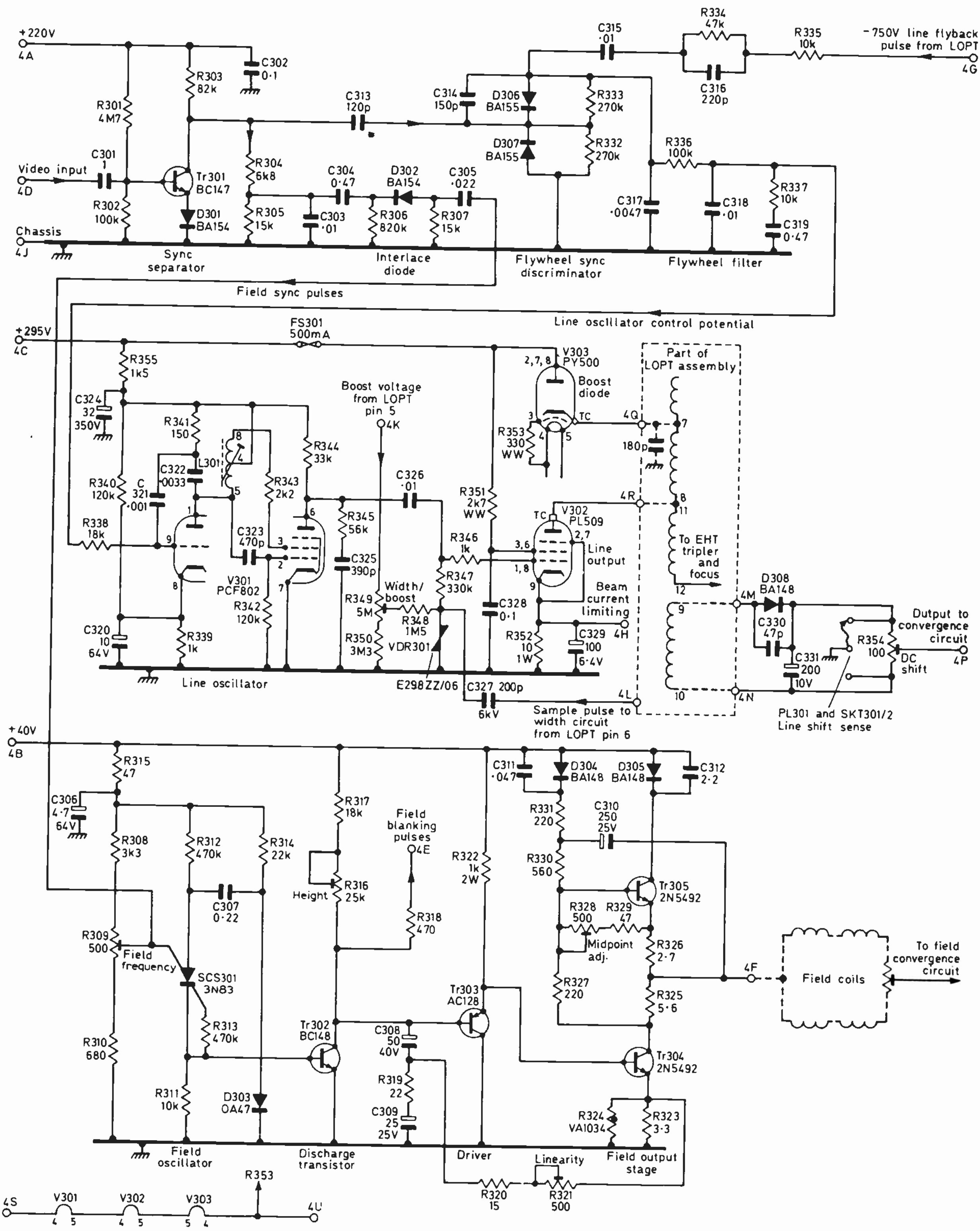


Fig. 3: Circuit of the timebase module.

the charging of C307 through R312, i.e. is set basically by the time-constant C307/R312, while the flyback duration depends on the rate at which C307 can discharge through the SCS, i.e. is set by the time-constant C307/R314. Both periods are also affected by the point at which the anode gate of the SCS switches, i.e. the anode gate potential, so R309 is the overall frequency control and will set the free-running frequency.

When a negative field sync pulse is applied to the anode gate connection of the SCS via C305 the voltage required at the anode for the device to turn on is much smaller and the sync pulse will therefore initiate the flyback. Note that when the device is synchronised in this way the setting of R309 is immaterial: this control affects only the free-running frequency of the oscillator.

Tr302 switches on during the flyback and switches off during the scan period, the output signal at its collector being directly coupled through to the field scan coils. The range of switched voltage available at Tr302 collector is set by the height control R316 which forms part of the collector load. The switch signals are coupled off via R318 to point 4E to act as the field blanking source for the picture tube. The signal at Tr302 collector is in fact a sawtooth as capacitors C308 and C309 charge towards h.t. when Tr302 is cut off and discharge through Tr302 when this device conducts: that is, the capacitors charge during the scan period and discharge during flyback.

Field Output Stage

The voltage sawtooth is fed via the emitter-follower driver Tr303 to the output transistors which are—despite first impressions—connected in Class A mode.

At the beginning of the scan Tr303 is bottomed and its emitter voltage is roughly at chassis potential. Consequently Tr304 is cut off, no current flowing in Tr304 or its collector load resistor R325. At this time about half the h.t. voltage is present at the junction of R325 and R326. The values of R327, R328 and R329 are chosen so that Tr305 is conducting when Tr304 is cut off. During the progress of the scan the current through Tr304 increases and the voltage developed across R325 gradually reduces the conduction of Tr305. When the flyback begins Tr304 is turned off, its base being clamped to chassis by the switching action of Tr302 and Tr303. The stored energy in the scan coils increases the emitter and base voltages of Tr305: when these voltages reach the h.t. voltage D305 cuts off and the scan coils ring with C312 to produce a large positive half-sinusoid of voltage. During the subsequent scan period the voltage across the scan coils gradually decreases from the h.t. voltage as Tr304 conducts.

Bootstrapping is used to provide the correct base drive for Tr305, using C310, R330, R331 and D304. This arrangement avoids any tendency there might be for unwanted d.c. components to appear in the scan coils. These would cause a field shift.

Linearity correction is provided by the feedback network for the emitter of Tr304 to the junction of R319/C308. Temperature and rail voltage variations are compensated by R324 in the emitter circuit of Tr304.

Construction

You will of course first gather together all the components needed for construction—the Component-Packs or your own alternatives. If you are makin your own printed board a master layout is availabl on application to the magazine office at 10p plus a large stamped and addressed envelope.

Drill the holes for the component leads in the printed circuit board, the $\frac{3}{16}$in. edge mounting holes and the holes for the valve bases, fuseholders and miniature sockets. You will need $\frac{1}{8}$in. holes for the B9A base, $\frac{5}{32}$in. holes for the B9D bases, $\frac{3}{32}$in. holes for the fuseholder and $\frac{5}{32}$in. holes for the miniature sockets. Note that the central area of copper under the B9A valve holder position is not intended for drilling unless you use a spigotted valve base: normally the B9A valve base supplied in Component-Pack 12 will not have a spigot.

Next solder the valve bases in the correct positions. There will be some mechanical leverage on the bases whenever a valve is plugged in or removed so the base pins should be turned over on the copper side before soldering. Then mount the resistors and capacitors followed by the diodes and all transistors except Tr304 and Tr305.

The heatsinks supplied for Tr304 and Tr305 are predrilled for 6BA bolt mounting. As with the transistors on the RGB module a smear of thermal conducting grease should be put on the metal contact at the back of the transistor before bolting down and soldering—you should have more than enough

The only thing then left to be mounted is the pot core used for L301. The core, a Siemens Siferrit type N22/250A, gives 250nH/turn^2 and for the required 29mH we therefore need 340 turns. The winding also has to be centre tapped. Wind fairly tightly 170 turns of 38 s.w.g. enamelled copper wire on the bobbin, take a few inches of wire out from the bobbin at that point, fold the wire back in and wind the last 170 turns *in the same direction* as the first 170.

Take the printed circuit base and note the position of the three contacts being used, 4, 5 and 8. Lay one half of the core into the base and place the bobbin inside and then clean off the enamel from the wire ends at points as close as possible to the core circumference and solder down—centre tap to pin 4 and the other two ends to pins 5 and 8 (it doesn't matter which winding is connected to which of these two pins).

When you are happy about the connections you have made take the other half of the core, smear a little Bostik on the edges of both halves and press together. Then take the spring clip and slip it over the core assembly, being sure to locate the locking pins correctly. Bend under the earth tag which is not used. When you mount the core on the printed circuit board check carefully that it is being correctly inserted. Check the base connections with the layout diagram. Next push in the plastic retainer and the adjusting screw and screw it part of the way home: use *only* the tool supplied for this purpose.

Final Points

Solder the one interconnection lead on the board (the heaters). Then solder a piece of wire into the miniature plug, passing the free end of the wire through the hole made for that purpose. Put the valves in the correct positions, fit a fuse into the fuseholder and check the board for errors. Note particularly the polarity of electrolytics and the pin

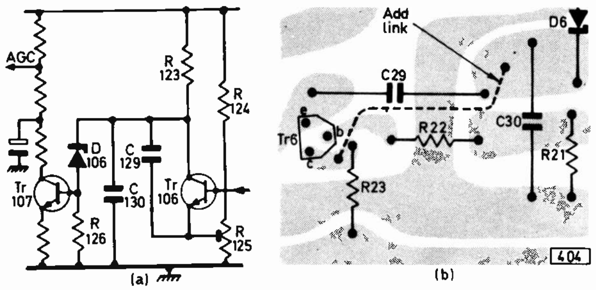


Fig. 4: A.G.C. circuit correction—see text.

connections of the field output transistors and the 3N83 silicon controlled switch.

Note: Type BRY39 silicon controlled switch may be used in place of the 3N83 but supplies are not available at the time of going to press.

Blank Boards: From Servitronix Ltd., 26 Killarney Rd., London SW18. RGB 45p, Timebase 65p inc. p. & p.

Corrections

As a number of readers have written to point out there is an error in the a.g.c. circuit and layout as given in our June and July issues. The collector of Tr106 should be connected to the junction of D106 cathode, C129 and C130 (see Fig. 4 (a)). Thus under maximum gain conditions Tr107 is bottomed by the voltage at its base set by the potential divider R123/D106/R126. When the detected sync pulses reach a certain amplitude Tr106 conducts on the pulse tips and the smoothing capacitor C129 is to an extent discharged: the base bias on Tr107 is thus reduced so that it conducts less, its collector voltage rising to give forward a.g.c. action. So why did our prototype work with the circuit error? C129 was found to be leaky so that Tr107 was biased on via R124 and R125. Two wrongs may not make a right morally: it seems they sometimes can electronically! We can't guarantee that all capacitors supplied for C129 will be sufficiently leaky so the modification shown in Fig. 4(b), linking the appropriate points on the board, must be made to all boards. When we did this and reset R125 everything worked according to the book.

A further error occurred in the July issue where the pin spacings of coil assembly L108/9/10/11 are shown differently in Figs. 1 and 2. The main layout diagram Fig. 1 is correct, and the assemblies are supplied ready-wound this way by P and R Windings. Fig. 2 is thus incorrect. If you have wound your own coil assembly and made the pin connections as in Fig. 2 these will unfortunately have to be reconnected as in Fig. 1 so that the coils are connected correctly in circuit. Also note (1) under Table 1 on page 407 in the July issue should read: L111 is wound at the top of the former; at the bottom L108 and L109 are bifilar wound *with L110 overwound* at the earthy end.

C803 was incorrectly shown in two places in the August issue: see correction on page 485. A few GEL263S1 i.c.s with no notch were supplied: they have a white dot on the top surface instead.

We apologise to readers for these mistakes.

Next Month: Chippies corner: we start woodworking on the cabinet!

COLOUR RECEIVER ALIGNMENT SERVICE

From the date of the appearance of this issue of the magazine the Alignment Service for the "Television" Colour Receiver I.F. Module is open. Please read the following notes about the Service very carefully. Any departure from the rules can only lead to delays and frustration for all.

(1) Do not make a booking for the Alignment Service until you have completed the construction of your i.f. module: if you do not meet your booking date you will lose half your first payment.

(2) All payments for the Alignment Service must be in the form of postal orders, cheques or money orders. *Cash or treasury notes must not be sent.* Cheques, etc. should be made payable to the "Colour Receiver Alignment Service" and should be crossed.

(3) When making bookings, enquiries etc. to the Alignment Service do not include correspondence intended for any other department of the magazine, editorial or advertisement.

(4) If uncompleted boards or boards damaged by the constructor are sent to the Service the right is reserved to refuse acceptance. The balance of payment will be returned to the constructor with his board and the reason(s) for refusal stated.

(5) Modules will be accepted for alignment only if packed in the special boxes which will be supplied on booking.

(6) Any dispute over the operation of the service will be passed to the Editor: he reserves the right to be the final arbiter on all such matters.

What You Must Do

If your i.f. module is complete and you are satisfied that the wiring is correct fill in the coupon below—or make a copy of it containing the same information—and send this together with a first payment of £1 to the address given on the coupon. The initial £1 payment is to cover the cost of the special polystyrene box manufactured for the safe postage of the i.f. modules, the basic administration of the booking service and a sign of good faith on the part of the constructor.

Within a fortnight of posting your coupon you should receive your polystyrene box together with a card acknowledging receipt of your payment of £1 and giving the date that has been arranged for your appointment. This will be in the form: "Please despatch your module to arrive during the week beginning . . ." Each Friday the week's modules will be despatched to the Alignment Centre. Any modules not received will be treated as a failure on the part of the constructor to observe the rules: they will be returned and a further fee of 50p will have to be paid when rebooking for the service—at the end of the queue. It is in the interest of the constructor therefore to despatch his module allowing sufficient postal time for its arrival during the relevant week. The constructor is very strongly urged to register the module's postage to the magazine. Note that to comply with PO Regulations the box should be secured with string and sealing wax.

On the label addressed to the Alignment Service the constructor should print the reference number given on his booking card. Inside the package he must include the balance of the Alignment Service payment—£1.55—and also 35p in stamps for the return by first class registered post *and a slip of paper giving his name and address.*

You should receive back your fully aligned module within one month of the booking week. If it is found to be faulty you will be notified separately of the work required and the cost above the already paid £1.55 alignment charge, and you will have the option of requesting return of the module for your own repair or meeting the charge requested. If the fault is due to component failure the faulty item will be returned with the module so that you can claim against the original supplier of the component.

Modules that are returned for the constructor's own repair will be aligned by the Service at a later date at a charge of £1. No booking will be required, the module just being forwarded to the address given on the coupon below together with the £1 fee and the return postage in stamps.

Don't be surprised if your booking date appears some while in the future: this will depend on the demand made on the Service.

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Dates when it will not be possible for you to despatch your module or receive it at your home address (please note this for as far forward as possible, certainly for the next six months—Christmas will be avoided in any case):

....

....

Unless notified to the contrary we shall align your module for the UK 625-line standard (System I). If you require alignment for another standard please state so here:

....

Please make out payments (not cash) to the Colour Receiver Alignment Service and post to Television, Colour Receiver Alignment Service, Fleetway House, Farringdon Street, LONDON EC4A 4AD.

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G. R. WILDING

No Raster

THERE was normal sound but no raster on a colour set fitted with the BRC 3000 chassis and the trouble was found to be the result of absence of voltage at the first anodes of the shadowmask tube. This fault, whether in a black-and-white or a colour set, is almost always the result of a short-circuit in a capacitor used to decouple the high-voltage feed. This particular receiver proved to be no exception, for on tracing back to the line timebase panel the 0·022μF decoupler C523 was found to be short-circuit. The tube first anode voltage in this chassis is obtained from a rectifier (W505) which is fed from a tapping on the line output transformer. This rectifier was found to be open-circuit—undoubtedly due to the short-circuit capacitor—and on replacing both these components 1kV was developed across the capacitor and a normal picture was obtained.

Fuse Blowing

THE complaint with a dual-standard Ekco receiver supplied from a 5A two-pin socket was that it blew the house fuses although the socket worked quite normally when other appliances were connected to it. On putting an ohmmeter across the set's plug pins only the usual heater circuit resistance was obtained: there was no h.t. short-circuit and the internal, correctly rated fuses were intact. Clearly the short-circuit was across the mains input and we suspected that either the receiver's on/off switch or the mains bypass capacitor was breaking down when the mains voltage was applied—though usually when either of these components break down they stay that way.

There were no signs of flashover on the switch and no taped joins on the mains lead so next we removed the top of the 5A plug—and found it badly discoloured and carbonised inside. Apparently a strand of wire had previously caused a heavy short inside the plug and though our ohmmeter gave no resistance reading across the pins the 240V mains could track along the carbonised interior.

We experienced a somewhat similar occurrence some time ago with a Ferguson receiver in which the tube aquadag earthing spring had fallen across a multipoint tag strip on the chassis. Even when the spring had been replaced the receiver's h.t. fuse blew repeatedly and this was found to be the result of aquadag particles on the spring becoming embedded in the insulation of the tag strip through the high instantaneous temperature of the original hefty flashover.

No Sound or Raster

THERE was no sound, raster or even line whistle on an Asa colour receiver but the characteristic initial buzz from the mains transformer on switching on proved that power was reaching the circuit. On removing the back the first thing we noticed, through holes in the e.h.t. can, was that the PL509 was running excessively hot due of course to zero or negligible line drive. It appeared therefore that the sound and vision failure was due to lack of h.t. to the sound output and line generator valves. We switched off immediately and studied the circuit diagram to see if there was a common h.t. supply resistor that could have gone open-circuit.

H.T. for the PCL86 sound valve is however taken via a 470Ω resistor from the mains bridge rectifier while h.t. for the PCF802 line generator is taken via a separate 220Ω resistor from the same source. The fact that the line output pentode was drawing current clearly indicated that there was ample output from the mains rectifier and as it was unlikely that both the feed resistors mentioned would simultaneously fail we checked with an ohmmeter and found that both h.t. supply points had the correct resistance from the rectifier's d.c. output. Lack of h.t. therefore was not the cause of the absent sound and vision.

On switching on again to make further quick tests we noticed that the PCL86, the PCF802 and an ECC81 were failing to warm up! We again consulted the circuit diagram which showed that the heaters of these three valves are connected in series across a mains transformer secondary winding. The heaters of three more valves are connected across a section of the primary winding while the heaters of another ECC81 and the tube are connected in parallel across another transformer secondary winding. A check revealed that the heater of the PCL86 was open-circuit and on replacing this valve normal sound and vision were obtained.

When servicing hybrid colour receivers therefore be prepared for unconventional heater circuits.

Lack of Height

Even with the height control fully advanced the raster on a 23in. console model fitted with the STC VC2 chassis was no more than 5in. high and very badly cramped towards the base. Replacement of the PCF80 and PCL85 field timebase valves produced no improvement so as it is difficult to make voltage tests without removing the chassis we first checked that the pentode cathode resistor was not being shorted by a defective decoupling capacitor. The capacitor proved to be OK so we removed the chassis and commenced making voltage tests, starting with the PCL85 pentode section as inadequate height with very bad linearity is usually caused by a defect in the output stage rather than in the generator.

All the pentode section voltages were normal but we found virtually zero volts on the PCF80 triode anode. This was due to R81 (Fig. 1) being open-circuit and on replacing this resistor normal height

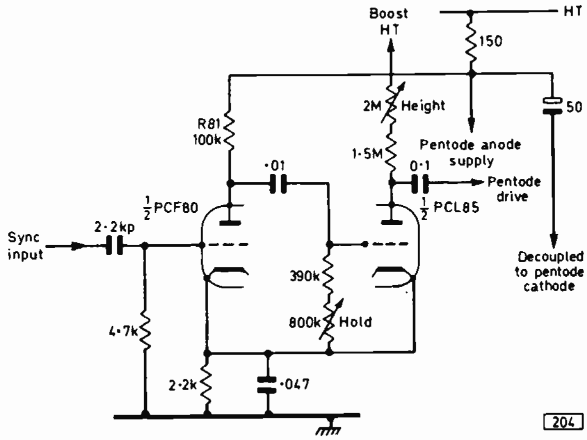


Fig. 1: Field oscillator circuit, STC-KB VC2 chassis.

was obtained. The unusual feature of this fault was the fact that oscillation occurred with almost zero triode anode voltage.

Reforming Electrolytics

THE high-capacitance, low working voltage electrolytics used to decouple the cathode resistors of field and sound output pentodes frequently dry up and lose capacitance—mainly due to high local temperatures. The result is either a cramped raster base or loss of volume (especially at the lower frequencies). The electrolytics used as reservoir and smoothing capacitors in the h.t. circuit on the other hand seldom give trouble. Direct shorts are extremely rare and when loss of value does occur in a smoothing capacitor this is usually first evident as a slight humbar, impaired line and/or field sync, increase in background hum or a tendency to sound-on-vision. When reservoir capacitors fall in value the h.t. voltage is markedly reduced and hum increases.

As replacement is rare stock electrolytics may have been on the shelf for some time and should therefore be reformed before being put into service. This reforming is necessary—or at least highly advisable—because it is the slight leakage current through the capacitor that maintains the thin film of oxide that functions as the dielectric: a long shelf life can cause this film to disintegrate. The simplest way of reforming electrolytics is to apply the working voltage to them via a 10-20kΩ resistor for about an hour. If the leakage current is then less than 1mA the capacitor can be assumed to be fully reformed. In most instances of course electrolytics reform on being put into circuit. This simple precaution however will prevent oldish stock capacitors from possibly shorting when the h.t. is applied, damaging the rectifier and surge limiter.

Weak Field Hold

THERE was good line sync but decidedly weak field lock on a Bush Model TV166. Our first move, naturally, was to replace the PCL85 field oscillator/output valve and as this produced no improvement we next tried a new PFL200 video amplifier/sync separator valve. This also failed to improve matters so we checked the interlace diode 3MR3. This was also ok, as were the surrounding resistors. Shunting another capacitor across 3C29 which couples the integrated field pulses to the grid of the PCL85 pentode section also made no improvement. As the cathodes of the triode and pentode sections of the PCL85 are decoupled by a common 500μF electrolytic we shunted another across it just in case but again without improving the position.

Although the line hold was good this didn't necessarily mean that the sync separator stage was above suspicion. The PFL200 operates in a conventional manner, with reduced anode and screen grid voltages, but the supply to the screen grid is unusual in being taken from a tapping point in the rectified heater supply. This positive supply is smoothed by a 22kΩ resistor and an 8μF electrolytic to produce 60V at the pentode screen. The object of this arrangement is to ensure that the receiver isn't used if the heater rectifier develops a short-circuit, overrunning the valves, since there will then be only a small a.c. voltage at the sync separator screen and this will constantly trip the field timebase and make viewing impossible. In our particular set the screen voltage was considerably below the scheduled 60V and the cause of the weak field hold was a severe loss of capacitance in the 8μF decoupling electrolytic. On replacing it normal results were obtained.

Intermittently Purple Picture

An intermittently purple picture was the complaint with a KB colour set fitted with the ITT CVC5 chassis. This chassis uses RGB drive and as anticipated when the fault developed the cause was simply a total lack of green output. When operating normally the voltages at the collectors of the R, G and B output transistors were all close to the correct figure of +138V. When the fault momentarily developed however the collector voltage of the green output transistor T26 (Fig. 2) rose to the rail potential of +240V. Clearly T26 was not then passing collector current and the resulting greatly increased voltage at the green c.r.t. cathode was biasing the green gun past cut-off. The cause of this could be total loss of forward bias, an open-circuit emitter resistor or a disconnection within the transistor (disconnection of any "electrode" will of course produce zero collector current). As T26's positive base supply is taken from the emitter of the driving emitter-follower failure of this transistor to pass current will result in zero emitter voltage and thus zero forward bias to T26. It was found however that T26's base voltage increased when the green output failed but that its emitter voltage dropped to zero. As T26's emitter was still returned to chassis via R178 it became obvious that the transistor had an intermittently open-circuit base-emitter junction and on replacing it and readjusting the drive control normal results were obtained.

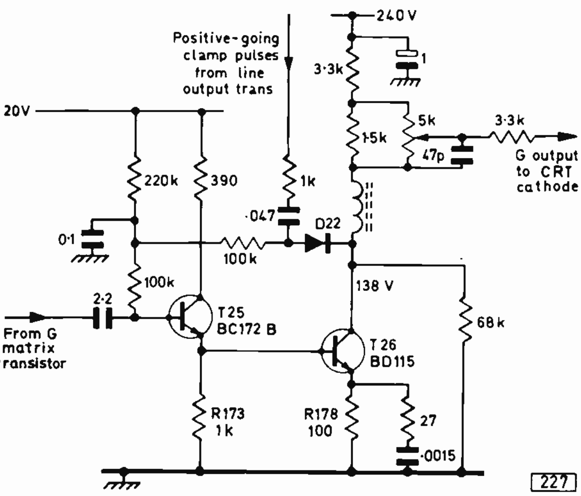


Fig. 2: ITT CVC5 chassis G driver and output stages.

No Picture

THE trouble was no picture on a set fitted with the Thorn 950 chassis and this was found to be due to lack of e.h.t.—only the slightest suggestion of a spark could be drawn from the anode of the PL504 line output valve. In such circumstances the best move to make first—even before trying a replacement valve—is to remove the top cap of the boost rectifier and check whether this results in an improved spark length. If it does it is almost certain that the boost reservoir capacitor is short-circuit.

This proved to be the case in the receiver in question. The boost reservoir capacitor C101 (0·22μF) in this chassis is readily identifiable by its bright red plastic encapsulation. In many receivers however the boost capacitor is not so easily found. What is the quickest way without a circuit diagram to locate the boost capacitor? As boost capacitors all have a high working voltage, look for a capacitor of fairly large size which gives a reading of zero resistance across it. This latter point rules out the possibility of getting confused with the S-correction capacitors (which have similar values) since when a boost capacitor breaks down it usually shorts completely.

Always ensure that the replacement is of working voltage rating at least equal to that of the original.

Top Raster Cramping

INSUFFICIENT height with particularly severe cramping at the top of the raster was the complaint with a GEC Model BT454DS. This was unusual since cramping usually occurs at the bottom of the picture (caused by a low-emission output pentode and/or a reduced value cathode bias resistor or a faulty decoupling electrolytic). Not surprisingly a new PCL85 failed to improve matters. The next step was to check the voltage at the pentode cathode and this was found to be almost 28V instead of 17·5V. This at first suggested excessive anode and screen currents due to a leaky grid coupling capacitor but as the voltages at these electrodes were noticeably *above* normal and it was apparent that the valve was failing to reach its normal operating temperature the only possible causes of the non-linearity were an increase in the value of the cathode bias resistor or an open-circuit bias resistor with a heavily leaking shunt electrolytic. Testing with an ohmmeter showed almost 600Ω from the pentode cathode pin (8) on the PCL85 valveholder to chassis due to a rise in value of R88 the nominally 390Ω cathode bias resistor. On changing this component and the shunting 250μF electrolytic which had somewhat dried up full height was obtained with perfect linearity.

CIRCUIT NOTES

H. K. HILLS

One has to be on one's toes in the TV field, with so much new and novel circuitry constantly being introduced. The following notes review some interesting bits of recent TV circuitry—and may provide the constructor with some new ideas to try out.

BRC Voltage Regulator

A simple but efficient two-transistor voltage regulator is used in the 12 and 14in. mains-battery portables recently introduced by BRC (1590/1591 chassis). It is designed to prevent variations in the supply voltage, whether from a 12V battery or the a.c. mains, causing variations in picture size, contrast and brightness.

The circuit is shown in Fig. 1 and though the operation of these and similar regulators may sometimes seem involved they simply consist of basically a voltage sensing stage which directly or via a d.c. amplifier then varies the forward bias applied to a power transistor which acts as a low-value variable resistor in series with the l.t. supply. If the voltage tends to rise the conductance of the power transistor is reduced so that most of the voltage rise is developed across its collector-emitter connections. Regulation extends therefore only up to the point at which the transistor is fully conductive.

In this BRC circuit the npn transistor VT22 in conjunction with the zener diode W17 senses changes in the output voltage, proportionately varying the forward bias to the pnp power transistor VT21 which is shunted across the 10Ω resistor R99. VT21 thus virtually short-circuits R99 when fully conductive, and to be effective in parallel with a resistor of such low value its working collector-emitter resistance must clearly be of comparable or smaller value.

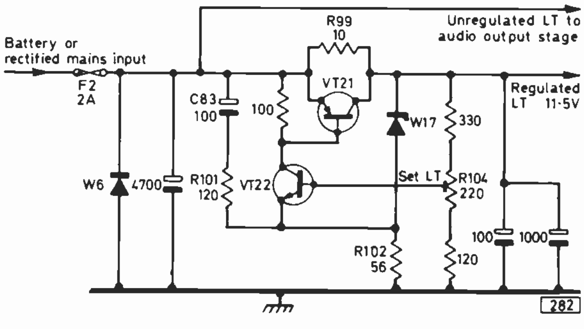


Fig. 1: Voltage regulator circuit used in the recently introduced BRC 1590/1591 chassis for use in their mains-battery portable models.

With the exception of the complementary push-pull sound output transistors all the stages in the chassis are fed via the VT21/R99 combination. The audio output transistors are supplied directly from the unregulated d.c. input, since being series connected they need maximum voltage for optimum performance while normal variations in supply potential have negligible effect on the audio output. In addition by keeping the current supply to the audio output stage out of the regulator the working temperature of the regulator and the power loss in it are reduced enabling it to control more closely the voltage to the timebase and signal amplifying stages which are of course affected to a much greater extent by supply voltage fluctuations.

About +12·5V from the nominal 12V battery or +16 to +17V from the full-wave mains rectifier is fed in via the fused (F2) input lead. If the battery connections are inadvertently reversed—making the supply negative to chassis—diode W6 presents a short-circuit and blows fuse F2.

The nominal stabilised l.t. potential is +11·5V, implying a 1V drop across VT21/R99 on battery operation and 4·5-5·5V voltage drop on mains operation. This clearly indicates that the regulator is able to accommodate wide variations in supply voltage. Potentiometer R104 sets the forward bias to VT22 and determines the l.t. rail voltage.

The emitter of the voltage sensing stage VT22 is connected to a potential divider consisting of the zener diode W17 and R102 across the supply rail. If the output voltage tends to rise above 11·5V this change will be communicated via the zener diode W17—across which the voltage remains constant of course—to VT22 emitter, the change of voltage across R102 altering the bias on VT22 so that it will conduct less. The base of VT22 is also of course connected to a potential divider across the supply but as this is purely resistive the change in potential at the base of VT22 will be much less than that at its emitter. An increase in the output voltage will thus lead to a rise in VT22's collector voltage and as VT21 is a pnp type it will be biased back. As a result its conductivity will decrease and it will act as a conductor of increased resistance across R99, the increased voltage drop across the combination being almost equal to the unwanted supply voltage rise. The reverse action occurs of course if the output voltage tends to fall.

To offset any hum present in the input which could impair the regulator operation on mains operation C83 in series with R101 applies an out-of-phase a.c. feed to the emitter of the voltage sensor VT22.

A neat, compact and efficient regulator, ideal for such battery-mains light-weight portables.

Wide-Range AGC System

The dual-standard Sony Model TV9-90UB mains-battery portable is fitted with separate v.h.f. and u.h.f. tuners: the former feeds the separate three-stage vision and sound i.f. channels via a response shaping filter network but between the u.h.f. tuner and the response filtering a two-stage i.f. preamplifier is incor

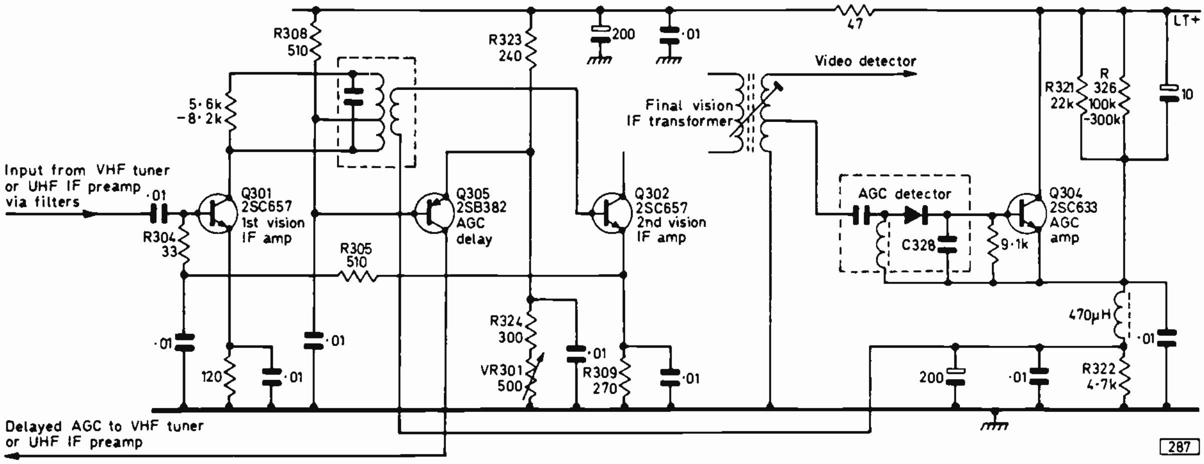


Fig. 2: Vision a.g.c. circuitry used in the Sony TV9-90UB mains-battery portable.

porated. This arrangement equalises the sensitivity on the two systems since although the v.h.f. tuner has three transistors (r.f. amplifier, oscillator and mixer) the u.h.f. tuner employs a diode mixer with a transistor r.f. amplifier and oscillator. Forward mean-level a.g.c. is applied to the first two vision i.f. stages while a delayed a.g.c. feed is taken to the r.f. amplifier on v.h.f. and to the first stage in the i.f. preamplifier on u.h.f. Thus on both systems there are three gain-controlled stages, to accommodate the receiver's high overall gain and the widely differing signal levels likely to be encountered.

The a.g.c. arrangements are shown in Fig. 2. The method of developing the a.g.c. potential to start with is unusual: a separate a.g.c. detector is fed via a capacitor from a tapping on the final i.f. transformer secondary. The positive output developed by this detector diode across C328 is applied to the a.g.c. transistor Q304 which is without fixed base bias. Thus on no signal this transistor is non-conducting and the potential at its emitter is determined by the potential divider consisting of R321 and R326 to the positive l.t. supply and R322 together with the input impedance of the second vision i.f. amplifier Q302. This is of course the basic a.g.c. source. When the output from the a.g.c. detector is sufficient Q304 starts to conduct and the voltage across R322 increases. The a.g.c. line thus moves positively, increasing the forward bias applied to Q302 and thus reducing the gain of this stage through forward a.g.c. action. As the signal strength rises so Q304 conducts more heavily to increase the a.g.c. action.

The first vision i.f. amplifier stage is biased via R305 from the emitter of the second vision i.f. amplifier: thus as the latter conducts more heavily with increasing signal strength so the voltage across R309 in its emitter lead increases in turn increasing the forward bias applied to the first vision i.f. amplifier and reducing the stage gain through forward a.g.c. action. A similar arrangement with a pair of i.f. stages controlled in this manner is used in the BRC 1500 single-standard chassis.

With high signal strengths delayed a.g.c. is introduced, being applied to the relevant front-end stage via transistor Q305. The emitter voltage of this transistor is set by VR301 while its base is fed from the collector of Q301. Thus as the collector voltage of the latter falls with increasing signal strength—increased forward a.g.c. increasing the collector current of this transistor—so the base of Q305 moves negatively and as this is a pnp transistor it starts to conduct. Its collector voltage then rises with respect to chassis, increasing the forward bias applied to the controlled front-end stage and again pulling back the gain through forward a.g.c. action.

The system used in this model for a.g.c. in the sound channel on v.h.f. was described in *Circuit Notes* April 1971 (page 276).

Separate Bass and Treble Controls

It is most unusual to find seperate bass and treble controls in a television receiver but this feature is provided in the Russian Temp series (for a detailed coverage of the basic chassis see our December 1971 issue). The audio section consists of a conventional triode-pentode valve (Fig. 3). The tone controls are incorporated in a negative feedback loop which applies part of the output signal across the unde-

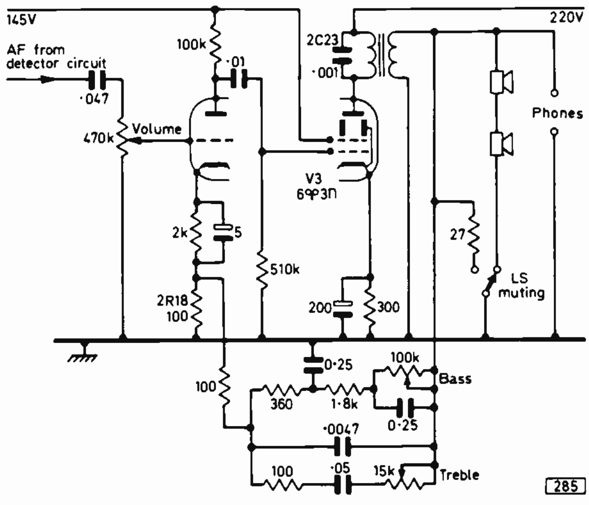


Fig. 3: The audio circuit used in the Russian Temp 7 series features separate bass and treble controls.

coupled 100Ω resistor 2R18 in the cathode lead of the triode. 2C23 across the output transformer primary provides a fixed amount of treble attenuation. As the triode grid is connected to chassis via the volume control its negative bias is provided by the voltage developed across its cathode resistors.

To try out this interesting circuit with UK valves all that is necessary is to substitute cathode resistors which provide the correct bias and also possibly to add a decoupled resistor in the feed to the pentode screen grid to ensure correct operating conditions. The greater the value of the undecoupled resistor in the cathode lead of the triode the greater is the degree of feedback introduced.

AF Muting

Several receivers now incorporate circuitry to mute the a.f. circuits until the line output stage comes into operation. This is done because otherwise with a.g.c. circuits that are gated on by pulses derived from the line output stage the gain will be at maximum until the line output stage comes into operation, resulting in excessive sound with possibly vision-on-sound buzz and the risk of extraneous noise being amplified to an audible level during the line output stage warm-up time. Various a.f. muting techniques are in use but that employed in the ITT-KB CVC5 colour chassis is particularly neat and interesting.

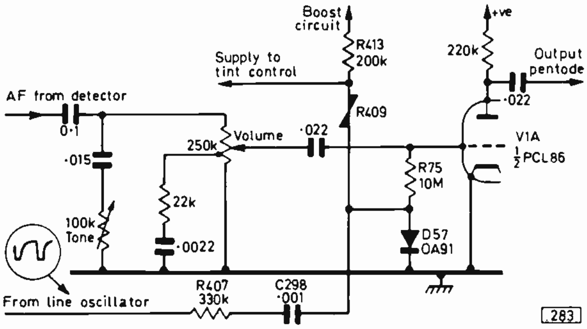
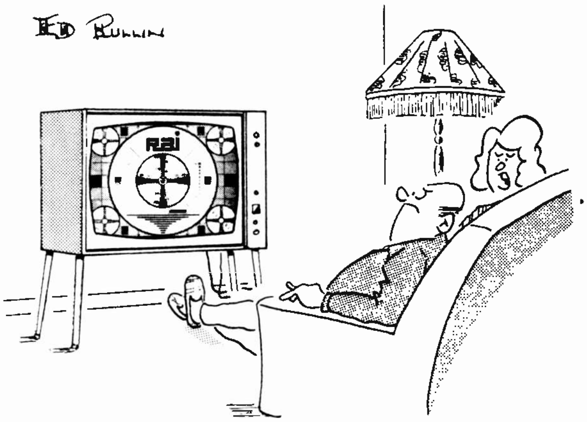


Fig. 4: A.F. muting system used in the ITT CVC5 chassis.

The circuit is shown in Fig. 4 V1A is a conventional a.f. amplifier but its grid resistor R75 is returned to chassis via the diode D57. During normal operation this diode is clamped to chassis as a result of the connection to the boost h.t. circuit via R409 and R413. D57 anode is also fed however with the line drive waveform via R407 and C298. Now while the line output stage takes an appreciable time to become operative, due mainly to the lengthy warm-up time of the boost rectifier, the PCF802 line oscillator used in this chassis will come into operation just as quickly as the PCL86 audio valve. As the oscillator output is a.c. coupled to D57 anode the result is that a considerable negative potential will be developed by D57. This of course will completely bias off the a.f. triode. Once the boost voltage develops however this negative potential will be over-ridden and the a.f. triode will then develop self-bias in the normal manner.

Hybrid AF Circuit

Hybrid—i.e. mixed valve and transistor—a.f. circuits are widely used in Continental monochrome and colour receivers and though some use up to three transistors before the output pentode most designs employ a single transistor especially when an intercarrier sound i.c. is incorporated. The BC168/PL95 combination used in recent Grundig monochrome receivers has two features which could well spark off some interesting experiments by constructors. First, d.c. coupling is used between the transistor and the valve. Secondly the l.t. supply for the transistor is obtained from the cathode of the valve.



"*I thought you fixed that aerial bracket!*"

The simple but ingenious circuit is shown in Fig. 5. R243 is the transistor's collector load resistor which is returned to the fully decoupled valve cathode while the junction of potential-divider R244/R237 provides forward bias to the transistor via R236. The value of the valve's cathode resistor is such as to bring the cathode potential up to +18V but as the control grid is returned via R245 to the transistor's collector which operates at +9V the effective bias on the valve is −9V.

Negative feedback is provided via C240/R242 and C242/R240 between the valve anode and the transistor's emitter while the current feed through these resistors helps to stabilise the transistor's d.c. working conditions.

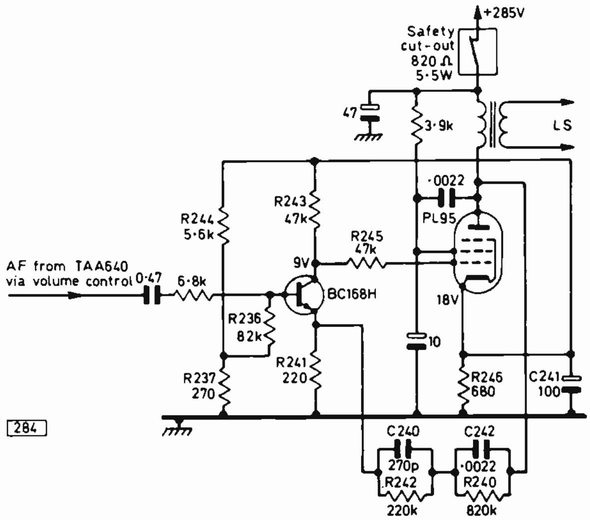
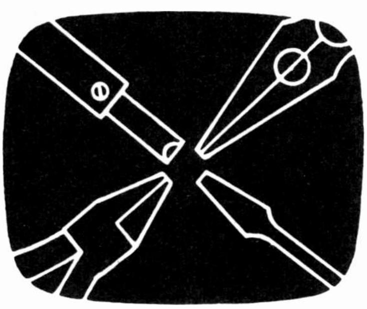


Fig. 5: Hybrid a.f. circuit used in some Grundig models.



SERVICING television receivers

L. LAWRY-JOHNS

BRC 1500 CHASSIS—cont.

Sound, No Picture

There is a thermal cut out (R124) in the HT1/HT3 supply line. Quite often this will be found open, usually denoting that there has been a heavy current demand from the line output stage. Closing the wires together will often cause the PY801 to overheat grossly so it pays to check first for shorts from the top cap of the PY801 to chassis. Practically a dead short may be found here and this could well be due to a shorted capacitor on the side of the line output transformer (C95 or C113 depending on the e.h.t. system used). The types fitted in this position on the 1400 chassis seem of late to be popping off like flies and it is fair to expect the same to happen on the 1500 chassis. The value depends upon whether the model is a 20kV or 15kV version (210pF or 160pF respectively). The voltage rating is most important. We have found that an 8kV ceramic doesn't seem to survive very long and we now make a point of fitting a 12kV type—even when this means putting two in parallel to make up the required value (a few pF one way or the other is not out of order, for example two 100pF 12kV in parallel suffice in the 20kV version).

This fault should not be confused with overheating in the line timebase which may also open the cut out. With this fault the PY801 does not react so violently although it and the PL504 may overheat. In this event the 30FL2 may be at fault, failing to drive the output stage. Where there is adequate line drive however and there is still a degree of overheating taking place it is quite likely that the line output transformer is at fault with shorted turns.

The EHT Tray

This is the flat grey tray which clips on to the line output transformer. Its purpose is to multiply the pulse voltage from the transformer and rectify it at the same time. The smaller 15kV models use a three-rectifier (sticks as they are called) tray, the 20kV models a five-stick tray. A lead from the final stick is taken to the tube cavity connector on the side of the bulb.

The load imposed on the rectifiers depends of course on the brightness of the picture. As the brilliance is increased so the current passing through the rectifiers increases. If one of the rectifier sticks is defective therefore the voltage dropped across it will increase with the brightness of the picture. This can have two effects. One is that the picture will expand and fade out. This is common to all sets with a low-emission or an undersupplied rectifier. The less common effect is of a picture which "sizzles" horizontally as the brightness is turned up, the expansion and defocusing being less marked. In most cases where these troubles are experienced it will be found that the final stick in the tray is marked due to the overheating occurring as a result of its resistance increasing and the voltage across it rising. The remedy is to replace the rectifier or the tray. The writer replaces the tray because he is a lazy coward (and so would you be if you'd just seen the static convergence varying by more than an inch before your very eyes on a set which had only required a green colour-difference amplifier . . . a free copy of *Babes in the Wood* for the first correct solution!).

Width Circuit Resistors

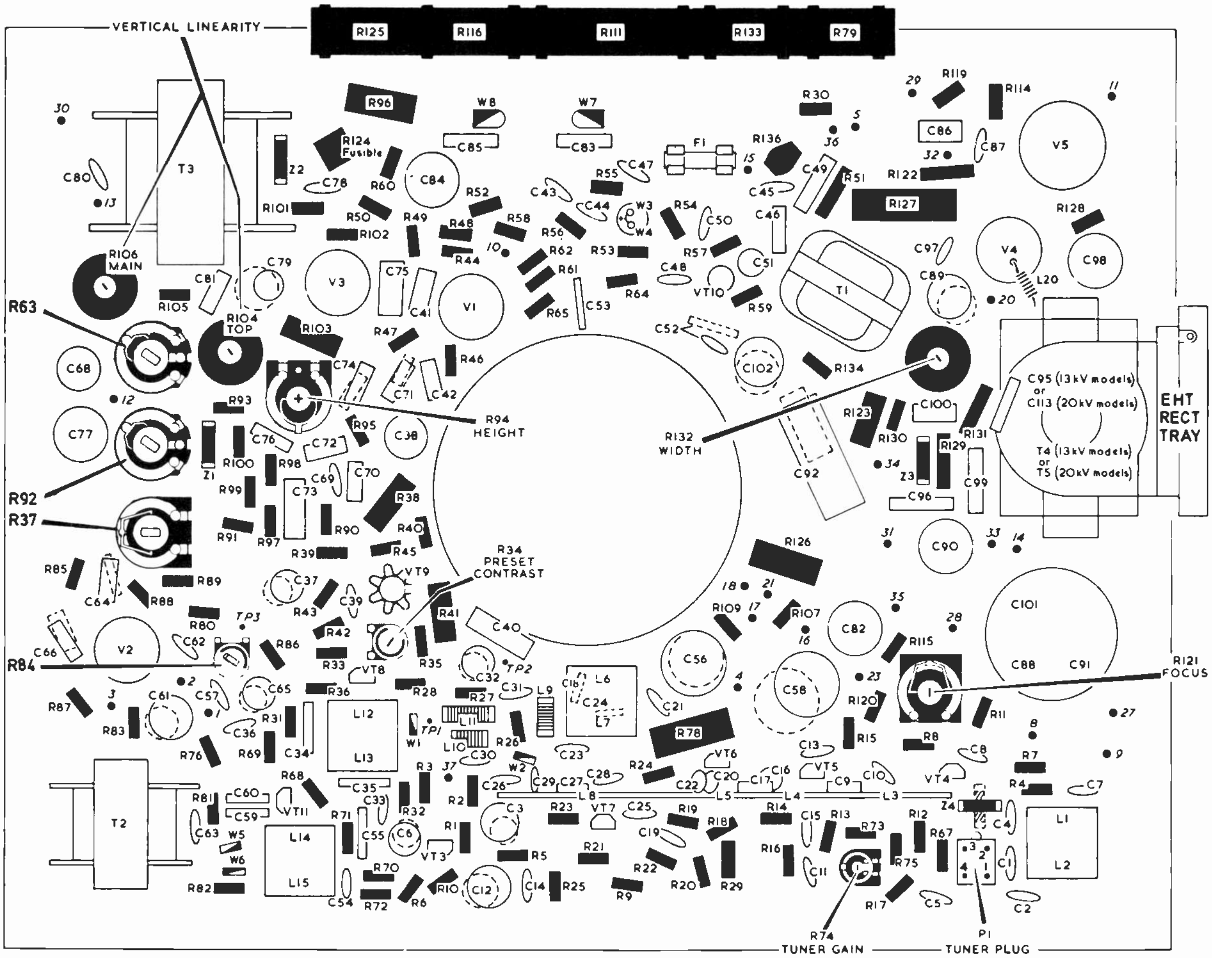
Whilst it is fairly obvious that a defective resistor in the R131 position will cause lack of width with the control having little effect, the symptoms caused by R129 going high-resistance are a little more hair raising. When it is open-circuit, perhaps because of faulty contact with the panel, the picture becomes like ripples on a stream together with a pulsating action which is difficult to describe. If a 1MΩ resistor from pin 1 or 2 of the PL504 valve base to chassis (pin 3 or 8) restores a more rational appearance this is where the trouble is most likely to be located (check resistors and tracks).

Faulty Main Smoothing

A picture which slowly undulates like a tired belly dancer (hips swinging and bottom rising and falling) should call attention to the main smoothing block. This is C101, C88 and C91. An exact replacement is far more pleasing than four leads going to some taped up can somewhere inside the cabinet.

Separate HT Feeds

When a particular section of the receiver fails, for example the sound output or the field timebase, our instinct is to note that the other stages are working and therefore to assume that the h.t. supply is in order. Over the last few years however it has become necessary for the h.t. supply to be more elaborately smoothed and decoupled. Each section of a set tends therefore to have its own supply line and thus smoothing resistor which can fail or be made to fail. In this chassis for example overheating in the line output stage could well be caused by R134 failing, a white line across the screen by R133, no sound by R96 and



NOTE All components marked thus - - - are alternative locations

Fig. 4: Component layout on the main chassis assembly.

so on. Each h.t. feed line should be checked first therefore if the relevant section suddenly becomes inoperative. Kids' stuff? Of course it is, but who hasn't been red faced at some time or the other by not following simple basic routines.

Field Timebase

A PCL85 with conventional cathode bias is used and as mentioned last month it is the cathode bias capacitor C79 which is most likely to be at fault, producing severe loss of height with greater compression at the bottom. The valve itself is not so "accident prone" as were earlier versions of the PCL85 but it should still be the first suspect in the event of total loss of scan, inadequate scan or vertical hold troubles. Check the value of R103 if the valve has had to be replaced.

The Transistor Stages

It is fair to say that we have not had much trouble with the transistor vision and sound amplifier stages. If the preset contrast control is properly set (and this should not be disturbed unless really necessary) together with the tuner gain (Local-Distant) control then absence of sound and vision signals can normally be tracked down to the stage which shows incorrect voltage readings: the readings to be expected are clearly shown on the circuit diagram.

All the transistors outside the tuner unit are npn types. This means that a cold test with an ohmmeter should be made with the negative probe to the base of the transistor and the positive probe to its emitter or collector to give a low reading (20Ω or so) and a higher reading when the meter leads are reversed. With the transistor left in circuit the associated components must be taken into account: the result will generally be a reading some four or five times higher. This is a rough check but seems to hold good for transistors used as amplifiers (not necessarily when used as oscillators).

Sound Faults

The sound ratio detector circuit doesn't give much trouble unless the diodes are unbalanced, the balance preset R84 is defective or C65 is faulty. In the event of distortion and severe vision buzz check these points.

Distortion without a buzz may be due to the PCL82 audio output valve and if this is so don't forget to check the value of R89 which may be damaged.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

By and large June 1972 was a fruitful month. Sporadic E conditions continued in full spate for much of the time although a lull was noted during the third week. It is not unusual for there to be breaks in reception for several days during the Sporadic E season—indeed such a break can give a welcome rest from many hours at the screen! The excellent conditions we have experienced seem to be present in other parts of Europe as well and like us our fellow enthusiasts overseas are noting a tendency for medium- to long-skip signals to predominate. Particularly rewarding has been the TV2 Finland transmitter at Tampere on ch.E2, with reception the best for many years. To the South East, Rumania has been reported at good strengths in the UK—an encouraging reception for the many newcomers to the hobby this year.

My own log for the period is as follows. As mentioned in previous columns many Sporadic E openings have occurred whilst I have been otherwise engaged and others have been well under way when I was able to switch on.

1/6/72 DFF (East Germany) E4—MS; TVE (Spain) E2, 4.
3/6/72 NRK (Norway) E2, 4; SR (Sweden) E2 plus unidentified signals; BRT (Belgium) E2 (trops).
4/6/72 JRT (Yugoslavia) E3, 4; also many unidentified signals.
5/6/72 TSS (USSR) R1, 2; CST (Czechoslovakia) R1, 2; TVP (Poland) R2; YLE (Finland) E2; NRK E2, 4; SR E2, 3, 4; ORF (Austria) E2a.
6/6/72 TSS R1 twice, R2 twice; TVR (Rumania) R2; TVP R2; MT (Hungary) R1, 2; DFF E3, 4; WG (West Germany) E2, 3, 4; Switzerland E2, 3, 4; JRT E4; RAI (Italy) IA, IB; ORTF (France) F2; CST R1 twice, R2. (This opening lasted for much of the day 0715-2000.)
7/6/72 TSS R1; YLE E2; SR E2, 3; NRK E2; RAI IA, IB; TVE E3.
8/6/72 TSS R1, 2; CST R1; TVP R1; MT R1; SR E2, 4; BRT E2 (trops).
9/6/72 NRK E2 twice, E3; SR E2; TVE E3, 4; RTP (Portugal) E3.
10/6/72 SR E2 twice, E4; RUV (Iceland) E4; CST R1.
12/6/72 TVE E2.
13/6/72 WG E2; BRT E2 (trops).
14/6/72 RUV E4; WG E2; JRT E4; also unidentified signals.
15/6/72 NRK E2, 3; SR E2; TVP R1; BRT E2 (trops).
16/6/72 TVE E2, 4; also unidentified signals.
17/6/72 BRT E2 (trops).
18/6/72 BRT E2; NOS (Holland) E4—both trops.
19-20/6/72 BRT E2 (trops).
21/6/72 TSS R1; TVE E2.
23/6/72 TSS R1; MT R1, 2; RAI IB; JRT E4; also unidentified signals.
24/6/72 TSS R1; TVP R1; MT R1, 2; SR E2, 3, 4; NRK E2, 3, 4; TVE E2, 3, 4; also unidentified signals; BRT E2 (trops).
25/6/72 TSS R1; TVE E2; SR E2, 3, 4; also unidentified signals; BRT E2 (trops).
26/6/72 TSS R1, TVE E2.
27/6/72 RTP E2, 3; TVE E2, 3, 4.
28/6/72 WG E2.
29/6/72 BRT E2 (trops).

Unless otherwise stated the receptions detailed above are via Sporadic E propagation. Improvements in tropospherics were also noted on several days—notably the 17th-20th period and also on the 25th with various ORTF stations at v.h.f. and u.h.f.

The amount of activity during the past few weeks has naturally brought forth a number of identification problems and other interesting items. One mystery that caused some confusion to a number of enthusiasts was the appearance on chs. E3 and E4 of captions carrying BRT/RTB titles in various forms, with either BRT or RTB and at times both. Since the signals were 625-line negative-going video ones they were not from Belgium. Keith Hamer eventually received the caption "RTB TV Vesti" and identified the source as Yugoslavia. Reports are also starting to trickle in that Yugoslavia is using the PM5544 electronic card, with either JRT in the upper black rectangle only or with JRT and RTV-LJNA in the upper and lower black rectangles respectively. The writing, as in the NRK PM5544 version, is extremely fine and difficult to resolve.

The Swiss PTT are now using the SWF type electronic card with the identification previously noted in this column and many enthusiasts have now received this pattern. It appears however that the older card with the prominent white cross is also still in use.

On June 7th at 1750 a weak test card F was noted on ch.E2. Others have also received this pattern and thanks to the Europese Testbeeldjagers this has been identified as NRK (Norway). So far this season the NRK have been seen using the PM5544, the SWF electronic type, and test cards F and G. Whilst on Scandinavia an interesting reception on June 8th at 1030 included the older type Swedish card with the identification "Vannas TV".

Geoffrey Chapman of Blandford, Dorset has sent us a photograph of his TVR (Rumania) reception on June 12th. Of particular interest is the caption which states "TVR-1 Colour". So it seems they are also in colour (SECAM) now which confirms other reports of TVR using colour bars. The other interesting point is the "TVR-1" which leads one to question the existence of a TVR-2!! We first discovered the TVP-2 network by noting captions with "TVP-1" on. Has anyone news about this??

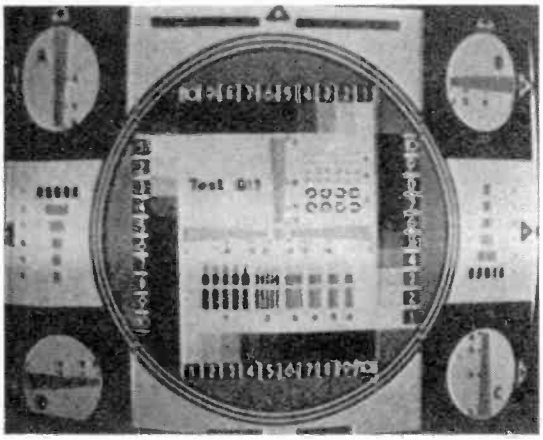
News Items

Finland: The Lahti ch.E40 transmitter has now been completed. The transmitter has an e.r.p. of 600kW (horizontal polarisation) and is on a very high hill at Tiirismaa, South Finland, with the terrain falling to the sea between 180-270°. This is very favourable for trop reception. Test transmissions are expected mid August. Further high-power u.h.f. stations are under construction at Kuopio, Pyhavuoro and Lapua.

Data Panel

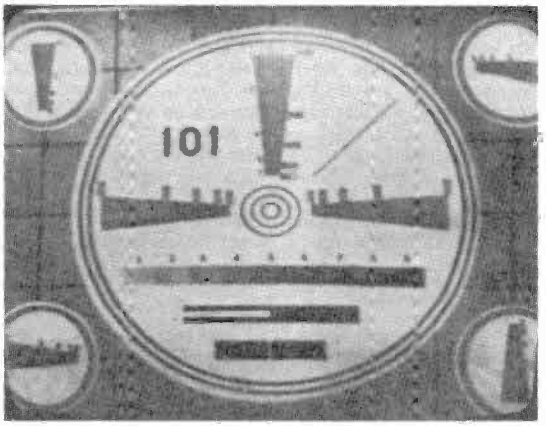
We are featuring this month detailed information on Albania. Considerable mystery surrounds the Albanian TV Network and information comes mainly from Italian DX enthusiasts living opposite Albania across the Adriatic. From what we have read the R3 and R7 transmissions differ for much of the time and it is

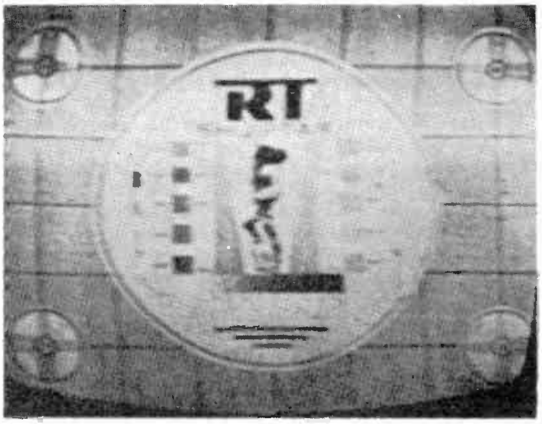
DATA PANEL 14—2nd series



1 Albanian ch.R7 test card.

2 Albanian ch.R7 station identification.





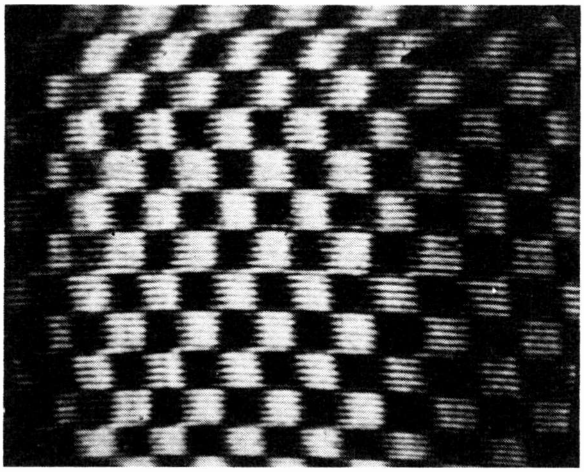
3 and 4 Albanian ch.R3 test cards.

5 Albanian ch.R3 station identification.

6 Main news caption TV UUTISET, YLE Finland.

Photographs 1–5, Albanian TV (Radiodiffusion Television Albanaise), from *Radio Bulletin* courtesy unknown Italian enthusiast. Photograph 6 courtesy OIRT, Prague.

interesting to note that alternative test patterns are used. The photographs were obtained from the Dutch magazine *Radio Bulletin* and were originally taken by Italian enthusiasts. Should any reader have information on the Albanian TV Service we would be grateful to hear from him.



Checkerboard pattern of Asian origin received on ch.R1 at over 5,000 miles (see George Peterson).

We are also concluding the series of main news captions used by the members of OIRT. Next month we hope to commence a series on clocks!!

George Peterson—Australian TV DX

We have mentioned the activities of George Peterson of Ayr Queensland from time to time. George was successful during the past two sunspot cycles in obtaining remarkable reception from various TV transmitters in Asia and Australasia—many of these receptions have been over 5,000 miles. In a recent letter George detailed activity during Spring 1972 (whilst our Mediterranean friends were viewing Gwelo, Rhodesia!). Transmitters in Korea, China and of unknown locations were received. The transmitter of the American Forces Korea Network —AFKN ch.A2—was a new reception and as with the other receptions was via Trans Equatorial Skip/Spread F. We are showing a ch.R1 test pattern believed to originate in China or Southern Russia—this pattern is apparently radiated continually when other transmitters go on to programme. It shows the reasonable quality that can at times be received via F2—a signal-strength meter indicated that this signal gave a field strength at Ayr ranging between 200-500μV!! Regular colour TV (PAL) transmissions are not expected to commence in Australia until March 1975 but George is having considerable success with an imported PAL receiver since many of the English videotaped programmes that are broadcast in Australia are transmitted with full colour information. George operates a very successful (and busy) radio/TV business and we feel sure that the experience now being obtained with the PAL system will be invaluable in the next few years. We wish him every success.

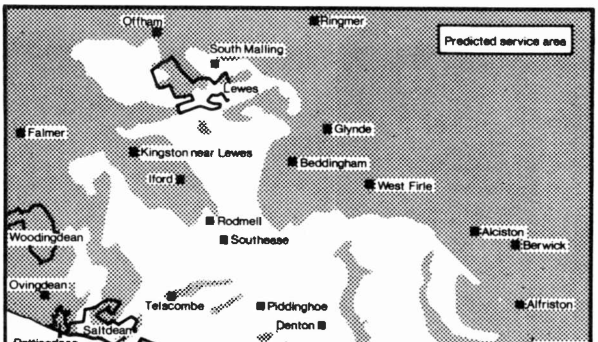
From our Correspondents

There has been a very full postbag this month thanks of course to the improved conditions! M. Dalby has sent in his log from Stroud, Gloucestershire. By all accounts things have been humming in that area with signals most days from all parts of Europe. Mr. Dalby sent in a sketch of a mystery test pattern noted on ch.E3 on June 6th with corner circles in white on a black background and a centre white square with rounded corners which contains a symbol resembling the figure 3 and a small letter b. The 3 dominates the square and above this would appear to be small writing. Did anyone see anything like this on June 6th?? John Lee of Coventry has contacted us regarding the identification carried on the TVE (Spanish) test card. He has seen the words "Canta Basilio" across the card in white letters. Unfortunately the answer is somewhat less exciting! TVE superimpose (as do certain other broadcasters) the name of the music being carried on the sound channel with the test card. Several other DXers have written in about this point so let's hope the mystery has now been cleared up! Torpoint in Cornwall is the home of Reg Roper, who has been carrying out experiments recently to enable him to take his TV receiver about in his car: problems (at present) have unfortunately terminated his activities in that direction! In addition to comments about TVE test card identification and the excellent conditions he has passed on news of an unusual u.h.f. array called the "Dipola" from Czechoslovakia. The high gain claimed would make this an ideal array for DX use and further information is awaited with interest. Our final UK letter is from Dave Bunyan of Sittingbourne Kent who has received YLE (Finland) ch.E3. This is a very elusive station to receive, at least in the South of England. Tervola ch.E3 YLE-1 is located adjacent to the Swedish/Finnish border about 50 miles North of the most Northern part of the Gulf of Bothnia and has an e.r.p. of 20kW. Incidently it was Dave who noted the old Swiss card in use as mentioned above.

Our concluding letter is from Cyprus. Yes, A. Papaeftychiou has been at it again! The F2 receptions from Rhodesia (the E2, 3, 4 transmitters from Rhodesia were all received) have dwindled but Sporadic E has opened up with signals from as far away as the UK noted. Not satisfied with this A. Papaeftychiou mentions that the tropospherics are also improving, notably Jordan ch.E3. An interesting reception occurred on May 24th. A football match at Barcelona (also relayed via Eurovision) was linked to the Jordan TV network via their new satellite receiving station. This in turn was received via tropospherics in Cyprus. As the letter puts it, "Last night thanks to the 'Jordanian Satellite Link' I attended the Rangers/Dynamo match direct from Barcelona!".

Stop Press!!!

Brief details have just been received from one of our regular correspondents suggesting possible reception of Jordan ch.E3 in Holland. Photographs for closer study are awaited and we hope to be able to give further information shortly. Jordan was received some years ago in East Germany by Ralf Erler of Parchim.



*The unshaded portion of the above map shows the expected service area of the **Newhaven** relay station. Channels: BBC-1 39, fourth 41, IBA 43, BBC-2 45. Receiving aerial group B, vertical polarisation. Map courtesy BBC Engineering Information Service.*

YOUR PROBLEMS SOLVED

★ **Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 523 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.**

FERGUSON 3651

There is a three-inch gap at the bottom of the picture plus another inch or so of foldover: at the top there is a further gap of an inch or so. The height control will raise the picture but will not move it down. The PCL85 field timebase valve has been replaced without making any improvement.—G. Trouncer (Evesham).

In this chassis (BRC 1400) the negative bias for the field output pentode is taken from a tap on the heater chain and applied to its grid circuit. The heater line should therefore give a negative voltage for this purpose. If there is a sudden change in the PCL85 operating conditions—as suggested by the condition you describe—the heater chain rectifier must be checked. In this chassis it often shorts, leading to the valves and tubes being grossly over-run. Change the diode (W10, upper right) before using the receiver again. The type of diode used for the replacement is not important provided the ratings are correct (the BY130 originally fitted could for example be replaced with a BY100).

SOBELL ST282DS

The screen is blank and there is no e.h.t. When the top cap of the PY800 boost diode is removed the e.h.t. is present. Replace the PY800 top cap and remove the scan coil plug PL6 and again the e.h.t. is present, along with a half raster. The line timebase valves and also the line output transformer have been replaced but the fault persists.—G. Howell (Manchester).

Replace the boost reservoir capacitor. This is C171 (0·25μF, 750V) and lies behind the centre tag strip below and to the right of the tube neck. This capacitor is short-circuit.

ULTRA V1780

When the contrast and brightness controls are fully advanced a faint picture can be seen—behind the flyback lines. The sound is OK and most of the valves have been recently renewed.—J. Hotchkiss (Andover).

If the faint picture persists when the brilliance control is set to zero the tube is almost certainly at fault. If the brilliance is controllable but the picture is faint check the 0·25μF coupling capacitor C50 from the video amplifier to the tube cathode. If this is in order check all the resistors in the video amplifier circuit and the back-to-front ratio of the video detector diode.

GEC BT318

The problem with this set is sound-on-vision: perfect sound or vision can be obtained but not together. The contrast control seems to have no effect except to produce line tear at the top of the picture at one end of its travel. Most of the Z749 valves have been replaced recently.—G. Allright (Maidstone).

Since the contrast control is not very effective and there seems to be cross-modulation it appears that there is a fault in the a.g.c. circuit. The components we suggest you check are the 1MΩ resistor R133 connected to the slider of the contrast control, the a.g.c. reservoir capacitor C135 (0·25μF) and the a.g.c. line filter R37 (1MΩ) and C48 (0·1μF).

ULTRA V1780

The height of the picture is only three quarters of what it should be and there is severe non-linearity which takes the form of a cramped band about 2in. high about a third of the way down from the top of the raster. I have checked all the capacitors and resistors in the field timebase and also the valve. The voltage at the top of the height control is about right at 315V. Does this mean shorted turns on the field output transformer or scan coils? Another fault is that electrical disturbances, for example a light being switched or the refrigerator coming on or going off, tend to make the contrast level, the volume (or both) change.—J. Harper (Exeter).

If you are sure that the field timebase valve is a good one and that all the resistors and capacitors are OK the most likely cause of the trouble is unfortunately the field output transformer. You could try shorting across the Varite in series with the scan coils in case this is faulty, but we doubt it. For the intermittent contrast reduction check the video coupling capacitor C50 (0·25μF). For the similar sound fault check the two audio coupling capacitors C93 (0·04μF) and C88 (0·05μF) and also the audio output pentode cathode decoupler C98 (50μF).

BAIRD 700

Whether colour is present or not there is a shimmering effect on the screen—on colour there is in addition a snow effect.—J. Hartford (Birkenhead).

We assume that the problem is a general background shimmering of the picture purity. If so the reason is almost certainly that the N600 thermistor is incorrectly positioned with respect to R601 in the power supply circuit. If these two components are not separated by exactly 0·25 in. there is a beat product between the field and mains frequency displayed on the screen as a purity shimmer. This chassis is unusual in employing an automatic degaussing circuit whose action is controlled by the temperature sensitivity of this N600 thermistor.

GEC 2014

The brightness is very low at one point on the movement of the control and the width is only two-thirds of the screen width. The h.t. rectifier and the line timebase valves have been replaced and the brightness control has been checked.—T. Raven (Barnes).

We take it that the h.t. is up to normal—about 240V on 405 lines (HT1). The fault could be due to a defective line output transformer but we suggest you first check the boost reservoir capacitor C176 (0·1μF 750V) and the v.d.r. in the width stabilisation circuit. This v.d.r. is positioned between the PY800 and the PL504 and can be checked by connecting a 500kΩ resistor across it. If this increases the width, replace the v.d.r. using a Mullard type E298ZZ/05.

TELEFUSION T2/19

There is vision-on-sound which gets worse as the set warms up. Sound-on-vision then appears with loss of contrast and the sound a little distorted. The fault is on 625 lines only. All relevant valves have been replaced and the usual checks made in the f.m. detector circuit—diodes, preset adjustment and alignment. An aerial attenuator has also been tried without improving matters. This set incidentally uses the Thorn 900 plus radio chassis.—C. Parker (Northcote).

Check the setting of the local-distant control. Then try replacing the video amplifier (PFL200). Check the video detector and if this is OK turn attention to the a.g.c. line. The first suspects here are the clamp diode W1 and the anti-lockout diode W3.

BAIRD 630

There is a fold in the line scan about one-third from the left. This fold can be varied in width from about ¾ in. to about ¼ in. by adjusting the line hold control but as the fold is being adjusted to minimum the picture loses lock. The line oscillator and output valves and the screen grid resistor of the latter have been replaced but the fault remains. There is also a gap at the bottom of the picture—about 2 in.—which cannot be rectified by adjusting the height control.—K. Johnson (Worthing).

The basic problem seems to us to be in the boost circuit and we suggest you check the boost rectifier V11 (PY88) and reservoir capacitor C129 (0·25μF 750V). With the boost voltage correct we would expect the height to be all right: if not check the PCL85 and its cathode decoupler C234 (100μF).

McMICHAEL MT65DS

The trouble is field bounce: after the field hold control has been adjusted the picture stays locked for only a moment then slips up and down. The usual cures—the PCL85 field timebase valve, R114 in series with the hold control and the two 0·005μF capacitors connected to the grid of the triode section of the valve—have been tried without success.—K. Holloway (Tring).

We suggest you replace the following capacitors: C110 (0·05μF) the field sync pulse integrating capacitor, C111 (300pF) the sync pulse coupling capacitor, C112 (0·05μF) the field timebase charging capacitor, and the 100μF electrolytic (C73) in the cathode circuit of the video amplifier (V5 PCL84). You may also have to replace the sync separator valve (V6 EF80).

EKCO T380

The vision is perfect but there is no sound except for a low buzz from the loudspeaker. This buzz varies with the setting of the volume control. All valves in the sound section have been replaced with known good ones.—A. MacPherson (South Shields).

From your description the trouble appears to be prior to the volume control. This means that the 30P12 audio output stage is in order. You should therefore apply a hum test to the top of the volume control—to ascertain the type of hum to expect—and then work back through the coupler C63 to pin 1 of the 6D2 sound interference limiter, across to pin 7 then back via the coupling components C57 and R44. If all is well here check the valve base voltages of the two sound i.f. amplifier stages V6 and V4 (both 6F23) and the screen grid decouplers—C41 and C34—of these two valves.

SOBELL 1000DS

The field scan is all right on switching on but after some ten minutes the height decreases by about 2 in. at the bottom and 1 in. at the top. After a further quarter of an hour it is impossible to lock the field timebase—the hold control is at the end of its travel at this stage. I have checked the PCL85 and all the voltages in this stage seem to be correct—F. Pemberthy (Didcot).

As the voltages are OK we suspect a faulty capacitor, the most likely being the field sync pulse integrating capacitor C123 (0·05μF). Other suspect capacitors are the field charging capacitor C90 (0·05μF) and C91 (0·005μF) connected to the triode grid of the PCL85.

MASTERADIO D500DST

Operation on 405 lines is excellent but on 625 lines there is sound-on-vision, i.e., white horizontal lines running across the picture accompanied by intermittent crackling noises which are unaffected by the volume control setting. The picture also has a snowy background and at times the sound drifts and is a bit distorted. Both tuner unit valves have been replaced recently.—T. Bryan (Hull).

Since operation on v.h.f. is OK and both u.h.f. tuner valves have been replaced we suspect the 1·8kΩ resistor which supplies h.t. to the PC86 inside the u.h.f. tuner.

FERRANTI T1084

This early dual-standard set has three main faults, foldover at the left-hand side (valve replacement will not cure this), intermittent tracking from the base of the e.h.t. rectifier holder to chassis and occasional buzz on 625-line sound with slight distortion.—H. J. Haddock (Cheam).

For the foldover problem we suggest you check the boost reservoir capacitor (C111, $0{\cdot}15\mu$F, 750V), the linearity coil L21 (wired correctly?) and its shunt components ($4{\cdot}7$kΩ and $0{\cdot}001\mu$F). As far as the tracking is concerned if the connections are good with no sharp edges it may be necessary to replace the e.h.t. rectifier base shroud. To clear the 625-line sound distortion reset the buzz preset RV2, check the electrolytic C85 (25μF) and realign the 625-line section of the sound i.f. transformer T7. (Most of these components are identified in Fig. 1, page 405, July 1971 TELEVISION.)

KB WV70

There is sound but no e.h.t. The width circuit resistors R144-6 glow red. The line output stage valves have all been replaced but the fault persists.—G. O'Keefe (Daventry).

Check the 4μF decoupler C125 in the width circuit since it appears that this is shorting. If this capacitor is OK the fault can only be in the line output transformer.

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TELEVISION SEPTEMBER 1972

TEST CASE

117

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

? *The field technician was sent to investigate the complaint of excessive though intermittent electrical interference on the screen of a Philips monochrome receiver. Unable to clear the fault on the spot the technician brought the receiver to the workshop with the report of interference-like dots occurring on the screen at random intervals with or without the aerial connected. This was a fair indication that the interference was internally generated.*

On test in the workshop it was found that the receiver operated without fault for an hour or so after which time there was a sudden display of white dots all over the screen accompanied by a very slight hissing noise from the speaker. The aerial was removed and the symptoms disappeared. They returned however when the brightness was advanced to reveal an unmodulated raster. Further investigation indicated that the interference effect could in fact be precipitated by advancing the brightness control with the aerial disconnected or by advancing either the brightness or contrast control with the aerial connected. At low picture illumination level the receiver would run for long periods without the trouble occurring. The spots had no specific pattern on the screen, being disposed in an absolutely random manner—similar to the effect produced by interference from a battery-operated electric motor of the type used in some toys.

Thinking that the insulation of the line output transformer was failing and producing retrace corona this component was replaced but the fault persisted.

What mistake in diagnosis was made by the bench technician and why should he have known from the symptom that the line output transformer was not *responsible? See next month's* TELEVISION *for the answer and for a further Test Case item.*

SOLUTION TO TEST CASE 116

Page 475 (last month)

Distorted 625-line sound from receivers using a ratio f.m. detector is generally caused by imbalance somewhere in the detector circuit. This was proved to be the case in the set under discussion as the distortion decreased when the a.m. rejection preset was set to the end of its range. It was eventually discovered that one of the ratio detector diodes was faulty and replacement and resetting of the a.m. rejection preset completely cured the distortion. Other causes of imbalance are change in value of one of the detector load resistors or a faulty shunt electrolytic. Misalignment of the intercarrier sound channel or ratio detector transformer can also produce the symptom, again with the distortion decreasing when the a.m. rejection preset is adjusted to range extreme.

In receivers using an EH90 locked oscillator discriminator valve, a.f. amplification *on both standards* is provided by this valve. A common fault is reduction in the value of the resistor (generally 18kΩ) connected between the h.t. line and the screen (pin 6) of the valve. In most circuits there is also a lower value resistor ($5{\cdot}6$kΩ) connected between pin 6 and the cathode (pin 2). This along with the actual cathode resistor (to chassis) can also be affected.

For correct operation this valve needs exactly the right voltages on its electrodes. Thus sound distortion in a receiver using an EH90 should lead first to a detailed check in this area, particularly when the sound of both standards is affected.

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