

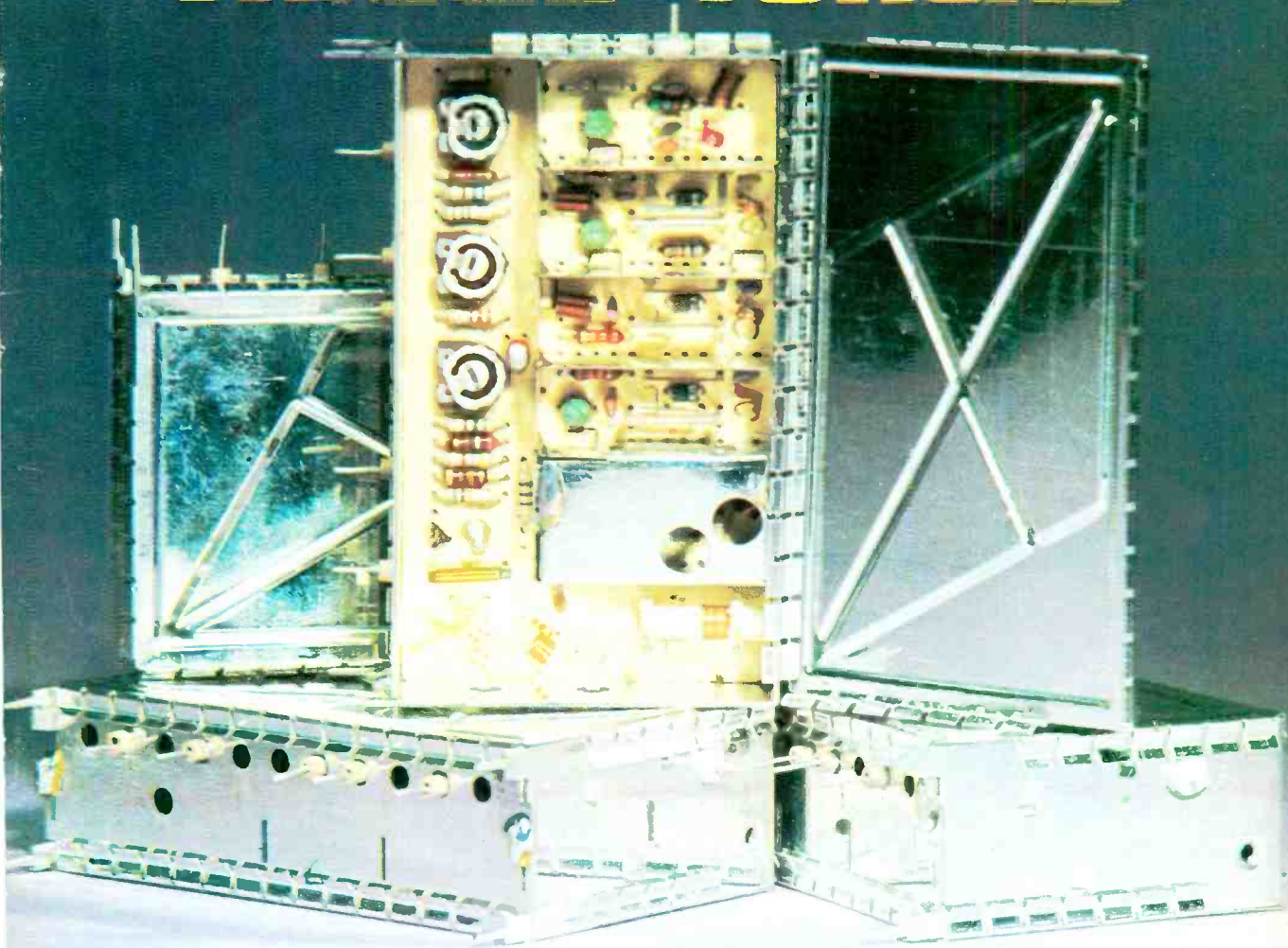
TELEVISION

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1973

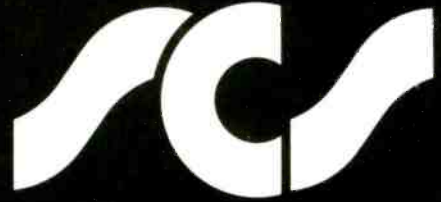
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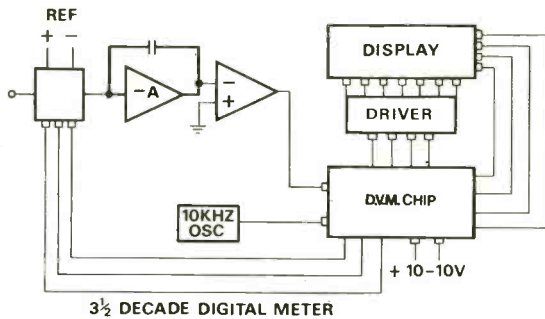
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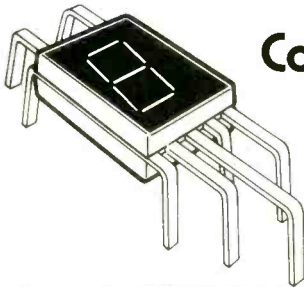
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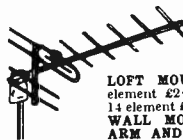
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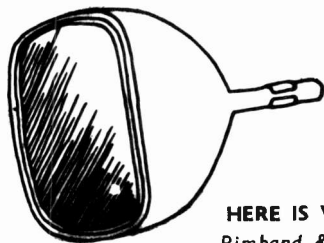
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TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

VOL 23 No 7
ISSUE 271

MAY 1973

AERIAL TIGHTROPE

Quite a straightforward job you would think: climbing a couple of ladders, strapping a chimney or fitting a bracket, attaching and wiring an aerial. So it is to those who know the job requirements. But there is much more to aerial erection than meets the elevated eye.

Each month sees the opening of new relay stations or main transmitters all of which add to the "flight paths" of the radio waves criss-crossing the skies. At the points of intersection pinpointed by a receiving aerial there are several kinds of signal hovering on adjacent frequencies just longing to find a route down the co-ax to the receiver. To make quite sure the receiver is tuned to the best signal at the location the aerial must be correctly dimensioned and—just as important—correctly directed.

Yet there are far too many aerial erectors who either do not know how or simply do not bother to instal the best aerial to the best advantage. A look around the roof-tops in any locality reveals some surprising anomalies of both erection and direction; is it like pointing a gun right off target.

Our sympathies go out therefore to the East Midlands Association of Aerial Contractors who have expressed concern over present aerial installation standards. Experienced aerial erectors use a suitable field strength meter and know the locality—every hill, chimney and pylon. A knowledge of transmitter power is not enough: when another aerial is only a foot or two to one side problems arise.

The National Federation of Aerial Contractors comes under strong criticism by the Association but is currently undertaking (see overpage) closer scrutiny of installations by member firms. How effective all this will be remains to be seen, but in our opinion the onus of ensuring that subcontracting aerial erectors as well as their own staff do the job properly rests squarely on the shoulders of the dealer and rental firm.

We recommend that anyone who wants the best that can be got from a receiver personally supervises the installation: in particular don't let the installers leave your premises until you are satisfied that you have the best possible aerial installation properly set up for your patch.

M. A. COLWELL—*Editor*

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THE NEXT ISSUE DATED JUNE
WILL BE PUBLISHED MAY 21

Cover: The ELC1043/05 varicap tuner units featured in our cover photograph this month were lent to us by **Forgestone Components** whose co-operation is gratefully acknowledged.

TELETOPICS



LOOKING TO THE FUTURE

WHAT will be "the latest" in television transmission and reception in ten to twenty years' time? The way things seem to be going are upwards in frequency and towards complete digitalisation of the television transmission path. The highest frequency in commercial use today is about 10GHz, but the continuing demand for spectrum space to extend existing services and provide new ones is already producing congestion in the microwave band below 10GHz. The IEE in association with the IEEE, the IERE and the Institution of Physics recently held a conference therefore on the propagation of radio waves at frequencies above 10GHz. This took place last April. Band VI (11.7-12.5GHz) is of course already allocated for television use. Meanwhile high-speed digital equipment for transmitting and receiving digital television video signals has been demonstrated recently to The Royal Television Society when a 30GHz television link was previewed. Such developments could eventually lead to only the camera tube and receiver display system being analogue devices.

ONWARD MARCH OF THE IC

The increasing presence of the i.c. in TV circuitry is high-lighted in the latest ITT chassis, the VC300 mains-battery portable chassis used in the Feather-light Super 12: six main i.c.s are used in this, with the entire signal circuitry, apart of course from the tuner and video output stage, being in i.c. form. For video demodulation a Motorola MC1330P synchronous detector i.c. is used—this is the third chassis to employ this device, the others being the Decca Gypsy portable and BRC 8000/8500 colour chassis. The other i.c.s used are all Texas devices which we haven't come across before. The MC1330P is partnered by an SN76650N which provides the i.f. amplification; the sound channel comprises an SN76660N as intercarrier amplifier and demodulator and an SN76001N audio amplifier; a further SN76660N provides a.f.c. for the varicap tuner; and an SN76532N acts as sync separator and line oscillator.

The latest issue of *Mullard Technical Communications* provides further information, including a complete TV receiver front-end design, on their TCA270 i.c. This sophisticated device incorporates no less than 90 transistors in integrated form! The functions it carries out are synchronous vision demodulation—with in addition a video preamplifier and noise suppression circuit—a.g.c. detection (with

optional gating) and amplification with outputs to control both the i.f. and tuner gains, and a.f.c. limiter/discriminator. It is already in use in two of the latest colour chassis, the GEC group C2110 series and Pye group 713 chassis.

NEW KIND OF TV SERVICE

A new type of commercially-operated TV service has been authorised by the US Federal Communications Committee. The new service, called Multipoint Distribution Service, will operate in the band 2.15-2.16GHz and is to start this year. The idea is that in each area an operator will be licenced by the FCC to run the service and given a channel. Organisations can then hire time from the operator in order to use the channel for local broadcast transmissions. The aim is to provide a low-cost means of visual communications between a central point in a metropolitan area and suitable local receivers: Microband Corporation of America who have received the first licence claim that the service can provide cheaper visual communications than the use of videocassettes or even film projection. The transmitted video signals may be digitally encoded to guarantee the privacy of the organisation taking time from the operating concern.

UHF SERVICE EXTENSIONS

The following three relay stations are now in operation:

Hebden Bridge ITV (Yorkshire Television programmes) channel 25. Aerial group A.

Roseheartly ITV (Grampian Television programmes) channel 41. Aerial group B.

Idle (Yorkshire) BBC-1 channel 21, BBC-2 channel 27. Aerial group A.

All these transmissions are vertically polarised.

1972 TRADE SCENE

Total television receiver deliveries to the UK market during 1972 reached a record 3,607,000 sets. Colour set deliveries totalled 1,775,000, an astonishing 93% increase on 1971. There is no record of the percentage of imported sets in these total delivery figures but colour TV set imports rose from £11.49 million in 1971 to £41.23 million in 1972. It is interesting to compare these figures with those released by the Electronic Industries Association of Japan. Despite anticipated difficulties in the home market and the clamp-down in the USA the Japanese colour receiver industry reported an improved year in 1972 with

production reaching a record 8,387,000 units, an increase of 22% compared to 1971. Exports at 1,848,000 sets were up 17.2%. We have heard reports of reluctance amongst UK setmakers to increase production capacity on the assumption presumably that demand is unlikely to go much higher. But the moral seems to be that those who have the capacity to produce capture the market. There is little sign yet of a slowdown in the UK market. Sidney Parker, chairman of Radio Rentals, reported recently that his organisation has a waiting list for colour sets of 15,000, customers having to wait on average 4-7 weeks for a set. He forecast 12 million colour sets in use in the UK by 1976 out of a total of 20 million sets with 60% on rental. That's a lot of demand still to come, and what about that Common Market that was going to be our salvation? It strikes us that someone should get cracking.

Here's an interesting sidelight on how tables can be turned. In the early 60s US electronics giants started to set up production units in the Far East to get the benefit of low local costs. Now a flow in the opposite direction seems to have started! Following recent currency revaluations the Japanese giant Matsushita Electronic Industrial Co. Ltd. is expanding colour set production in Puerto Rico to an aimed 15,000 sets a month to retain its share of the US market. Next . . .

SONY TO START COLOUR SET PRODUCTION IN THE UK

Sony is planning to start production of colour sets in South Wales. Initial production will be at the rate of 5,000 sets a month, building up to 120,000 a year. The plant is expected to come into operation towards the end of 1975. The announcement states that the sets will be "designed to receive phase alternation by line (PAL) broadcasts": this leaves open the question whether they will be PAL specification sets or receivers like Sony's present ones which simply delete alternate lines of the transmitted chrominance signal, repeating the set of chrominance lines actually used by the decoder, so as to get round the PAL system phase alternations.

DECODING PAL

We have commented before on the techniques used in various imported "non-PAL" receivers (Sony and Teleton) to decode the PAL transmissions. The circuit used in Sanyo models came our way recently and the heart of the decoder section is shown in block diagram form in Fig. 1. This could perhaps be better described as an uncoder rather than a decoder since its operation simply converts the PAL signal to an NTSC one. A bistable triggered by

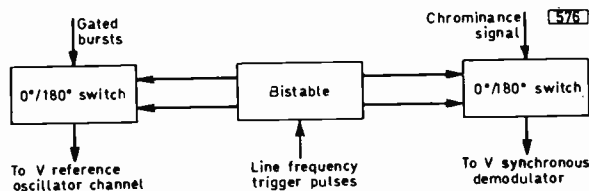


Fig. 1: Sanyo's method of PAL decoding.

line frequency pulses drives two 180° phase switches, one of which removes the alternate line switching from the V chrominance signal while the other shifts the bursts so that a burst feed with the correct phase characteristics to drive a separate V reference oscillator is obtained. There is no idem, so if you switch on and get green faces presumably you have to switch off and try again.

CHECK ON AERIAL CONTRACTORS

A serious effort is being made by the National Federation of Aerial Contractors Ltd. (124a High Street, Sutton, Surrey) to improve standards in the TV aerial contracting industry. In its recent annual report the Ministry of Posts and Telecommunications reported 55,000 complaints of bad reception: there was an increase of 85% in u.h.f. aerial installation complaints. Although thirty-two causes of these complaints were listed in the report the majority of complaints related to inefficient aerial installations. The NFAC plans to inspect its members' installations regularly at random, and to inspect the work of companies applying for membership in addition to checking their trade references. Faulty workmanship is to be reported to a special standards committee. It is hoped that these measures will reduce the number of viewer complaints and alert consumers and all those employing aerial contractors to what the NFAC calls the very large number of "roof top racketeers".

BRC NOW THORN CONSUMER ELECTRONICS

We are by now well used to ITT instead of STC and should be getting used to Rank Radio International instead of Rank-Bush-Murphy. Now the giant of the UK television industry has decided to join in this fashion for name changing. The British Radio Corporation has changed its name to Thorn Consumer Electronics, which somehow is going to take a bit of getting used to. The main brands Ferguson, Ultra, HMV and Marconiphone are to be continued. BRC was formed by Thorn and EMI in 1958 when EMI decided to withdraw from direct participation in the domestic radio and TV market: the Ultra brand was later taken over from the company of the same name when they too decided to withdraw from the domestic market. For a while Philco sets were also being produced and sold by BRC. Whilst new names may well assist marketing strategy they cause problems years later to those who have to service sets with no longer listed company names on them. Which is why we in the magazine talk about things like ITT/STC sets and now, presumably, TCE/BRC/Thorn ones.

THE "COLOUR 20"

A "British designed and made" colour set, the "Colour 20", has been introduced by Steeplestone Products Ltd. (Cinema House, Middle Barton, Oxford). The set features touch tuning with a red channel indicator, slider controls and an easy to service modular chassis—even tube change can be done quickly in the home. Distribution is through appointed wholesalers. A mains-battery portable and a 26in. model are proposed for release later.

THE LID OFF

VARICAP TUNERS

KEITH CUMMINS

ATTENTION is being increasingly focused on the varicap diode tuner as the latest, sophisticated means of television receiver front-end tuning—in both colour and black-and-white sets. The main purpose of this article is to investigate the servicing problems associated with this comparatively new method of tuning. First however let's briefly recap on the principles involved.

The tuners use variable-capacitance (or "varicap") diodes as the variable tuning elements: the effective capacitance of the diodes is controlled by the reverse bias applied across them, tuning being achieved by varying this voltage. As the reverse bias across a varicap diode is increased so its junction depletion region widens thus reducing its capacitance.

The ELC1043

Fig. 1 shows the circuit of the widely used ELC1043 varicap tuner and Fig. 2 the layout. The components are mounted on a copper-clad glass-fibre laminate printed board, all the tuned circuits being in screened compartments. The oscillator tuned circuit has a screening cover to give additional shielding to minimise radiation. The entire tuner is housed in a metal box with the external connections brought out through feedthrough capacitors.

Circuit Description

There are two r.f. amplifier transistors, VT1 and VT2, the third transistor VT3 being the oscillator/mixer. Each of the four half-wave tuned lines (L6, L10, L14 and L17) is terminated at one end by a fixed capacitor and tuned at the other end by a BB105B varicap diode. Tuning is effected by varying the voltage applied to pin 5 between 0.3-28V. The tuning voltage is obtained from an external bank of switched potentiometers (see Fig. 3).

For optimum noise performance the input circuit is untuned, the input being fed to VT1 emitter via a two-stage high-pass filter. The first stage output is developed across L6 and inductively coupled by L7 to the second stage. The bandpass circuit L10/D2 and L14/D3 is coupled to the mixer/oscillator stage

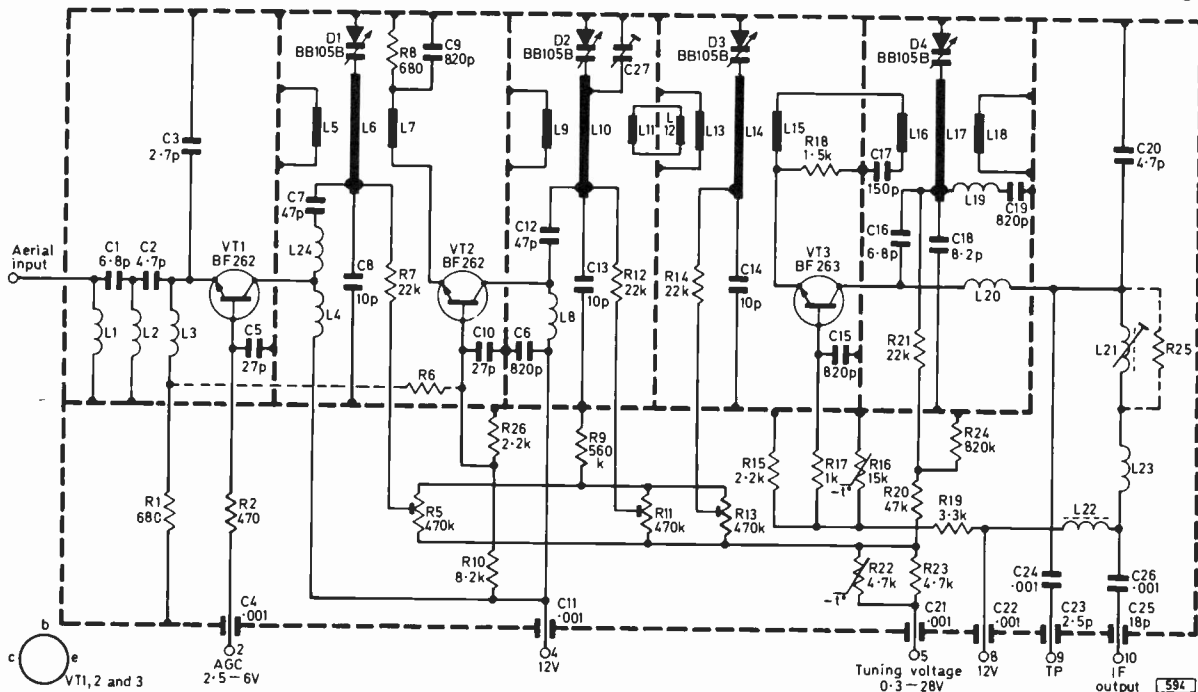


Fig. 1: Circuit of the widely used ELC1043 varicap tuner. The ELC1043/05 is similar except for the transistor types used.

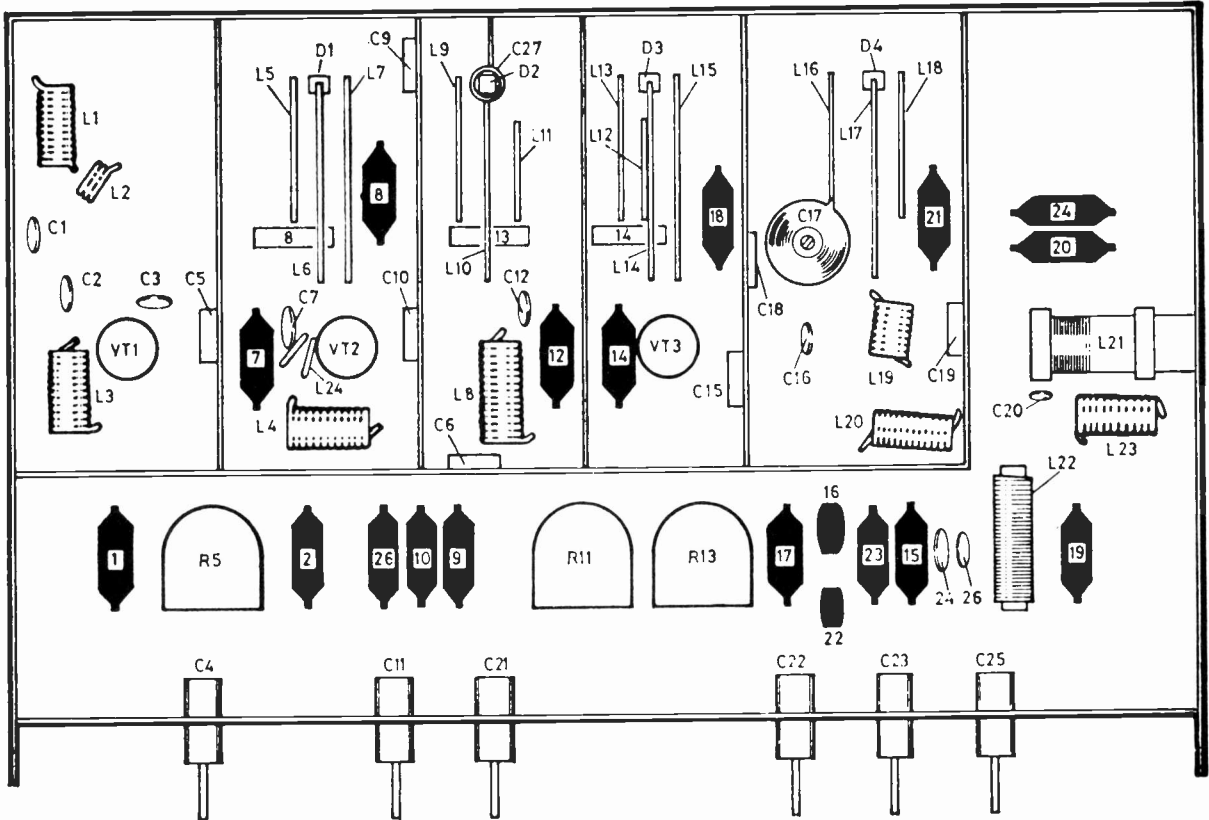


Fig. 2: Layout of the ELC1043 varicap tuner. Resistors shown black, capacitors white.

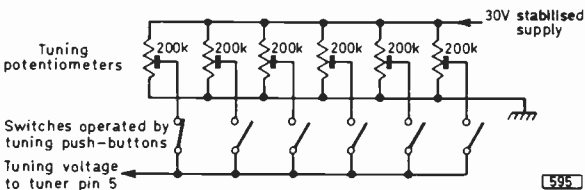


Fig. 3: Typical potentiometer control unit.

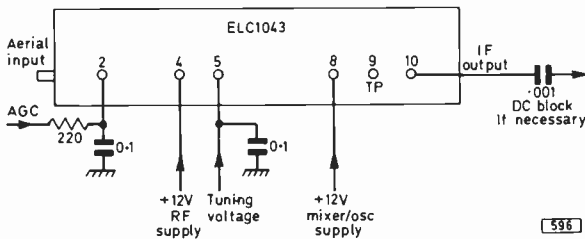


Fig. 4: External connections to the ELC1043.

by the loop L15 which also serves, with L16, to couple the oscillator tuned circuit L17/D4 to VT3 emitter. L16 is terminated by a capacitor (C17) which is large enough to ensure that VT3 emitter circuit presents a low impedance at the i.f. The i.f. output coil is L21 which is intended to form the primary of a double-tuned bandpass circuit.

Forward a.g.c. is applied to the base of VT1: in some tuners R6 is connected so that a.g.c. is applied

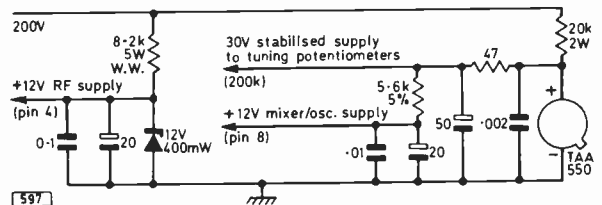


Fig. 5: Typical power supply circuit.

to VT2 base also. The bias applied to D1, D2 and D3 is precisely controlled by the tracking presets R5, R11 and R13. The thermistors R16 and R22 are incorporated to improve the oscillator frequency stability during the receiver's warm-up period.

External Connections

External connections to the ELC1043 are shown in Fig. 4 while Fig. 5 shows typical power supply arrangements. A separate stabilised supply is generally provided for the r.f. stages because of the variation in current drawn under different a.g.c. conditions. Two r.f. amplifier stages are used because of the lower Q of diode-tuned circuits.

The varicap diodes take the place of the conventional mechanical tuning capacitors then and as a result the tuner itself has no moving parts. Since there is no need for any mechanical coupling between the tuning controls and the tuner itself the tuner can be situated at the rear of the set, close

to the aerial socket. This is an advantage both from the point of view of aerial matching and temperature.

Mechanical Tuner Problems

To get the servicing problems in perspective let us next consider the tuning arrangements previously used. The earliest of these, employed on v.h.f., was the switched tuner which was either of the turret or incremental type. The turret tuner substituted a coil-bearing "biscuit" mounted on the rotating drum or turret when channels were changed. Twelve positions were normally provided, with a fine tuning knob to adjust the local oscillator frequency. As its name suggests the incremental tuner simply added more inductance to the tuned circuits at every downward channel movement: thus the highest inductance was present on channel one and the least on channel 12 (which normally covered 13 as well with manipulation of the fine tuner).

The movement towards u.h.f. TV working, initially with dual-standard sets and later with single-standard ones, brought about the need for u.h.f. tuners. In the earliest u.h.f. receivers valve tuners which were not particularly efficient were used. The drive mechanism was usually a dual-speed rotary system calibrated from channels 21 to 68. Experience in the field indicated that 625-line television was in many cases considered by the viewer to be inferior to 405-line reception, on account of the poor signal-to-noise ratio achieved by the valve tuners. Many viewers were not prepared to use external u.h.f. aerials of course, having achieved satisfactory reception on v.h.f. with an indoor aerial: this aggravated the situation even more.

Another aspect which caused difficulty was the care needed to tune in a u.h.f. channel using a rotary tuner covering the whole of Bands IV and V. Many viewers simply could not tune in BBC-2 correctly with such a tuning mechanism, finding that they had passed right over the channel they wanted before realising what they had done.

The advent of transistor tuners rapidly improved the quality of u.h.f. reception but use of a rotary mechanism was continued by many manufacturers. Thus while potential reception was improved the same tuning difficulties remained and viewers continued to gravitate towards 405-line viewing using the "old faithful" switched tuner.

The operational breakthrough came with the introduction of the push-button u.h.f. channel change. The mechanism is basically simple. Adjustable push-buttons press down on a lever bar which in turn rotates the tuner's variable capacitors to the appropriate position. Each button is capable of tuning over the entire u.h.f. bands and this leads to customer confusion at times when after some adjustments which were too heavy handed they find themselves receiving ITV on a BBC button!

Mechanical Faults

Mechanical tuning obviously has its snags. There are for example contact springs which earth the tuning capacitor and go intermittent. This gives rise to the most random tuning defects, capable of driving the most patient viewer to a state of total exas-

peration. It is also possible for the rotation mechanism to hang up and jam intermittently, or just become sticky, so that the reset accuracy of the mechanism is impaired and the receiver has to be retuned every time the channel is changed. The vanes in the tuning capacitor can also short out at different settings, thereby eliminating some channels.

On to the Varicap Tuner

It will be seen then that mechanical defects can cause very irritating fault symptoms. If one thinks along the lines that anything mechanical is nasty, then the elimination of mechanical parts can only be to the good. The logic of this is splendid—provided the electronic replacement for the mechanical system is more reliable! Otherwise we are leaping out of the frying pan into the fire!

In the light of experience gained with mechanical tuning devices it seems great that with the varicap tuner we have at last dispensed with the dreaded rotary tuning capacitor, replacing it instead with a variable voltage to the tuner.

Let us think about this however since things are never quite as simple as they first appear. The tuning voltage has to be variable in order to tune the receiver. Obviously then a means of varying the voltage has to be provided to act as the tuning control. As it is a voltage that has to be varied the tuning control takes the form of a potentiometer. Now we have returned to a mechanical system again, though in a less complex form. A potentiometer is required for each channel, selected by pressing the appropriate channel button.

We have lost a tuning capacitor and its rotating mechanism and gained a set of pots and selector switches therefore. Provided the pots and switches are mechanically more reliable than the tuning capacitor we should be better off—or should we?

Need for Voltage Stabilisation

The voltage selected by the pots cannot be allowed to drift otherwise the receiver will go off-tune. The voltage supply to the pots has to be stabilised therefore and a stabilising zener diode or integrated circuit (TAA550) is needed for this purpose. Any failure in this part of the circuit will give rise to tuning drift or worse, a total loss of reception. A short-circuit TAA550 for example will completely remove the tuning voltage while if it is open-circuit the tuning can vary with picture brightness. Likewise any intermittency in the potentiometers or associated switching and/or resistors can also cause problems.

Relative Reliability of Tuners

It will be seen then that in order to lose our troublesome mechanical arrangement we have had to introduce considerably more electronics which we trust are going to be more reliable. In addition we have not so far considered the relative reliability of the varicap tuner itself compared with the mechanical type. Since two r.f. transistors are generally used to compensate for the reduced Q of the varicap tuned circuits we immediately have twice the likelihood of an r.f. stage breaking down! And

being semiconductors the varicap diodes themselves are more likely to fail than the sections of a ganged tuning capacitor.

It is reasonable then to conclude that if mechanical faults are the most prevalent the use of varicap tuners will make life easier. Mechanical faults are generally not too difficult to sort out however and the field engineer can often cope with them in the home. Can the same be said of the varicap tuner? It seems that this type of tuner does not need so much attention as its mechanical counterpart but is likely to throw up some much more difficult faults when it does, resulting in bench repairs being needed. So far my own experience has indicated that varicap tuning faults nearly always need servicing on the bench.

Generally speaking it seems true to say that varicap tuners themselves are adequately reliable: the snags result from the tuning system and stabilised power supply.

Tuning Drift with Varicap Tuners

If a varicap tuned receiver is constantly drifting off tune the +30V supply should be the number one suspect. It is best to connect an Avometer permanently to the supply so that it can be precisely monitored—if necessary write down the exact voltage measured. If the receiver drifts, check the voltage. If it has changed, even slightly, this may well be enough to be the cause of the fault. To pinpoint and confirm the diagnosis aerosol freezer should be applied to the stabiliser i.c. or zener. If the voltage returns to normal or changes wildly for the worse the stabiliser is almost certainly the cause of the trouble and should be replaced. A prolonged soak test should then be carried out.

A Difficult Fault

A classic horror of a fault occurred in a Grundig colour set using the arrangement shown in Fig. 6(a). In this an area of resistive material is deposited on a panel, contact being made at the two edges by means of metallic strips. Sliders for each tuning control button are placed side by side and move up and down across the resistive area, thus picking off the required tuning voltage. The equivalent circuit is shown in Fig. 6(b).

The fault was irritating and random. The set would go off tune suddenly and need retuning before any signals could be received. If left long enough without any adjustment being made the receiver would revert to normal on its own, sometimes after two hours or more.

After due contemplation of the fault it was decided not to disturb the normal three buttons

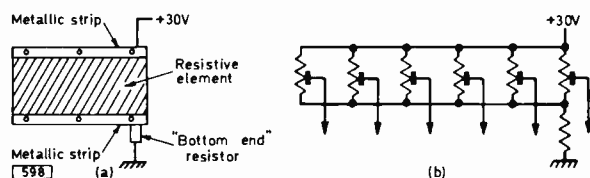


Fig. 6: Grundig tuning pot arrangement.

when the fault occurred but to retune instead on the remaining ones. When the fault occurred all one had to do therefore was to press the alternative button and all would be restored to normal. The next time failure occurred the picture could be restored by reverting to the original button. It was proved therefore that the fault had two distinct states.

Careful monitoring of the +30V supply revealed no change in voltage at all however! The stabilizer i.c. was nevertheless changed as a precautionary measure, without much conviction and without success! The varicap tuner was then replaced in its entirety but the fault persisted. It was at any rate proved that the fault lay somewhere in the tuning pot arrangement.

The Cure

As the receiver was being used on low (group A) channels the sliders of the pots were near the low-voltage end of the resistive track. A voltage measurement was next taken from the metallic strip at the low-voltage end of the track to earth. This voltage was fluctuating. The lead to the varicap tuner was removed but this did not affect the variation. The "bottom-end" resistor shown was then shorted out and the buttons were retuned to positions farther up the track. As this cured the fault it was concluded that the bottom-end resistor was intermittent. This particular component is also printed and was left permanently shorted therefore: no further fault has occurred.

Varicaps: Summing Up

This particular fault could only have occurred with the varicap tuning system and took many hours of soak testing to reveal. It serves to illustrate the kind of trouble which can occur with varicap tuning.

It must be said in all fairness that when working well the varicap tuner is very consistent, tuning being particularly easy. The system is ideal for colour sets since automatic frequency control can be easily applied. A.F.C. is not new however: it was employed with the mechanical tuner used in the BRC 2000 series dual-standard colour chassis for example. The mechanical faults with this tuner are minimal, the classic one being the lever bar falling off! This is easy to see and put right.

Signal-to-Noise Ratio

Another point concerning varicap tuners arises with their use in colour receivers. The makers of the most expensive colour receiver on the market still do not use a varicap tuner but instead use a mechanical one. The makers' claim is that the signal-to-noise ratio of the varicap tuner is inadequate for their colour standards. Undoubtedly the results obtained on the receiver seem to confirm this.

Interestingly, the same manufacturers use varicap tuners in their black-and-white receivers, and the tuning button system is often full of troublesome intermittent contacts.

The varicap tuner has its advantages and disadvantages then. Probably the simplest comment would be to say that when it is good it is very very good but when it is bad it is horrid!

LONG-DISTANCE TELEVISION

ROGER BUNNEY

FEBRUARY has been a quiet month from the long-distance television angle. Sporadic E was little in evidence and MS (meteor shower/scatter) also left much to be desired. The only lift in the month occurred over the weekend of the 3rd/4th when tropospherics came into their own. From this location (8 miles North of Southampton in the Test Valley) ORTF (France) was very much in evidence with the farthest station noted being Limoges ch. E50. A considerable number of ORTF stations were received at both v.h.f. and u.h.f. It was not until the 11th however that I was able to log Lille ORTF-3 ch. E24 as a new station (and a new network!)—thanks to the local BBC-2 transmission which usually occupies this channel being off for the afternoon. Graham Deaves from his advantageous location near Norwich, East Anglia was active and managed to receive good colour from East Germany (GDR) again. It is interesting to note that while conditions died down here during Sunday afternoon the 4th in East Anglia they continued through until late Sunday. Certainly these winter tropospherics gave a welcome respite from the dim conditions normal at this time of the year. My log for the month is as follows.

- 1/2/73 NRK (Norway) ch. E2—MS; NOS (Holland) E4; BRT (Belgium) E2—both trop.
- 2/2/73 SR (Sweden) E2; CST (Czechoslovakia) R1; TVP (Poland) R1—all MS; BRT E2—trop.
- 3/2/73 NRK E4; ORF (Austria) E2a; CST R1—all MS; BRT E2—trop.
- 4/2/73 NOS E4; BRT E2—both trop; also various ORTF (France) stations in Bands III and u.h.f. up to ch. E50.
- 5/2/73 DFF (GDR) E4—MS; BRT E2—trop.
- 6/2/73 DFF E4; SR E4—both MS.
- 7/2/73 BRT E2—trop.
- 8/2/73 NRK E4; TVP R1—both MS; BRT E2—trop.
- 9/2/73 NOS E4; BRT E2—both trop.
- 10/2/73 ORF E2a; WG (West Germany) E2—both MS; NOS E4; BRT E2—both trop.
- 11/2/73 NRK E4—MS; NOS E4; BRT E8, 10; ORTF Lille E24—all trop; BRT E3—see later.
- 12/2/73 SR E2; WG E2—both MS; BRT E2—trop.
- 14/2/73 SR E2—MS.
- 15/2/73 WG E2—MS; BRT E2, 10—both trop.
- 16/2/73 NRK E4; DFF E4; CST R1—all MS; BRT E2—trop.
- 17/2/73 SR E4—MS; NOS E4; BRT E2, 10—trop.
- 18/2/73 BRT E2; also ORTF improvement at u.h.f.—trop.
- 19/2/73 DFF E4—MS; BRT E2—trop.
- 20/2/73 BRT E2—trop.
- 22/2/73 SR E2; NRK E2; CST R1—MS.
- 23/2/73 BRT E2—trop.
- 24/2/73 WG E2—MS; BRT E2—trop.
- 25/2/73 NOS E4; BRT E2—trop.
- 26/2/73 BRT E2—trop.
- 27/2/73 CST R1—MS.
- 28/2/73 SR E4; CST R1—MS.

It is gratifying to note the considerable increase in loggings compared to previous months now that the new aerial system (described last month) is in operation. I propose to continue logging BRT Belgium ch. E2 for another month but if it continues as regularly as at present I feel this must be discontinued—as indeed is also the case with several Northern French v.h.f. stations.

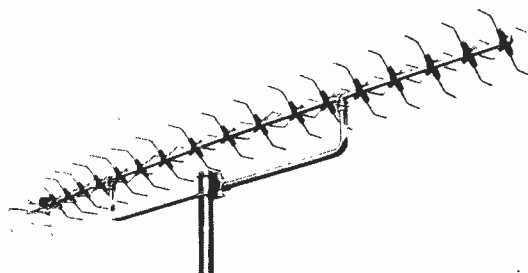
For those who leave for work early it may be of interest to know that CST (Czechoslovakia) close after programmes with a very generous period of test transmissions. They are often noted from 2230 GMT onwards with the conventional test card or the distinctive electronic pattern (we are featuring CST this month in our Data Panel).

On Sunday morning February 11th Belgium ch. E3 was noted at 0845 appearing in short medium-strength bursts (not unlike MS). The Liege transmitter is of course at far too short a distance from here for MS and I feel that this may have been aircraft reflection. Indeed this is a propagation possibility that could prove useful for receiving v.h.f. (u.h.f.??) transmitters that are just too far—say up to 400 miles—for reception under quiet conditions. Pursuing the subject further I find that the RSGB published a series of articles on this very subject (*RSGB Bulletin*, November-December 1966) entitled "A little flutter on v.h.f." These articles delved into the theory at some length. Basically a high-flying aircraft—say at 6,000 ft.—on a course that takes it over and along a direct signal path between a transmitter and receiver which are say 250 miles apart will for a period be able to see both the transmitter and receiver. During such a period signal reflection is possible. Obviously an aircraft flying *along* the path offers a greater chance of signal reflection than one *crossing* the same signal path. I think this phenomenon must often occur and ask enthusiasts who live on or near flight paths to keep a very careful watch for relatively short-skip signals. My location does not unfortunately have any flight paths associated with it so I must rely on others' observations. We will be pleased to report any findings in due course.

Interest was recently shown in a high-gain aerial manufactured by the West German Fuba Company (see February column). We are pleased to show this month the J Beam (Northampton) MBM70. This has been developed for very high gain from their well established Multibeam range. Peak gain reaches almost 20dB, the low being fractionally under 18dB. Thus gain is maintained at a very high figure over the complete group bandwidth.

News Items

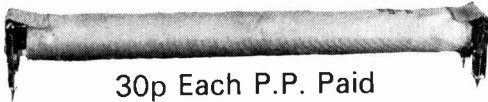
Jordan: We understand that plans are being made for the introduction of colour transmissions which may well start "within a few months". Plans are also being considered for the installation of two further TV transmitters, one in the North and the other in the South,



J Beam's Multibeam MBM70 u.h.f. aerial.

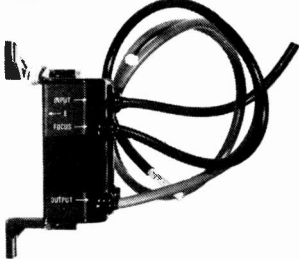
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SPECIAL OFFER IF panel, leading British maker, similar design to "Television" panel, includes TAA350, lum. delay line AFC generator, etc., incl. circuit, £8.90 p.p. 35p. Convergence Panel Pots, Coils, etc. available, CRT Base 25p. C.R.T. Shields £1.85 p.p. 50p. Degaussing Coil Pack No. 19 (state size) £2.30. G.E.C. Colour decoder panels (for parts) incl. DL20, crystal & approx. 50% of resistors. Conds., diodes, transist., etc. for "Television" decoder £3.50 p.p. 30p.

PHILIPS G6 single standard convergence control panel, incl. 16 controls, switches etc. and circuits £5.00 p.p. 30p.

PHILIPS G8 decoder panel part complete incl. I/C £2.50 I.F. Panel part/compl incl. modules £2.50 p.p. 30p.

BUSH CTV25 timebase units, line frame, E.H.T. surplus £4.50 p.p. 80p.

VARICAP/VARACTOR ELC 1043 UHF tuner (for "Television" colour receiver) £4.50. VHF Varicap tuners for band 1 & 3 £2.85, Varicap tuners salvaged £1.50 p.p. 25p.

UHF 625 kits and tuners. Lists available at reduced prices. UHF tuners, transistd. £2.85; incl. s/m drive, indicator £3.85; 6 position pushbutton £4.95. UHF/VHF transistd. tuner, latest type, incl. circuit £3.25, Cyldon valve type £1.50 p.p. 30p.

MURPHY 600/700 series UHF conversion kits in cabinet plinth assembly, can be used as separate UHF receiver £7.50 p.p. 50p.

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EKCO 221 to 394, FERRANTI 1001 to 1065	£4.30	P/SCOTT 1419 to 1725,733 to 738	£1.75
EKCO, FERR 418, 1093 etc.	£4.30	REG. 10-6, 10-17	£2.50
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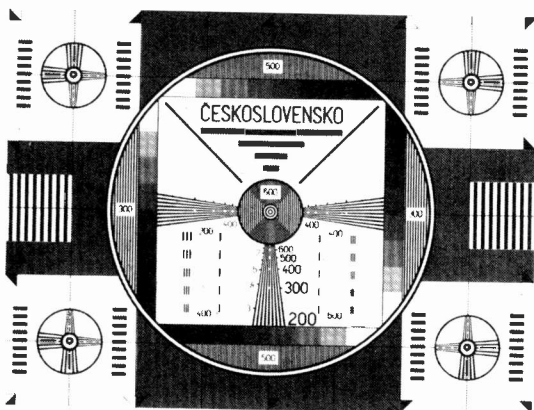
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DATA PANEL 22—2nd series



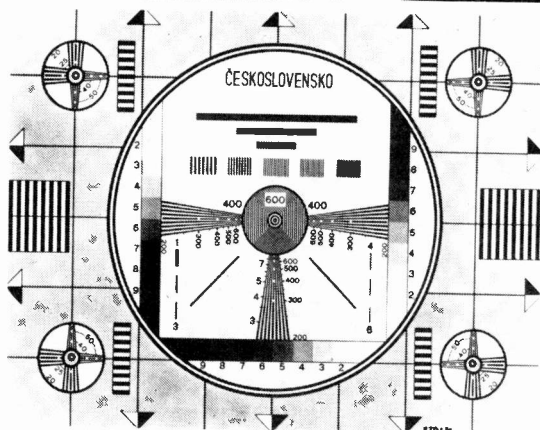
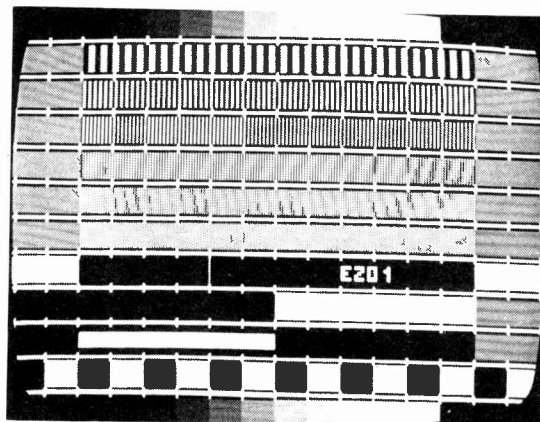
Above left: Test Card used by Československo Televize. Variations include insertion of transmitter identification at bottom centre of the frame. Very rarely a thin black grid is superimposed over the whole card.

Above right: Electronic pattern used by Československo Televize. Various identifications are inserted, the most common one being "CS U 01".

Right: This Československo Televize test card has never been received off-air but is sent out by the authorities as the official one. It may be used by the few u.h.f. stations at present in operation.

Photographs courtesy Keith Hamer and Československo Televize.

CZECHOSLOVAKIA—ČESKOSLOVENSKO TELEVIZE



"to provide a more satisfactory coverage of the whole country". At the moment we know nothing of the intended channels but they are likely to be in Band III. (Item from the Asian Broadcasting Union-ABU.) Yugoslavia/Italy: Michele Dolci reports that Yugoslavia is to extend its u.h.f. colour transmissions. A network of u.h.f. transmitters is to be constructed along the Adriatic coast to serve ships on the Adriatic. Work is expected to commence as early as May this year. Of particular interest is the fact that although the programme material will be similar to the rest of the JRT network the programme languages will be Italian and English.

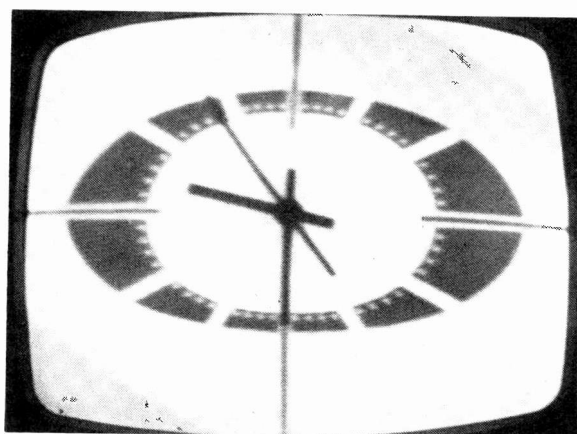
In the March column we commented that the rebuilding of certain West German transmitters for the Bayerischer Rundfunk would include facilities for two sound channels. Graham Deaves has drawn our attention to a recent EBU paper in which the matter is discussed at length. For systems B and G two sound signals can frequency modulate two carriers of frequencies 5.5 and 5.742 MHz above the vision carrier and with levels respectively 10dB and 16dB below the vision carrier. At present for system B/G there is one carrier spaced at 5.5MHz. The two sound carrier system has been tested over Heidelberg and we understand it may eventually be used for bilingual transmissions.

From Our Correspondents . . .

Antonio Carvalho of Porto has again been of great assistance, providing a photograph of the RTP clock

and reporting test card changes. The EBU bar pattern which has been used by Portugal for a long time now carries the inscription RTP LISB. This should assist us in the coming SpE season.

W. G. Williamson of Yell, Shetland, comments on the various Auroral phenomena he has witnessed. In view of the possibilities of really exotic DX he is equipping himself to be able to explore any signals via this mode. His local station is Bressay on ch. B3. This has been



Clock used by Radio Televisao Portuguesa (Portugal):
Photo courtesy Antonio Carvalho.

received here twice via SpE over my local station Rowridge which is also on ch. B3. It is not uncommon for Southern DXers to receive extreme Northern BBC-1 transmitters, and vice versa of course!

Beginners' Guide: Choosing a Receiver

A number of important points need to be taken into account when selecting a receiver for long-distance television reception. Various suggestions follow: the extent to which a receiver is modified depends upon the individual—his enthusiasm for and knowledge of the hobby (courage also?). Until a few years ago the DX enthusiast would usually modify a 405-line receiver to operate at 625 lines. With the vast number of dual-standard receivers now available at low prices however it seems a wise move to use one of these. Certainly we recommend using a separate receiver for DX use and not the domestic one—in the interests of family peace!

It is essential that the receiver used for DX reception operates at 625 lines, has high gain (with stability) and flywheel line sync. Push-button tuning is not practical since it is necessary to cover numerous channels quickly: dial tuning for u.h.f. and turret tuning for v.h.f. is suggested. It is desirable that the timebases, video detector(s) and i.f. strip can be operated *independently*—the reason for this will be seen later. The extent to which this can be achieved depends on the receiver. Many receivers, e.g. BRC ones, use a single chassis with a long switching assembly: isolating the various switch sections can be difficult. In other chassis such as the Bush TV125 series the switching can be isolated with ease.

Tuners: At u.h.f. a fully variable tuning system should be used rather than push-buttons and to exploit their low-noise performance transistor tuners rather than valve ones are essential. At v.h.f. valve operation is satisfactory. If a turret v.h.f. tuner is employed it should be loaded with coils for the appropriate channels in frequency ascending order, i.e. ch. E2, ch. R1, ch. F2 etc. When we reach Band II (TV) there is the problem of obtaining coils though we understand that certain export versions of UK tuners are made so that the manufacturers could possibly supply coils. Otherwise the coils will have to be wound by hand or resort made to using a v.h.f. to u.h.f. converter (see August 1972 column). When the turret tuner has been fully loaded with coils for Bands I and II there will be little room for Band III coils: the best solution is a second v.h.f. turret loaded with Band III coils only. In both cases the normal UK coils should have sufficient range on the local oscillator coil slug to tune to the foreign channel.

In many receivers the h.t. is removed from the v.h.f. tuner when switching to 625 lines. Consequently the switching for this operation must be located and a separate switch fitted for manual operation. At u.h.f. the v.h.f. tuner often acts as an i.f. amplifier so this must be borne in mind when adjusting the h.t. supplies to the two tuners. Since we wish to operate at v.h.f. with 625 lines some adjustment will be essential: again this depends on the particular chassis. Often the only need is to short-circuit a resistor: other chassis may be more complicated.

I.F. Strip: Where possible a three-stage valve i.f. strip should be used. It is most desirable to be able to switch the strip between wideband (i.e. the 625-line position) and narrowband (i.e. the 405-line position) operation independently of the detector switching. The reasons for this are as follows. With increasing bandwidth the gain tends to fall and the noise to rise. With a very weak signal and wide bandwidth (5.5MHz) the signal will be extremely noisy but on switching to the narrow bandwidth (3MHz) position the signal will be considerably



"Why can't you watch TV like other kids?!"

cleaner, stronger and much more easy to synchronise. There is loss of quality with the narrow bandwidth of course but if the signal is sufficiently strong we can switch to the wide bandwidth position. Another very important point is selectivity. The channel allocation charts given previously show that many channels of different transmission standards are in close proximity, e.g. ch. E2 and ch. R1. If strong signals occur on both channels simultaneously during a good Sporadic E opening they will tend to merge on the wide bandwidth position whereas on the narrow bandwidth position they can be independently tuned with greater ease.

Video Detector(s): It is essential to be able to switch for either positive- or negative-going video since both types of signal will be received with 625 lines and at both v.h.f. and u.h.f. Thus the detector switching should be isolated from the i.f. strip switching. This can often be achieved, e.g. in the Bush TV125 series, by cutting the long switching assembly. On other chassis it may be easier to isolate the detector connections to the main switching gang and fit a small low-loss slide switch adjacent to the detector(s). If the latter course is adopted all connections must be kept to the minimum length. On many receivers the video amplifier biasing is changed according to the video standard in use: this switching must of course be retained with modified switch assemblies.

Timebases: Since the receiver is designed to operate at 625 lines there is no work to do here apart from any modification to enable the 819-line standard (ORTF-France) to be resolved. The efficiency of a timebase at this frequency depends on receiver design and can only be determined by experiment. If operation on this standard will only occasionally be required the timebase can be operated at 405 lines which results in two pictures being resolved side by side.

We have covered only briefly the requirements for a DX receiver. The degree of modification can be extensive, such as improved sync circuits, a.g.c., etc. It is important however that the receiver is working at full efficiency since we are dealing with signals which at times are barely measurable.

Caution is needed since the live chassis technique is used in the vast majority of UK-produced sets and operation with the rear cover removed whilst handling aerial feeders can result in an unpleasant shock!

We will continue next month with aerial systems.

FAULT FINDING GUIDE

3

John Law

SOUND CHANNEL GEC/SOBELL D-S MODELS

A BLOCK diagram of the sound signal path in a typical 405-line only model is shown in Fig. 1(a). The sound and vision i.f. signals from the tuner unit are amplified in a common i.f. stage after which the signals split to go to their respective channels. After further amplification the 38.15MHz sound signal is detected by a diode and is then usually passed via a diode interference limiter and the volume control to a triode-pentode audio amplifier such as a PCL82 or PCL86 which provides adequate amplification to load the loudspeaker. This is conventional amplitude-modulated sound detection and amplification.

For 625-line reception a different arrangement is used as shown in Fig. 1(b). The sound signal is of course frequency modulated and a system known as intercarrier sound is employed. This technique is used mainly to overcome the problem of sound drift in the u.h.f. tuner. All tuners suffer to some extent from drift but on the 405-line channels this is not a serious problem and can be overcome by careful design. On the higher frequency 625-line channels however the problem is very much greater and the drift can be so great as to cause loss of signal. The tuner output consists of the vision i.f. signal at 39.4MHz (in the models we are considering this month) and the sound i.f. signal at 33.4MHz. The point of the arrangement is that the 6MHz difference between them remains constant; the vision signal is a.m. Both signals are amplified in the common i.f. channel and pass to the vision detector which rectifies the vision signal and passes it to the video amplifier. In addition to doing this the diode detector, being a non-linear device, intermodulates the

two intermediate frequencies thereby producing their sum and difference frequencies. The basic frequencies and their sum are suppressed in the circuit, leaving the 6MHz difference frequency which carries the f.m. sound information. This is also generally passed through the video amplifier circuit where it is tapped off via a 6MHz filter and passed to the intercarrier amplifier. There follows f.m. detection and the usual audio amplification.

Although the two-diode ratio detector is generally used for f.m. demodulation the Pye/Ekco and GEC/Sobell groups in their dual-standard models for many years used an EH90 heptode valve for f.m. demodulation in what is known as a locked-oscillator discriminator circuit. Among the advantages claimed for this design are savings in components, high audio output and very solid lock-in giving constant output despite variations in signal strength. The high audio output is adequate to drive a pentode output stage direct, leaving the triode section of the usual triode/pentode free for some other purpose.

The circuit we are dealing with this month is the sound channel used in many GEC/Sobell models including the GEC BT454DS/2000/2010 and later series and the Sobell ST196DS/ST290DS/1000/1010 and later series. The circuit remained substantially the same for some ten years but the component reference numbers used in our circuit drawing (Fig. 2) are those which were used on the 2010/1010 groups. These chassis appear from time to time in our workshops.

On 625 lines the intercarrier f.m. signal is passed via a 6MHz trap in the cathode circuit of the video output pentode V5A, C103 and the bandpass transformer T4 to the sound i.f. amplifier V6. The 405-line sound signal is shorted out by SW2-3 which also retunes T2 (in the anode circuit of the first i.f. amplifier) for sound attenuation at 33.4MHz by connecting C116 into circuit. On 625 lines SW2-3 brings the 6MHz oscillator coil L47 into operation: this is then connected between the suppressor grid (pin 7) and the cathode of the locked-oscillator discriminator valve V7.

When a signal is fed to V7 control grid the electron flow through the suppressor grid to the anode induces a replica of the input voltage on the

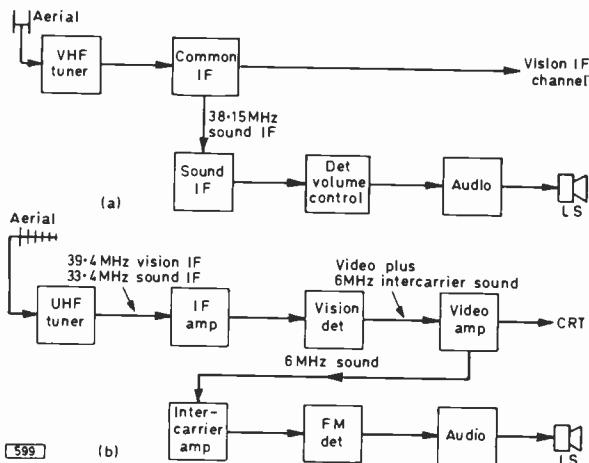


Fig. 1: (a) Sound channel on v.h.f.; (b) sound channel on u.h.f. using the intercarrier system.

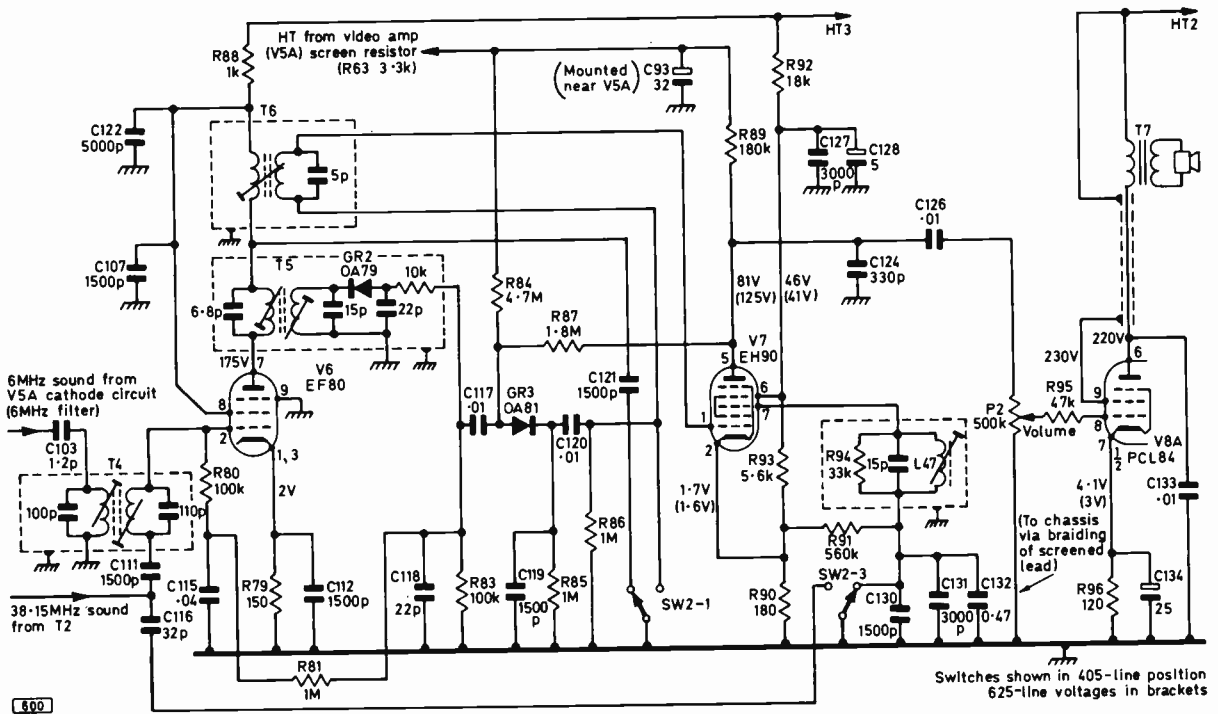


Fig. 2: The sound only circuitry used in GEC/Sobell dual-standard models. Component reference numbers apply to the 2010/1010 series. There are minor component alterations in the group's earlier and later dual-standard chassis. McMichael and Masteradio dual-standard models were fitted with the same chassis.

suppressor grid but lagging by 90°. The suppressor grid is tied to the 6MHz oscillator circuit and the input signal will tend to lock to this frequency. Inside this locked-in range however the input signal is deviating in sympathy with the modulation so that the phase difference between the signals at the control and suppressor grids is no longer a constant 90° but increases and decreases as the input frequency varies. Since the anode current is a function of this phase relationship between the two signals the result is that a demodulated audio signal is developed across the anode load resistor R89.

The screen voltage (pin 6) is supplied through the chain R92, R93 and the cathode resistor R90 and is decoupled by C127 and C128 in parallel. The audio signal passes via C126 and the volume control to the audio output valve which consists of the pentode section of a PCL84.

On 405 lines the 38.15MHz sound i.f. signal is amplified by V6, detected by GR2 and then passes via the noise limiter diode GR3 to the EH90 control grid. Switch SW2-3 short-circuits the oscillator circuit at the suppressor grid so that the valve is left operating as a high-gain audio amplifier. Switch SW2-1 switches T6 between the requirements of 405- and 625-line operation.

Perhaps the most common fault is sound distortion on both 405- and 625-line reception. Close inspection will show that R92 and R93 in the heptode screen supply circuit are discoloured—evidence of over-running. R92 is tucked away in a corner of the chassis below V7: R93 is placed between V7 and PL1 the B9A base which carries the supply plug. Both resistors are rated at 2W.

In use the value of R92 (18kΩ) drops over a

period of time causing an increase in V7 anode current. Increased current over-runs R93 which in turn drops in value. Both resistors run hot, discolour and sound distortion appears. The only cure is to replace both resistors. This needs care: the panel has printed tracks connecting components on both sides and careless use of the soldering iron can loosen the print. It is important of course to ensure that a lead passing through the panel is soldered to the correct points on both sides. The value of the two resistors is not critical: R92 (18kΩ) can be replaced by 22kΩ and R93 (5.6kΩ) by 4.7kΩ or even 6.2kΩ. The wattage rating of both must be at least 2W however.

When this fault is present the cathode bias resistor R90 is seldom affected, presumably because of its low value. If it is found to be discoloured the cause is likely to be an interelectrode short in the EH90, causing excessive current flow through the valve and R90. This fault is usually accompanied by loss of sound; R92 and R93 are not discoloured. In one case loss of sound and 12V at V7 cathode instead of 1.6V was due to R90 increasing in value from 180Ω to 5kΩ. Where the bias voltage has been above normal for some time R90 should be replaced even if it still reads 180Ω to lessen the possibility of future breakdown.

Varying sound output level with a tendency to instability has been traced to C128, V7 screen decoupling electrolytic, being defective.

Very low but undistorted sound was traced to shorted turns on the audio output transformer T7.

Leakage in the audio coupling capacitor C126 can cause distorted sound.

—continued on page 325

Assessing

RECEIVER PERFORMANCE

PART 4

E.J. HOARE

COLOUR PERFORMANCE

We are now going to change horses in mid stream and switch to colour. All the test procedures we have been discussing are just as important on a colour receiver as on a monochrome one and we will assume that they have been carried out. As we said earlier it is no use worrying about the colour performance until a good monochrome picture has been obtained. Colour is something which is *added* to a monochrome picture: it is not fundamentally a different system.

To produce a colour picture you need a c.r.t. system capable of displaying colour and the signals to drive it. Once again it is important to get the priorities right when devising a streamlined test procedure and obviously the display system is the right point at which to begin. We know from the results of the earlier tests that the scanning, synchronising, e.h.t., focus and luminance drive are OK, so we can carry on from there.

Anyone accustomed to working with colour receivers has the terms purity, convergence and grey-scale tracking engraved in his mind. The fact is that these three aspects of receiver performance lie at the heart of a good colour picture.

Purity

First purity. This can only be properly checked in near total darkness, so make the necessary arrangements. The next point is that you need a white, noise-free screen with no picture information present. The best way of achieving this is to use a test pattern generator which will give a blank synchronised picture. Alternatively disconnect the i.f. output from the tuner where it is fed to the first i.f. stage or disable the i.f. channel in some other convenient way, making sure that the luminance output stage is working normally. Adjust the brightness control to give a moderately bright raster which is well focused.

Now look critically at the screen for any localised areas of spurious colour. If the entire screen area is completely even the purity is very good. A hint of discolouration is common enough to the point of being normal but any obvious patches of colour are not permissible and if present the purity should be readjusted. It is often instructive to take a watch-

maker's eyeglass and look at the individual phosphor dots. Fig. 1 shows what you are likely to see. Any overlap of an electron beam on the wrong coloured phosphor dot will cause impurity.

Most receivers incorporate switches to enable the red, green and blue fields to be examined separately but looking at a white field provides by far the most critical test. It is quite common to find that the red, green and blue fields when viewed individually appear to be of perfectly even colour all over: it comes as a surprise then to find that when all three guns are switched on together to give a white raster the result is not very good with faint blotches of spurious colour visible.

The eyeglass test will tell you why. The cure is to make very delicate adjustments to the purity magnets and the position of the deflection yoke whilst keeping a careful watch on the white raster. In a few cases it will be found impossible to get completely perfect purity with a particular combination of shadowmask c.r.t. and deflection yoke.

Having achieved the best purity of which the receiver—and yourself!—are capable keep an eye on it over a period of a few days or weeks and see by how much it changes. Make sure that young Charlie does not go sticking his permanent magnet on the screen to see the colours change: interesting, but not very helpful!

Convergence

Three separate coloured images do not have three times the appeal of a single one so good convergence is the second basic requirement of a colour

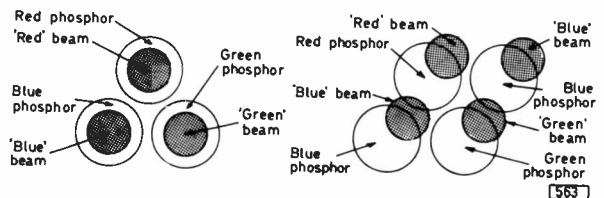


Fig. 1: What the watchmaker saw on the screen of a shadowmask tube! (a) A rare case of perfect purity. (b) Things are getting badly mixed up here!

receiver. Let us get one or two simple facts clear from the start. *Static convergence*, which is usually adjusted by permanent magnets on the convergence yoke but occasionally by a d.c. current controlled by potentiometers, refers *only* to the process of getting the red, green and blue beams exactly coincident at the *centre* of the screen and *nowhere else*. *Dynamic convergence*, which is controlled by a number of potentiometers and variable inductances, achieves coincidence of the three images *on and along the horizontal and vertical centre lines* of the screen. It is important to note that there are normally *no* controls for adjusting the convergence in the corners of the screen—at least not with 90° deflection shadowmask c.r.t.s. Improvements can be made in the corners only at the expense of some degradation along the two centre lines of the picture.

Having adjusted the convergence carefully you can feel reasonably satisfied if the errors in the corners are not much more than about one eighth of an inch, and a little less at the middle of the four edges of the screen. See Fig. 2.

Grey-Scale Tracking

Grey-scale tracking is the last of our three completely routine adjustments although with some receivers a fourth item—concerning colour-difference drives—is involved. First of all display a black and white picture, preferably a test pattern of some kind. If you have no manual colour killer switch detune the receiver until the colour drops out. The picture will not be as sharp but this is not too important. Now examine critically the very dark grey (almost black) areas. Are they a pure neutral grey, or are they slightly coloured? If there is any hint of colour at all the potentiometers controlling the voltages to the c.r.t. first anode electrodes need adjustment. Follow the adjustment procedure relevant to your particular design of receiver, or adjust any *two* of the three controls.

Now look at the brightest highlights: are they the colour of illuminant D? You may well ask what colour constitutes illuminant D! If you haven't a reference light source (who has?) the easy answer is broadly this. If you can persuade yourself that the white light has even the slightest hint of red, green or blue or a combination of any two of these then the highlight colour needs adjustment. Once again, follow the appropriate instructions or adjust any *two* of the three highlight controls. Any appreciable error will cause the all-important pastel colours such as skin tones to be distorted. Check the dark grey areas again and readjust if necessary. Finally inspect the mid-grey tones to see if these are a pure neutral colour also. They usually are, but if not there is nothing you can do about it.

Colour Fidelity

The experienced engineer assesses the colour performance of a receiver by tuning in to the transmitted IBA or BBC colour-bar test pattern. A single glance tells him whether there is any significant error. The red, green and blue bars only show major errors: the complementary colours yellow, cyan and magenta are the ones requiring very critical attention. The yellow bar should be a pure buttery yellow; the

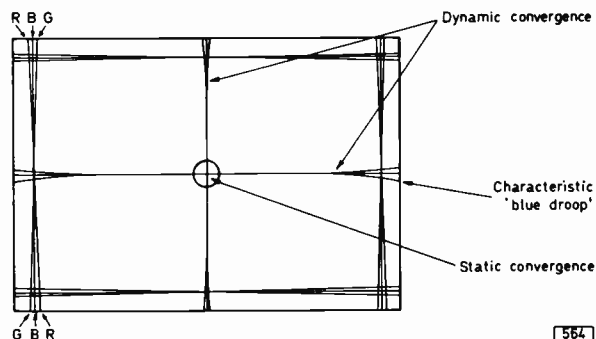


Fig. 2: Convergence can never be perfect but should be good over the central screen area. Red and green lines usually tend to cross over and a certain amount of "blue droop" is almost unavoidable.

cyan one should be predominantly blue with a fairly obvious hint of green; the magenta bar should be equally red and blue.

Check your receiver in this way and also by viewing a wide variety of programme material. If the colour is faulty check the grey-scale tracking again and if your receiver uses colour-difference as opposed to RGB tube drive check these adjustments too. If the colours are still wrong switch off each gun in turn and make sure that all three are working normally. The fault must be somewhere within the scope of the tests you have just carried out.

Colour Controls

Try the action of the saturation—more usually called colour—control and make sure that it has sufficient range to give you too much colour. Adjust it in conjunction with the contrast control and see how bright a picture you can get with correct colour rendering. Is there enough drive to the c.r.t. to obtain the brightest usable picture? Do the two controls work completely independently or are they electrically coupled? In some designs the saturation is automatically maintained at the correct level as you adjust the contrast.

If your receiver has not got a.f.c. detune until the colour drops out. Is there an adequate tuning range over which normal colour is obtained? If a.f.c. is fitted there should be very little change to the picture as you detune until you suddenly get to the point where the picture breaks up.

Colour Resolution

In addition to the fidelity of the colour rendering we are also interested in the apparent sharpness of the coloured image. This is to some extent an optical illusion, because in practice it is the resolution of the luminance (black and white) component that determines whether or not the coloured areas look sharp and clear. If the monochrome picture is well resolved the coloured one should also be well resolved. To check this find a clearly defined area of one well saturated colour and examine it closely.

There are three things to look for. First, is the colour smeared out at the edges of the area so that even at a distance the colour looks blurred, as shown in Fig. 3(a)? If so the bandwidth of the colour signal

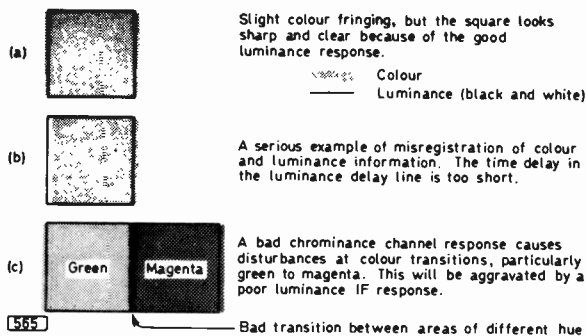


Fig. 3: Examples of imperfect colour resolution.

is too narrow. The -3dB bandwidth of the chrominance channel in the decoder is normally limited to a little under 1.0MHz : this is enough to give good picture quality in conjunction with a normal luminance bandwidth of around 4.0MHz . A chrominance bandwidth of say 0.5MHz on the other hand is barely adequate and will give poor colour resolution.

The next point, shown in Fig. 3(b), concerns the registration of the luminance and chrominance information. They must be correctly superimposed if an impression of good colour resolution is to be achieved. Any error here is caused by the time delay of the luminance delay line not being suitably matched to the difference between the luminance and chrominance bandwidths. It is this difference in bandwidth that gives rise to misregistration of the two signals and hence the need to slow down the luminance signal.

Colour Transitions

The last point here concerns the quality of colour transitions, i.e. points where one well saturated colour suddenly changes to a colour of a completely different hue. The best test is to look at normal transmitted colour bars, having first tuned in the receiver very carefully. A small amount of disturbance at the transition from one bar to the next is inevitable, but this should be narrow and little more than a subdued blur. If a large smudgy area is present between the green and magenta bars—see Fig. 3(c)—your chrominance passband response is not very good.

You have been busy collecting quite a lot more information about the colour performance of your receiver so make sure that it is all duly recorded on your test sheet before turning to the next items.

Patterning

We have already looked for patterning on the monochrome picture and have discussed a number of possibilities. Now we do the same again on the colour picture. There are two reasons for doing this. First the 4.43 and 1.57MHz patterning usually visible to some extent on a monochrome picture looks different on a colour one, particularly at points of colour transition. Too much 4.43MHz patterning will cause desaturation of the colour and in particular you will be unable to get clear, deep reds—only rather orange ones. Look out for this. Our second reason for being interested in patterning is that any

beat pattern present on the colour picture but not on the monochrome one is not only undesirable but proves that there is a defect in the decoder circuit. This is a useful diagnosis for future reference.

Decoding Errors

The colour decoding circuits have to perform quite a large number of different functions and there are five more that we can easily check: decoding accuracy, ident, colour switching, a.c.c. and colour killing.

First of all tune in to a colour-bar pattern or a picture with highly saturated colours and look for blinds (Venetian blinds or Hanover bars, to give them a continental flavour!). These as shown in Fig. 4(a) appear as differences of saturation or hue on alternate pairs of lines. The differences will be small and on a well aligned receiver with a good decoder they should not be visible. Clearly visible bars are indicative of a badly designed decoder or serious misalignment.

In the PAL system the R-Y colour-difference signal has to be inverted from line to line; the term "ident" refers to the correct identification of the phasing of this switching operation. If the phase is wrong the colour appearing on the c.r.t. screen will be of completely wrong hue—magenta will appear green and so on. Test this by changing channels slowly about twenty times. If the hue is always the same and correct then the ident process is functioning properly.

An allied problem is the switch itself: instead of switching out of step so to speak it may not be switching at all. In this case one line will be of the correct hue but the next line will be different. Due to the use of interlaced scanning the fault will show up as differences between pairs of lines, as in the case of blinds, but a great deal worse. If you look at colours in the region of orange and green (which contain relatively large amounts of the switched R-Y signal) you will be able to distinguish the difference in hue very easily. The effect is so clear that there is no danger of confusing a faulty switch with normal amounts of blinds.

Now a.c.c. or automatic chrominance/colouring control. In monochrome receivers you have a.g.c. to keep the contrast of the picture constant with changes of signal strength. In colour receivers you have a.c.c. as well to keep the saturation (amount of colour) constant with changes in the amplitude of signal components at the colour subcarrier frequency caused by detuning the receiver or by vagaries of signal propagation between the transmitter and the receiver. Test the a.c.c. action by detuning the

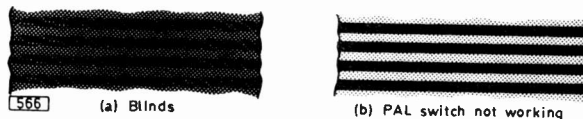


Fig. 4: The difference between blinds and the effect of a faulty PAL switch is obvious once you have compared them closely. (a) Blinds: slight differences in saturation and/or hue between consecutive pairs of lines. (b) PAL switch not working: obvious differences in hue between consecutive pairs of lines, such as orange and green.

receiver a reasonable amount and observing whether the colour remains reasonably constant until it suddenly drops out altogether.

Colour Killing

Talking of colour drop-out brings us to colour killing. If the colour decoder circuits are left working when there is no colour signal being transmitted they will be operating at full gain. Thus any electrical noise present will pass through the decoder and appear as coloured noise on the c.r.t. screen. Black and white noise is bad enough but coloured noise looks dreadful! To prevent this a colour killer circuit is fitted. This switches off the colour circuits when there is no colour in the signal being received. Check the action of the colour killer by detuning the receiver until only a black and white picture is present (however bad). If there is no coloured noise present the colour killer is OK.

Fringe Performance

There is not much left to test now except a few more aspects of weak signal performance. Plug in a weak, noisy signal and repeat the tests described under the previous three headings—namely patterning, ident, colour switching, a.c.c. and particularly colour killing. Make sure that no new patterning or other peculiar disturbances are present and that the colour killer does not switch off the colour before the signal strength is so low that the picture is unusable. An ill-designed colour killer may exhibit this annoying habit and leave you with quite a good monochrome picture when it ought to be in colour!

How Good is your Receiver?

If you have carried out all the tests we have discussed in this series you should have enough information to be able to assess the quality of your receiver, whether it is a monochrome or a colour one, on a reasonably sound basis. Furthermore you will have done so in a systematic and efficient way: it is unlikely therefore that any significant defect will have been overlooked. This anyway is the basis on which we have attempted to tackle the problem and your own experiences will soon show whether the approach has been successful.

Owners of commercially manufactured receivers should not have found many items that gave rise to adverse comment, though inevitably there will have been one or two which did not as it were deserve full five-star rating. It is nevertheless encouraging to find that one's receiver is in fact working properly, and the process of carrying out a complete test programme can hardly fail to be instructive.

Home constructed receivers that have yet to be completely debugged are unlikely to have emerged from such rigorous testing unscathed. Indeed you may well have a surprisingly long list of items which you would like to improve upon: do not be dismayed, this is a normal part of the process of constructing your own receiver. In later articles we will offer advice on how to tackle some of the problems.

A quick check list of the complete test programme was given last month on page 271. ■

NEXT MONTH IN

TELEVISION

THE PIL TUBE

One of the most significant developments for some time in colour television is RCA's Precision-in-Line tube which is to be produced in the UK by Thorn (Mazda). This tube has a shadowmask with slits instead of dots, giving increased brightness. The major step forward however is that by using in-line guns with a specially designed toroidal scanning yoke the need for dynamic convergence adjustments has been completely eliminated. In fact the coils are attached to the tube and if necessary both must be replaced together. Setting up is almost as simple as with a monochrome set therefore.

TACKLING FIELD FAULTS

Field timebase failure is the most common TV set fault. If changing the valve doesn't do the trick just how do you find where the fault lies? Next month we describe practical methods of field timebase testing.

REVERSE AND FORWARD AGC

The application of a.g.c. depends on the characteristics of the devices—valves and transistors—to which it is applied. With transistors there are two opposite techniques of a.g.c.—forward and reverse. The precise mechanisms, not too well known, will be explained next month.

TV RECEIVER SERVICING

One of the first modern UK-produced portable TV chassis was the BRC 1580 chassis: next month Les Lawry-Johns describes the chassis and what goes wrong with it.

TEST REPORT

The next article in this series reports on the Nombrex RC bridge which E. M. Bristol has found to be a useful workshop aid.

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The 'CROFTON' CCTV Camera Kit

M. J. HUGHES, MA

CROFTON Electronics (15 Cambridge Road, Kingston-upon-Thames, Surrey) are now offering a complete kit of engineered parts and components together with assembly instructions for the Mullard educational TV camera. This "do-it-yourself" TV camera first made news in 1970 when it was featured on television in the programme *Tomorrow's World*. Although there have been several modifications to the circuit since it says something for the quality of the signal produced by the camera even then that the BBC allowed its video output to be piped direct into their transmission system as part of the live broadcast. Initially Linstead Electronics offered the camera in kit form and it was advertised on several occasions: in one way or another however it never really got off the ground. Apparently most of the problems were associated with the production of a simple "foolproof" mechanical layout suitable for the home constructor or teaching establishment. Crofton Electronics and the Mullard Educational Service have since up-dated the design and it is now available as a truly "do-it-yourself" camera backed by a "get-it-going" service (not that the average constructor should have any difficulties).

We purchased a complete kit (including vidicon, lens, deflection coils and case) for £96 and gave it for assembly to a trainee wireman who had only three weeks *total* electronics experience. With no help apart from the occasional reminder about colour codes and capacitor and diode polarities he



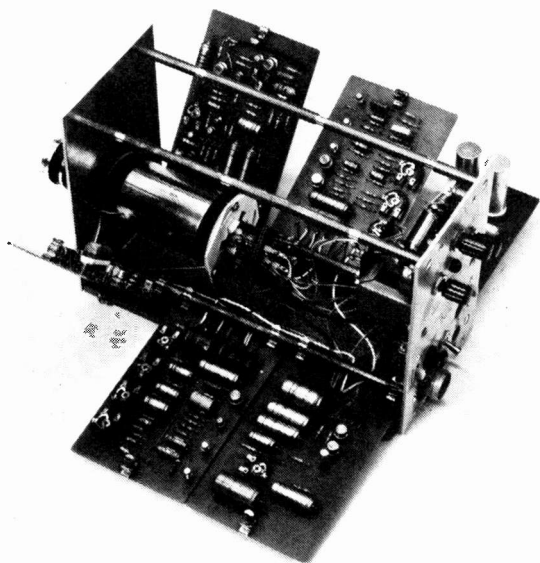
had the camera assembled in two days. Much to our surprise—let alone his—when we connected it to a monitor it worked first time. There were admittedly a few minor adjustments to be made to the preset controls—line frequency (either 405 or 625), scan amplitudes, picture centring and magnetic focus—but these were all straightforward and adequately covered in the manual.

We were very impressed by the quality of the kit. It arrived well packaged, the components grouped in polythene bags for each logical stage of construction. The vidicon was in a genuine Mullard container with the manufacturer's guarantee. Apart from one or two transistors all components were new branded devices that fitted perfectly into the printed boards (we understand that the transistor exceptions were caused by delivery problems with the manufacturer and should now be cleared up). No "wrong value" components were supplied but somehow a zener diode and a preset potentiometer had been omitted. A word of warning on this point: Crofton will only undertake to replace a missing component if the polythene bag containing the group it appears in is returned to them *unopened*. It may sound mean but you can see their point of view.

The layout is excellent (see photograph) and a novel arrangement is used for mounting the six separate "hinge down" circuit boards. Considering the airiness of the layout the camera is remarkably compact, measuring only $11\frac{1}{2} \times 4\frac{1}{2} \times 7$ in. (excluding lens protrusion). The case finish is grey hammer and all necessary controls (plus optional extras) are mounted on the rear plate.

The basic kit provides a composite video output but there is an option for switching to "non-comp". An input socket (left unconnected in the basic kit) is provided to accommodate external sync, cuing or talkback if these are required. For an extra £6.50 Crofton can supply a kit and instructions for a

—continued on page 325



Internal layout of the camera.

RENOVATING the RENTALS

13 BRC 2000 CHASSIS

CALEB BRADLEY B Sc

— TIMEBASES

We shall deal this month with the timebases. The field ("frame") timebase and audio circuits are on the same board, see Fig. 8: also on this board are certain stages relating to the c.r.t. grid circuit, the blanking transistor VT6 and brightness stabiliser stage VT7 (see Fig. 10).

With earlier boards field collapse is often due to W4 (OA5) going open-circuit: the BA148 used on later boards is a much more reliable replacement. Failure of VT3 gives the same symptom. The only other common frame fault is reduced height with bottom cramping in which case leap for the bootstrap



Fig. 8: The field timebase and audio circuits are on the same board. See also Fig. 10.

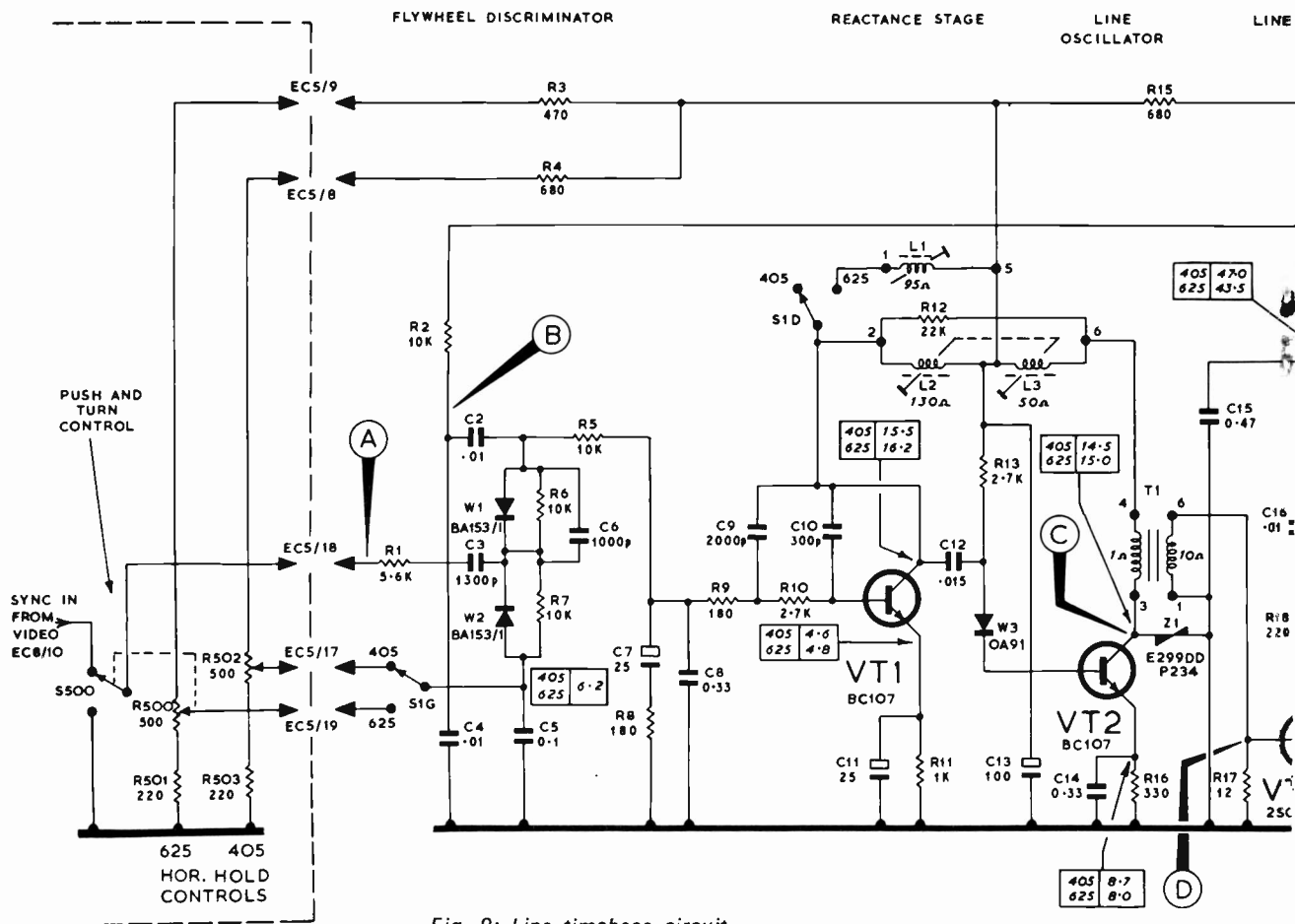


Fig. 9: Line timebase circuit.

electrolytic C9. The frame output pair VT4/5 are very reliable whereas the audio output pair VT12/13 are just the opposite. No sound however can also be due to the clip leads having been pulled off the loudspeaker tags or an open-circuit loudspeaker.

Here are some setting-up notes. The vertical balance control R21 is set for 24V d.c. at TP3. On some boards only, R11 is variable and should be turned anticlockwise (increasing resistance) just enough to remove cramping at the very top of the picture due to VT4 turning off completely at the start of the scan. The sound balance control R49 is set for 17V d.c. at TP2.

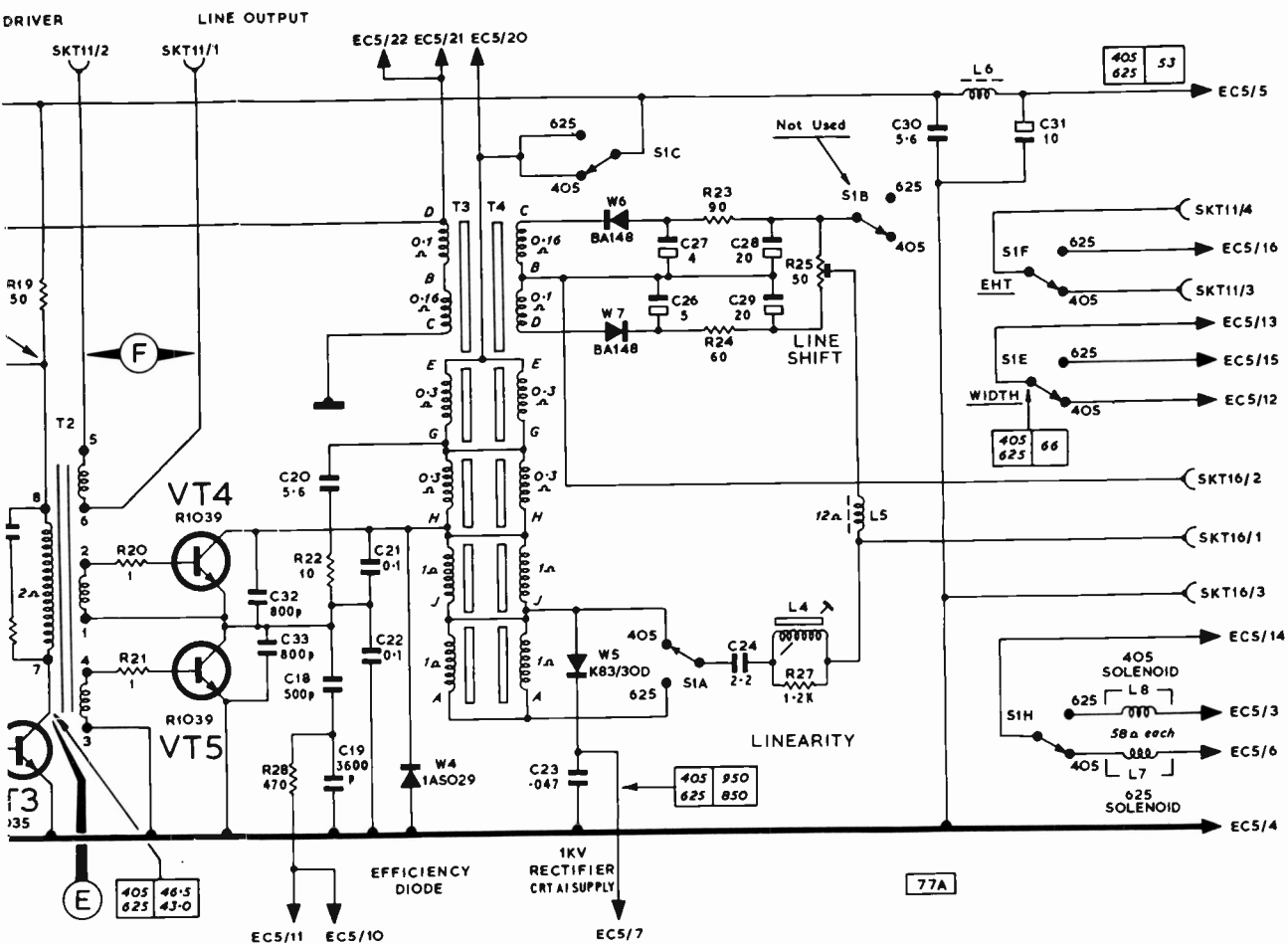
The base of the brightness stabiliser transistor VT7 is fed with a preset voltage derived from the stabilised 66V supply. It draws a constant current therefore through R33. This provides a bias of approximately 30V via R35 and R36 to the c.r.t. grids, the bias tracking with any fluctuation in the 270V rail used by the video board. Picture brightness is in this way stabilised. The setting of the grid bias control is part of the grey-scale adjustment procedure which was given in the March issue. A common fault here is VT7 shorting and incinerating R33.

Line and field flyback blanking are achieved as follows. Negative pulses are extracted from the frame oscillator by C11, amplified by VT6 and applied via C15 to the c.r.t. grid circuit; negative

line pulses from EC5/22 on the line timebase board pass via EC6/9 and C13/R32 to C15. During the forward scan W7 conducts current from R28: at line or field flyback the relevant negative pulse causes W7 to block and biases off the c.r.t. via C15. The appearance of flyback lines on the picture can usually be blamed on VT6.

The line timebase circuit is shown in Fig. 9 and consists of a reactance controlled Hartley oscillator, a driver and output pair with transformer coupling throughout. The driver transformer T2 has two isolated secondary windings which drive the cascaded output transistors VT4/5 and a third winding which drives the separate e.h.t. board. The three transformers are extremely reliable. Faults which do occur are failure of the flywheel sync diodes W1/2 giving unstable line lock (separate diodes can be used for replacement) or change in the value of R3 or R15 which upsets line lock. The oscillator coil L2/3 sometimes pulls away from the track: if the "ears" on its former are cut off it will seat better on the board. VT1 and VT2 are reliable but VT3 fails. Be thankful if you find you have the earlier square D1418 line output transistors fitted since these seem much more reliable than the R1039 fitted later.

If the value of C18 fitted is 330pF it is advisable to up-date it to 500pF and C19 to 3,600pF (3,000pF acceptable also) to avoid the right-hand colour loss mentioned with some video boards. Alternatively



add a 150k Ω resistor across C18 (330pF).

The efficiency diode W4 goes open-circuit causing a brightness change over about a third of the picture (not foldover though). Also C21 and C22 can go leaky. The c.r.t. first anode supply reservoir C23 can short: this removes all picture since the power supply trip operates. The A1 supplies can also be shorted by faulty 1nF smoothers on the convergence board; this burns up associated resistors and the beam switches. The A1 supply rectifier W5 (which can make a bad smell when it goes short-circuit) can be

replaced with a BY127. Check the value of R27 across the linearity coil if the picture suffers from vertical striations on the left.

The contacts S1C serve to interrupt the h.t. supply during a system change. Note also that the lead out at EC5/20 goes to the cathode of a diode on the junction block EC3; the anode of this goes to the main 30V rail. With S1C in an intermediate position the 30V rail is heavily loaded giving the impression of a short on the rail—see “a misleading fault condition” in the March issue instalment. The contacts of S1C take a heavy current and become pitted.

The line shift voltage is obtained from an isolated secondary on the line output transformer. This supplies rectifiers W6 and W7. The output is smoothed by C26 to C29, tapped off by R25 and fed through the line scan coils via the isolating choke L5. If R25 comes to one end of its travel and you need more shift try swapping R23 and R24. If the horizontal shift control is completely ineffective check W6 and W7.

Finally this month some further notes which got left out of the March instalment when we dealt with the video board. If R50 has to be replaced use a resistor rated at 1W or more. The luminance input coupling electrolytic C1 causes numerous faults from poor video to no sync. If it is necessary to replace the RGB output pairs it is best to use BF179 transistors in place of the BF178s for better reliability.

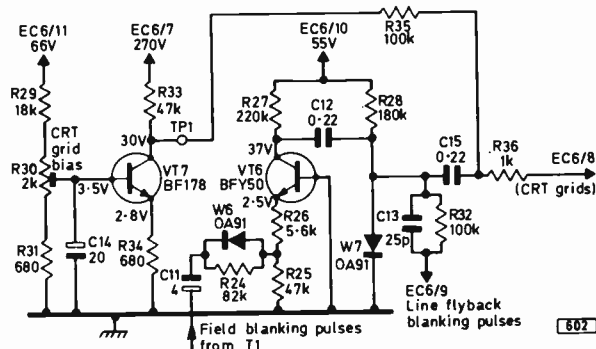


Fig. 10: The brightness stabiliser and flyback blanking circuits are also on the frame board.

THE 'TELEVISION' COLOUR RECEIVER

PART 14

CRT BASE PANEL

THE C.R.T. base panel carries the various supply and signal potentials to the shadowmask tube; it also incorporates the beam limiting and line and field flyback blanking circuits.

The R, G and B video signals come straight from the drive controls on the third convergence panel: 1.5kV spark gaps (SG708-710) are fitted at each cathode to protect the drive circuitry from flashovers. The current limiting resistors for the feeds are already provided on the drive circuitry (R410-R412).

The d.c. background (first anode) feeds to the tube also come from the third convergence panel, to 9A, 9B and 9C. Current limiting resistors (R713-R715) are provided together with 1.5kV spark gaps (SG701-703) in case of flashovers.

The focus potential feed from the focus control unit passes from point 9F on the panel through R716—acting as a limiting resistor—to the tube second anodes. A 6-8kV spark gap (SG704) protects both the tube from excessive voltage from the focus unit and the focus unit in the case of tube flashovers from the final anode.

The tube heaters (parallel fed) are supplied from 9D and 9E and each leg is again protected by 1.5kV spark gaps (SG706-707). It is not really practical to provide flashover current limiting in the heater feed but these electrodes are in any case far less vulnerable than all the other electrodes in the tube.

The tube grids are connected together and protected by a single spark gap (SG705) and a single current limiting resistor (R712). With RGB drive the grids must carry a d.c. potential which is sufficiently positive to allow full use of the tube's transfer characteristic with the picture signals at the cathodes. This potential is normally between 30 and 35V. Line and field flyback blanking can also be applied at the grids and to achieve cut off the polarity of the blanking signals must of course be negative.

Flyback Blanking

A small modification has been made to earlier plans in order to simplify the interconnections. The field blanking waveform now comes from the convergence panel (instead of the timebase panel): a field frequency sawtooth voltage is picked up at 5M on the second convergence panel and coupled to 9M on the c.r.t. base panel and then through C702. This capacitor together with the shunt resistance in the circuit (mainly R711) differentiates the sawtooth to provide a rectangular blanking pulse. D702 prevents positive overshoots passing to the c.r.t. grids.

The line flyback blanking pulses are taken from

5E on the second convergence panel. They require little treatment on application to the base panel at 9N but their amplitude is reduced by the potential division of R709 and R710 to R711. Again any positive signal excursions are prevented from reaching the tube by D702.

C703 acts as a feed capacitor for the line and field blanking signals and as a d.c. block from the bias supply for the grids.

The grid bias originates from the receiver's boost rail. The approximately 800V applied to 9P is reduced to about 33V by the potential divider action of the circuit. This potential is fed to the tube grids via the series transistor Tr701 and the current limiter R708. R708 also prevents any significant

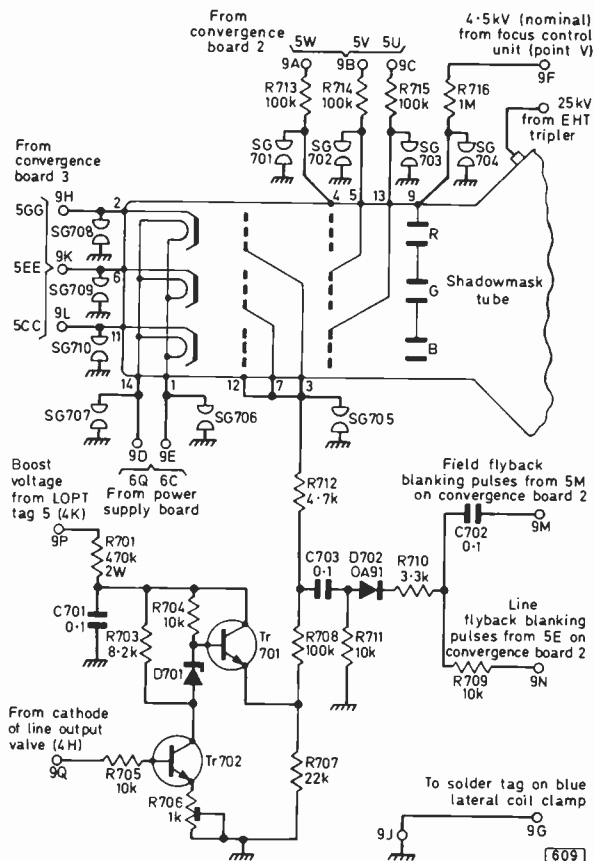


Fig.1: C.R.T. base circuit, including the beam limiter.

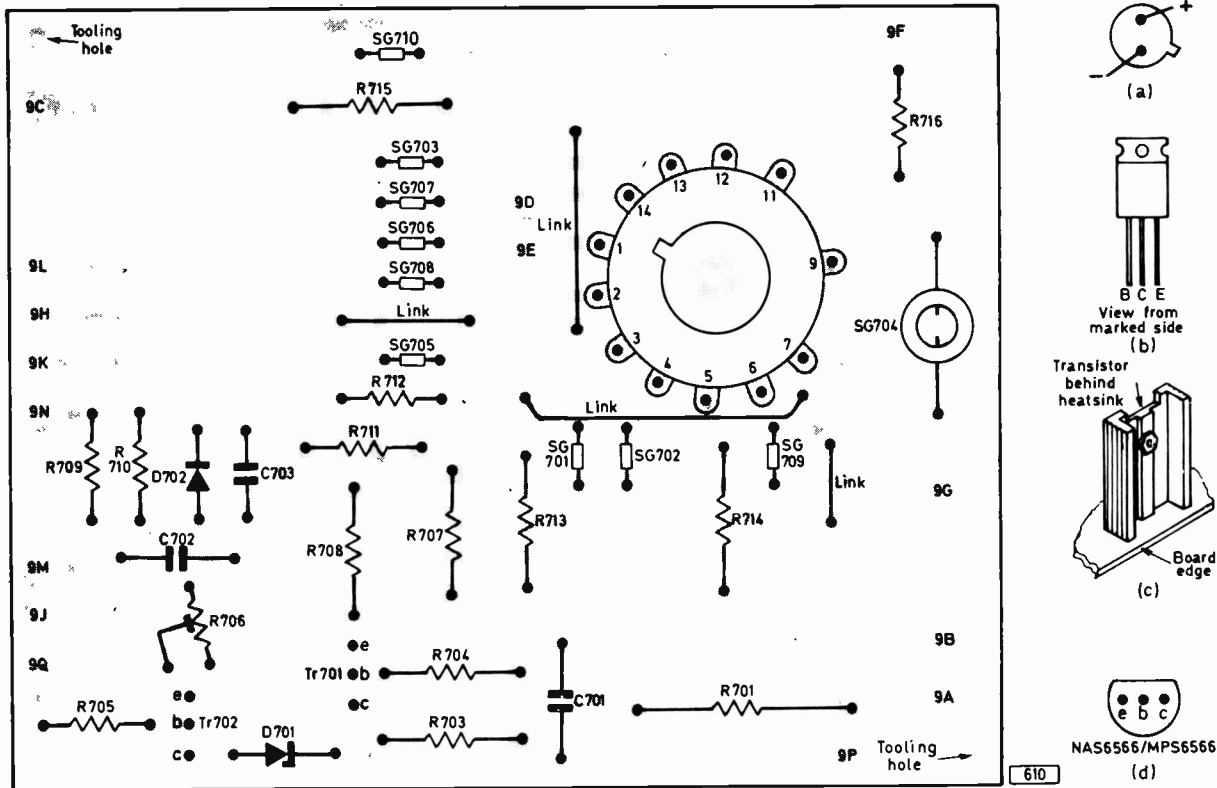


Fig. 2 (above left): Layout of the tube base board: the c.r.t. base is mounted on the board from the copper side. The board size is 5 1/4 in. x 4 in. View is from the copper side.

Fig. 3 (right): (a) Correct TAA550 connections. (b) Correct 2N5492 connections. (c) Method suggested by reader A. M. Melville for mounting the 2N5492: the heatsink is mounted vertically between the transistor mounting holes and the edge of the board with the transistor behind. (d) NAS6566/MPS6566 connections, from below.

reduction of the line and field blanking pulses applied to the tube.

Beam Current Limiting

The beam current limiter acts on this d.c. feed potential. We made provision at the line output valve cathode to extract a control potential across R352 (10Ω). Note was made then that under normal conditions this potential should vary from little over 1V up to about 2.5V depending on the beam current drawn by the tube.

This control potential is coupled to the base of Tr702 through R705. This resistor prevents the line output valve anode current passing through the limiter circuit, the maximum I_b of Tr702 being about 100μA.

The conduction point of Tr702 is controlled by its emitter preset R706. When Tr702 is conducting a current drain of about 5mA will produce an emitter bias of up to 5V with R706 suitably set. The limiting action begins when the bias applied to Tr702 base turns it on. This pulls its collector potential down from the rail voltage. Connected between Tr702 collector and Tr701 base is a 22V zener diode: thus with Tr702 fully conducting the base potential applied to Tr701 will be held at 22V plus the bias potential at Tr702 emitter, i.e. a range of about 22-27V. The emitter of Tr701 follows its base so that when Tr702 is driven on by excessive current

through the line output valve the c.r.t. grids will be held at a reduced potential until the beam current falls. Once Tr702 turns on the effect is progressive.

Constructional Details

The spark gaps used on the panel are discrete components: this is much preferable to using gaps formed in the printed-circuit panel itself. Unless the manufacturing control is very tight with the latter type of gap the actual arcing voltage can be very unreliable. Another advantage of using discrete gaps is that they can be easily and cheaply replaced should they be damaged under fault conditions. The lower voltage gaps consist of a ceramic block with metal bonding on top except over the small gap. The larger 6-8kV gap consists of a plastic ring with the lead wires locked into the ring at the required spacing from one another.

No special resistors are used on the base panel: it is sometimes expected that the focus anode feed resistor should be a high-voltage type. In fact this is not so because the potential across the resistor is minute, the current drain by the focus anodes being virtually immeasurable.

When you receive—or finish making—the printed-circuit panel for the c.r.t. base the hole for the tube socket will have already been made. This is slightly larger in diameter (1 1/4 in.) than the base diameter itself to allow space for the spring-contact fingers.

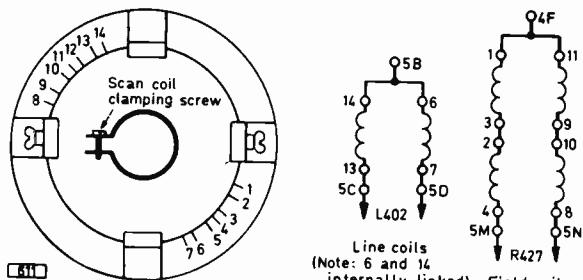


Fig. 4: Connections to Plessey scan coils. Interconnect 1 and 11, 2 and 3, 9 and 10. Field input from 4F to 1, field return from 4 and 8 to 5M and 5N respectively on convergence panel. Line input from 5B to 6. (Make sure the internal link is between 6 and 14—it may be between 7 and 13 on a few assemblies.) Line return from 7 and 13 to 5D and 5C respectively on convergence panel. The coil pin numbers in Fig. 3, Part 8 do not apply.

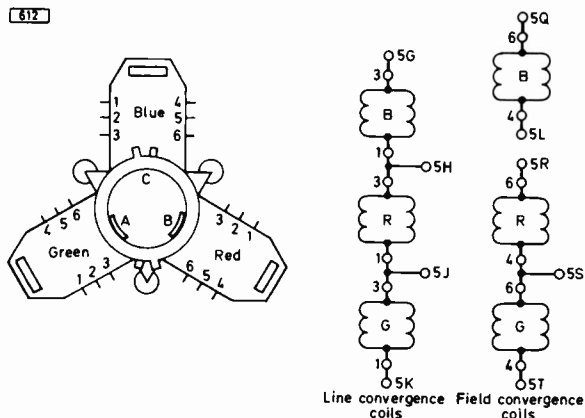


Fig. 5: Connections to Plessey radial convergence coil assembly. Interconnections: blue 1 and red 3, red 1 and green 3, red 4 and green 6. Field circuit: blue from 5Q to blue 6, return from blue 4 to 5L; red from 5R to red 6, green from 5T to green 4, return to 5S from red 4. Line circuit: blue in from 5G to blue 3, blue return/red in to blue 1 from 5H, red return/green in to red 1 from 5J, green return from green 1 to 5K. Coil pin numbers in Fig. 3, Part 8 do not apply.

Also marked on the panel will be the shape of the cut out required to accommodate the focus anode ring trap. This can be formed with a small hacksaw blade: cut two straight lines from the edges of the circle for each side then finish off the rounded end with a suitable round-sided file. You must then drill the two 1/8 in. diameter holes adjacent to the ring trap: the purpose of these is to prevent any possible tracking across the printed-circuit panel from the focus anode connection to either chassis or another pin connection. There is always the possibility even on the best made panel that very small traces of copper have been left on etched areas.

The tube base socket can now be mounted. A protective sticky sheet may be supplied across the insertion side of the base; this should be removed. The base can then be pushed hard into the board in the hole for it. Note that the base is inserted from

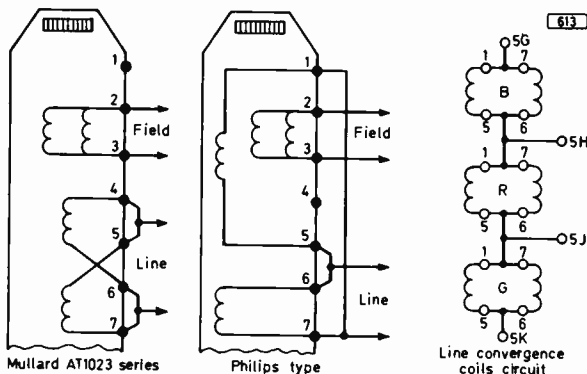


Fig. 6: Some Philips type radial convergence units are being supplied by Manor Supplies. These are equivalent to the Mullard AT1023 series and are of the same shape but as shown above the line convergence coil connections differ. Interconnections: 1 and 7, 5 and 6 of each limb, blue 5/6 to red 7, red 5/6 to green 7. External connections 5G to blue 1, 5H to blue 5, 5J to red 5, 5K to green 5.

the copper side of the board with the c.r.t. pin insertion holes in the base then appearing on that same side. When fully inserted the base will stand off the copper side slightly but all the tabs on the base will line up with the soldering points on the panel. It should then be soldered in place.

Next put in the interconnecting links required across the base panel and then mount the other components. Note that the spark gaps should all be mounted about 1/16 in. above the board.

One final lead is now added. This is the chassis connection for the blue lateral coil. About six inches of wire should be connected to 9G and attached to the solder tag that should be already supplied mounted on the locking screw of the blue lateral coil assembly.

Important Corrections

The connections to IC501 the TAA550 stabiliser i.c. were incorrectly shown in each place in the March issue. The correct connections are shown in Fig. 3(a): the pin nearest the tab is the negative (anode) connection and must be connected to chassis. It is unfortunately probable that if the i.f. pre-amplifier/tuner module is powered with the TAA550 connected the wrong way round it will be damaged.

We have now had an opportunity to look further into the problem about the heatsinks for the field output transistors and the connections to the alternative type of field output transistor supplied, the 2N5492. Due to a misunderstanding between ourselves, the suppliers and the board manufacturers the heatsinks do foul R19, R20 and C9. The solution is to mount these three small components on the copper side of the board. The BD131 pin connections given in the September issue are correct: the device should be bolted on the top of the heatsink which rests on the chassis. The base and emitter connections of the 2N5492 are reversed relative to the BD131—see Fig. 3(b). One solution to the problem is to mount this transistor on its back with a washer beneath the tab and the heatsink on top. Another solution, suggested by a reader, is to mount the

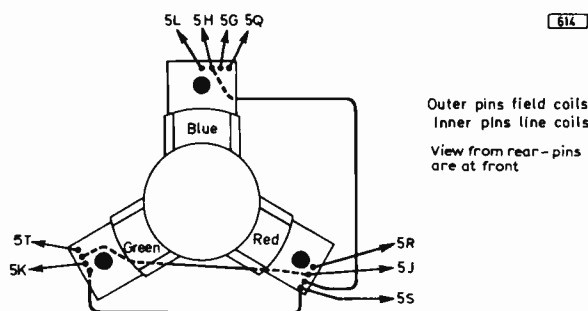


Fig. 7: Where a scan/convergence assembly with convergence rider units is supplied these will generally be of the Mullard AT4046/15 type. Interconnections and external connections are shown above.

transistor and heatsink vertically with the heatsink fixed to the board using Araldite: this solution has the advantage that R19, R20 and C9 can be mounted on the component side of the board.

The field scan coil connections given in the caption to Fig. 4 last month for the Mullard AT1023 series deflection coils will give an upside down picture. The correct connections are as follows: interconnect 4 and 5, 4' and 5', 6 and 3'; input is from 4F to 6 or 3', return from 3 to 5N and 6' to 5M. The pin numbering in Fig. 3, page 17, of the November issue should be amended accordingly. The external field convergence coil connections were not included in the caption to Fig. 5 last month: these are as in Fig. 3 in the November issue.

There have been some queries about the mains transformer and production versions are being obtained in order to investigate the situation.

Tube Neck Components

As mentioned last month some of the scan coil and radial convergence assemblies supplied to constructors will be Plessey ones. The physical connections and equivalent circuits (since the pin numbering given in Fig. 3 of Part 8 in the November issue does not apply) are shown in Figs. 4 and 5. Note the plastic flaps at positions A and B on the radial convergence assembly to hold it in position on the c.r.t. neck: there is no flap at position C. The label is usually on the blue section of the radial assembly, at the top. In a few cases the internal link may be between pins 7 and 13 instead of pins 6 and 14 of the deflection coils and this should be checked and rectified. The blue lateral assembly supplied will also be a Plessey type but this is almost identical to the Mullard type illustrated last month.

In many cases the scan and radial convergence assemblies supplied by Manor Supplies will be of the Philips/Mullard type: as Fig. 6 shows the only difference is in the line coil pin connections on each limb of the radial convergence assembly.

Mullard deflection yokes may in a few cases have been supplied with shorting links across the field coil tags: these should be removed before use. Where "rider" radial convergence units are supplied these will generally be the later Mullard type AT4046/15: the appropriate connections are shown in Fig. 7. These units have superseded the earlier AT4046/07 series. For safety during transit the riders are removed from the housing and packed separately: they are simply pushed home into the sockets.

Table 1: Components List

Component-Pack 22

R701 470k Ω	R707 22k Ω	R712 4.7k Ω
R703 8.2k Ω	R708 100k Ω	R713 100k Ω
R704 10k Ω	R709 10k Ω	R714 100k Ω
R705 10k Ω	R710 3.3k Ω	R715 100k Ω
R706 1k Ω preset	R711 10k Ω	R716 1M Ω

All resistors carbon-film 5% $\frac{1}{4}$ W except R701 which is 2W 5% and R706 which is a miniature horizontal preset.

C701 0.1 μ F 250V

C702 0.1 μ F 250V

C703 0.1 μ F 250V

All capacitors are miniature foil, metallised foil or polyester.

D701 400mW zener diode, 22V (BZY88C22 or similar)

D702 OA91 or SSD108

(All diode markings indicate cathode connection)

Tr701 NAS 6566 or MPS 6566

Tr702 NAS 6566 or MPS 6566

SG701-SG703 1.5kV spark gaps

SG704 6-8kV spark gap

SG705-SG710 1.5kV spark gaps

B14G ceramic valve base with side contacts for p-c mounting

Suppliers

Pack 22 Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk
Cost £2.34 including postage, packing and VAT.

Printed Circuit Board:

E. J. Papworth & Son Ltd., 80 Merton High Street, London SW19
Cost: £0.85 including postage and VAT.

ALIGNING THE IF MODULE

We know that there are a number of groups of constructors aligning their own i.f. modules for the colour receiver. While the circuit description and other information in the June and July 1972 issues of the magazine probably gives sufficient data for the professional, the author was horrified after a visit to one group to see the procedures being adopted: it is clear that some other readers need a little more help. This we give below in two forms, using sweep equipment and spot-frequency testing. We emphasise that the latter should only be used if everything else is absolutely impossible.

Sweep Alignment

A certain minimum amount of equipment is required for sweep alignment. Not only should this equipment be to hand, it should also be familiar to the user in every detail: if you can't "feel" alignment it is pointless to even attempt it.

(1) A sweep generator or wobulator *with* markers, covering at least 30-45MHz and with an output level controllable down to 1mV.

(2) A dual-trace oscilloscope of at least 0.8MHz Y-amplifier capability and with external X-amplifier facilities. Two high-impedance probes should be available.

(3) A 20V and a 40V power supply.

(4) A picture monitor capable of handling a 4V

composite video signal.

(5) An audio amplifier with high input impedance and sensitivity of at least 20mV.

(6) The tuner panel and preamplifier designed for the colour receiver (March 1973).

(7) A suitable trimming tool for the Neosid cores (either from a manufacturer's service kit or a well-shaped plastic knitting needle).

Setting Up

The output of the sweep generator or wobbulator should be connected to the input of the preamplifier on the tuner panel. The isolating capacitor C522 can be taken out of circuit so that the tuner does not double terminate the generator. The generator output level should be set to about 10mV. This is equivalent to an input to the tuner of between 400 and 700 μ V—depending on which tuner is used. This does not give alignment at the most sensitive condition of the receiver but it is a good mean level. Provided the generator output is a reasonable 50 or 75 Ω , no matching network is required for the feed into the preamplifier. If this is not the case the manufacturer will have quoted a suitable matching network in the handbook on his equipment.

The preamplifier output at 8K should be connected via 10in. (no longer) of coaxial cable to the input point on the i.f. module—at 2B. The cable screen should be chassis connected at both ends—at 8D on the tuner panel and the 2J point adjacent to 2B on the i.f. module.

The only output from the i.f. module that must be loaded during alignment is the tuner a.g.c. feed from 2K: this should be connected direct to 8A on the tuner module even though the tuner itself is not being used at this stage.

Connect the plus 20V power supply output with the positive lead to a position on the l.t. outer strip of the i.f. module adjacent to the connection of R155. The earthed lead should be connected to 2J on the copper adjacent (near C150). The supply should be decoupled by at least 16 μ F to simulate the decoupling that is present in the receiver power supply. Connect the 40V supply to the tuner board, positive to 8J, negative to 8D. Check IC501 connections—see correction on page 316.

Check that the board you are aligning has received the modifications noted to the a.g.c. chain in the September 1972, January and April 1973 issues of the magazine. For R130 use 680 Ω unless it is found later that insufficient control range is obtained. Ensure that R159 is 6.8k Ω .

Core locking compound (for source see end) should be applied to each core on the i.f. module—just a dab around the bottom ends of the threads is all that is needed—and all the cores inserted until they are flush with the tops of the cans. There is only one core in each coil assembly: the circuit diagram is misleading in this respect.

Apply power to the tuner panel and the i.f. module. Note that the i.f. module will draw up to 150mA at 20V. If the current is vastly different from this figure switch off and recheck your connections to the board and if necessary the board itself.

Have the i.f. module laid in front of you with the delay line to the right; this makes the process of coil identification much easier. Initially turn the a.g.c. threshold control (R125) fully clockwise and

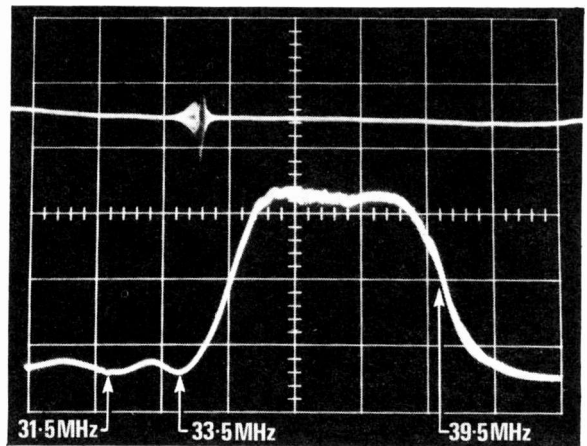


Fig. 8: Typical luminance output at point 2I on the i.f. module. Vertical deflection 2V/cm. Notice traces of instability due to operation at full gain—not present under normal operating conditions. Vertically linear display shows the rejectors as being virtually on the base line—compare with the logarithmic display shown in Fig. 4, page 411, July 1972. Horizontal deflection 1.5MHz/cm. 3dB (6dB voltage) bandwidth approximately 5MHz.

set the a.g.c. crossover control (R133) as clockwise as possible for stability. Monitoring on the oscilloscope should be at the luminance output point at 2I with markers either superimposed through the sweep generator or—more preferable—on the second trace of the c.r.o.

The oscilloscope should be locked to the sweep and the frequency range being swept set to about 30-42MHz.

Procedure

Coil numbers in the following instructions refer to only the first coil in every can, the board's group number (1 . .) being dropped for simplicity—e.g. the assembly L123/L124/L125 is referred to just as L23.

As soon as possible during the alignment the core of L501 should be adjusted to check that its effects are minimal to the response: if this is not so the generator output impedance must be considered as being suspect.

- (1) Adjust the sound notch L1 and adjacent channel vision rejector L4 so that they can be seen "passing through" the frequency range to a position out of the way at about 30MHz.
- (2) Adjust L2 so that the response rolls off from the vision carrier at 39.5MHz up in frequency.
- (3) Adjust L6 for minimum output on the overall response.
- (4) Adjust L8. A peak will be seen to run through the response and then come back to give maximum gain at the vision carrier (39.5MHz). This is the correct position.
- (5) Adjust L1 for maximum rejection at 33.5MHz (the level of rejection is already set by the component values but may be checked to be between 40 and 45dB below reference vision carrier).
- (6) Adjust L4 for maximum rejection at 31.5MHz.
- (7) L3, L5 and L7 should be adjusted to flatten the response and obtain the correct shape. It may be

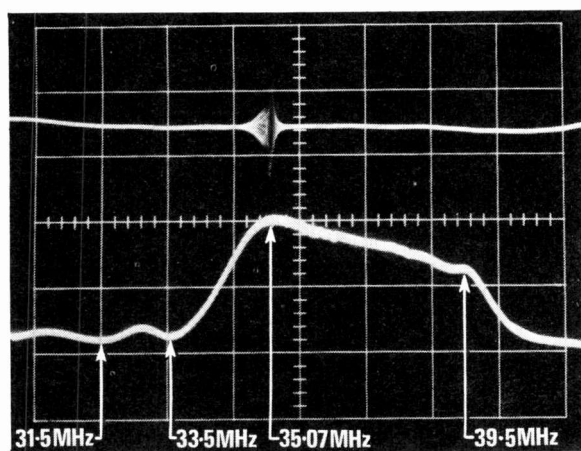


Fig. 9: Chrominance response before bandwidth restriction: this response is not normally observed during alignment.

necessary to adjust L8 *very slightly* to achieve the best results.

(8) Check response bandwidth to be *at least* 5MHz between -6dB points.

(9) Connect the second Y amplifier of the oscilloscope to the a.f.c. output at 2F.

(10) Adjust L23 to give the correct a.f.c. output (shown on page 229 of March 1973 issue and in the photo in this issue). This is the only coil with which there are usually two peaks or apparently correct positions. The first cannot normally be used as it creates too great a loading on the luminance output point—this can be seen running through the luminance output on the first trace of the c.r.o. The second peak should give a large enough and wide enough bandwidth response.

(11) Connect up the tuner on the tuner panel with a suitable supply potential, an aerial feed and varactor control panel for tuning purposes. Reconnect the disabled isolating capacitor C522 and turn the sweep generator output down after removing its input lead from the panel. Connect a picture monitor to the luminance output and set up the varactor control panel to tune into a local station. Leave the a.f.c. open-circuit.

(12) Adjust the a.g.c. threshold control R125 to give a satisfactory picture level for the monitor.

(13) Connect the audio amplifier to point 2C on the board.

(14) Adjust the a.g.c. crossover control R133 to give minimum picture poise consistent with minimum sound background noise.

(15) Adjust L26 for maximum audio output.

(16) Display the luminance output on one channel of the oscilloscope (on normal timebase) so as to look at a line period of the received transmission. Display the output from the i.f. board chrominance chain (at 2D) on the second channel of the oscilloscope.

(17) Adjust the a.c.c. control (R149) fully anti-clockwise (maximum chroma).

(18) Adjust L21 for maximum chrominance output (note that the signal display will also have 6MHz intercarrier content on it—this is removed by the decoder filters: to look for maximum chrominance therefore examine the burst position).

(19) Adjust L17, monitoring the audio output: as the core is inserted a 'vision carrier buzz will be heard, then there is a "clean" central position before a second vision carrier appears. The core should be set to the central "clean" position.

(20) Adjust L15 for maximum chrominance output (monitoring point 2D).

The constructor should now return through the procedure as necessary to balance all the outputs and responses. At all times the luminance output level should be limited to about 3V peak-to-peak by adjustment of the generator output level or the a.g.c. threshold. It should be noted that it is best to adjust the audio and chrominance outputs on off-air signals as their accuracy is better than the majority of test generators and the problems of correctly introducing 4.43 and 6MHz signals into the i.f. module are avoided. Care must obviously be taken however to ensure that the correct tuning position is set up on the varactor control unit on the station used to allow chrominance and sound through the i.f. strip. This can be checked on the visual display of the luminance output.

Note also that L14 is adjusted later—for minimum patterning on the final picture display.

Faults

If the module appears to be faulty the coil continuities should be checked first. By far the most common fault found by the Alignment Service has been open-circuit coils. If there appears to be no audio output check that the board interconnecting links are all in position. The next suspect is the sound i.c. itself. (See comments on i.c. soldering last month.)

If there is instability on the module—at normal luminance output levels—then in nine cases out of ten it will be due to either C116 or C121 having been left with long wire ends above the board. If these are silver mica capacitors the excess insulation usually found on the legs should be chipped off to allow closer mounting.

Spot-Frequency Alignment

The very best advice to a constructor wishing to spot align his module is *don't*. We appreciate however that there may be some circumstances—particularly for overseas constructors—where nothing else is practical. The essential thing to appreciate is the limitations of the system. It is impossible for example when using spot-alignment techniques to be absolutely sure that there are no phase reversals within the passband or that the edges of the passband are not tearing down to the base line. Both may give group delay distortions that result in reasonable results on some types of picture and quite dreadful results on other picture content.

Additionally the resetting accuracy of most spot-frequency oscillators is poor and it is essential that frequency settings are always approached from a known direction—say up in frequency.

For spot alignment you are looking for a d.c. level at the luminance and chrominance outputs corresponding to the amplitude of separate carriers at the generator frequency. It is quite in order therefore to use a multimeter as the measuring device. For setting the rejectors however the instrument should

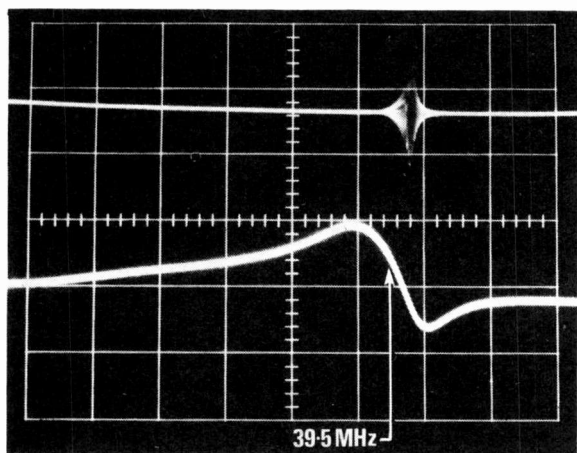


Fig. 10: Typical a.f.c. response. The centre of the slope is set to the vision carrier frequency (39.5MHz). Vertical deflection 0.2V/cm., horizontal deflection 2MHz/cm.

be very sensitive. The same is true for direct audio and chrominance output monitoring.

To proceed with the alignment set things up as given at the beginning of the previous set of instructions. Then proceed as follows:

- (1) Adjust L1 and L4 cores so that they are approximately half-way into the formers.
- (2) Adjust L2 for maximum rejection (minimum output) at 41.5MHz.
- (3) Adjust L6 for minimum output at the vision carrier (39.5MHz).
- (4) Adjust L8 to the *second* peak at the vision carrier (39.5MHz).
- (5) Adjust L1 for maximum rejection (minimum output) at the sound carrier (33.5MHz).
- (6) Adjust L4 for maximum rejection (minimum output) at the adjacent channel vision frequency (31.5MHz).
- (7) Adjust L3, L5 and L7 for a reasonably flat output for generator frequencies of 34 to 39MHz. This requires manual swinging of the generator across this band while adjusting the three cores. The process is complicated and requires some skill. The three cores should *not* be adjusted to peak at any specific frequencies—the *Qs* are different for a normal band-pass arrangement. *Don't* touch L8 during this adjustment.
- (8) Check that the response bandwidth is at least 5MHz. Check that there are no major spurious responses outside this bandpass.
- (9) Connect monitoring test meter to point 2F (a.f.c. output).
- (10) Adjust L23 to the second point at which the output is zero at 2F at the vision carrier frequency (39.5MHz). Check for at least plus and minus 0.1V p-p output at 38.5 and 40.5MHz respectively.
- (11)–(20) Proceed as for wobbulator alignment (11)–(20).

Aligned Strips: Warning

We have already received some indications that returned i.f. modules from the Alignment Service have been tampered with by constructors. That is of course your privilege but don't please expect us to

have much sympathy with you. If there is any obvious damage to the module on receipt then this is covered by the postal registration on the module and the magazine should be informed as soon as possible. Don't check for various outputs from the module when you haven't the instruments to check correctly—we have for example had reports from one or two constructors that chroma couldn't be seen with an Avo and that adjustment of such and such core did not return it concluding that a particular fault was present. A reading of the alignment instructions above—even if you are having your board aligned by the Service—should give you an idea of the difficulties involved in such amateurish attacks on the module.

Core Locking

All i.f. modules passing through the Alignment Service have their adjusting cores locked with core locking compound. For those aligning their own boards and to lock the coils on the decoder panel a source of compound is required.

Elastic string should only be used in equipment where it is known that the core has to be inserted by a very small amount: this is not generally true of the colour i.f. strip or the decoder. Elastic string over a long core length only leads to excess tightening of the core in the former and this usually causes a fracture in the former.

The locking compound should be applied with care—it is rather difficult material to clean off unwanted positions. A disposable instrument such as a cocktail stick or stout knitting needle is recommended. Only a small amount of compound should be used on each core.

A small tub of non-hardening, high melting point core locking compound is being made available for the project by East Cornwall Components, PO Box 4, Saltash, Cornwall, PL12 4EY at 40p including p and p and VAT.

Supply Notes

Mr. Papworth tells us that it is unlikely that he will have the c.r.t. base boards ready by publication date: those who order early may therefore have to wait a week or so.

A print pattern for the c.r.t. base board is available from the magazine office for 5p plus stamped, addressed envelope: blank boards ($\frac{1}{8}$ in.) cut to size (but without c.r.t. base hole) are available for 28p including post and packing from Servitronix Ltd., 26 Killarney Road, London SW18.

We have received from Forgestone a complete list of revised prices including VAT for the various Packs they supply. These are as follows: Pack 2 £5.70, Pack 5 £1.35, Pack 12 £0.34—these three Packs will be supplied for a total of £7.20 if ordered together; Pack 14 £9.95, ELC1043/05 tuner £4.95—these two items will be supplied for £14.75 if ordered together; Pack 16 £11.35; Pack 19 £2.55, degaussing shields for 19/20/22in. tubes £2.50, for 25/26in. tubes £2.60—Pack 19 plus a shield for the smaller tube sizes will be supplied together for £4.85, Pack 19 plus a shield for the larger tube sizes for £4.95; Pack 21 £11.40, Pack 22 £2.34—Packs 21 and 22 together £13.50.

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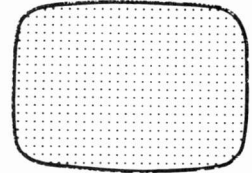
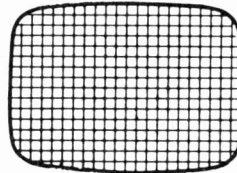
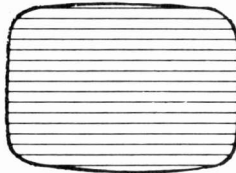
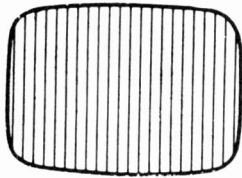
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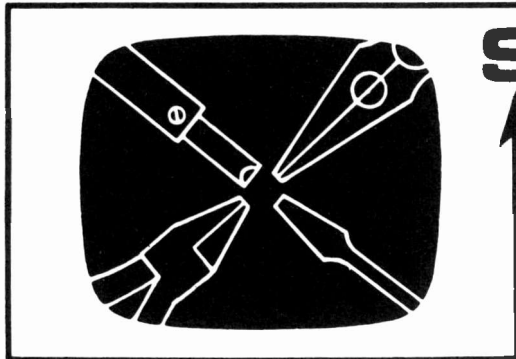
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The Field Circuit

The field timebase does not seem to give much trouble and even the PCL805 seems to be surviving better—but we mustn't count our chickens too early and I'll probably have to eat those words within a very short time of putting them down on paper! Poor linearity has been found to be the result of incorrect contact in the general linearity control 3RV7 rather than component failure or the valve, but we expect 3C18 to start drying up before long to give the more common field faults. In a couple of cases field collapse has been found to be the result of 3C11 being faulty. Let us however pass on to the more sticky things that have happened.

The Sound Stages

The audio output valve is a PCL86. This can give trouble of the more predictable kind—internal shorts causing the cathode resistor to cook up or, less severely, grid current causing a certain amount of overheating with obvious sound distortion. On more than one occasion however we have found that distortion develops after an hour or so of use, with the volume falling off to practically nothing. The PCL86 has checked out, with good hum from the volume control tags. Removal of can E to check the internal components has then restored normal sound after it has been off for a few seconds. Further heating and cooling has shown 2VT8 to be at fault, failing as soon as the temperature is raised and coming into operation again when cool. The voltage across 2R41 is the clue. This should be 4V when normal but drops to zero under the fault condition with the heat on.

The Video Stage

A similar condition can occur in the video stage—with the picture lost but the sound remaining normal. In most cases this is the result of the video output transistor 2VT6 becoming open-circuit. Again the clue is the voltage (should be 3.2V) across the emitter resistor (2R29). The absence of this voltage together with a high voltage at the collector (should be about 100V under normal conditions) is enough to throw suspicion upon the transistor. A similar state of affairs will arise of course if the base voltage falls from its normal 3-4V—but this doesn't seem to happen (it should of course be checked). If the video output stage is in order the emitter-follower 2VT5

should receive attention. Whilst this could well be the cause of trouble the sound would in this case also be affected as the take off point is from its emitter.

Before leaving this area we would mention as a warning a report of a brightness circuit fault. You will notice an unusual feed from the line coils via 3C9 to the brightness circuit v.d.r.—this is not the blanking pulse feed which is via 3C51 and 3R71. The result of 3C9 being faulty can be variation of brightness over a period of time. The purpose of 3C9 is as follows. At switch off the line timebase continues to operate for a time producing flyback pulses which 3C9 couples to 3VDR2. The v.d.r. rectifies these pulses, producing a positive potential at the grid of the c.r.t. to ensure that the e.h.t. is discharged.

The Signal Stages

Four BF123 transistors are used in the i.f. strip, two in the cascode stage 2VT2/3. It is probably coincidence that we have had trouble with the BF123 in the intercarrier sound stage (can E) but not in the can C or D stages. Possibly other people have had different experience and trouble with any of these transistors is quite on the cards. It is also likely that others have had trouble with the a.g.c. circuit: we haven't and so again can't comment.

The Tuner Unit

We can however comment on the tuner. Here the BF180 r.f. amplifier seems to fail leading to very

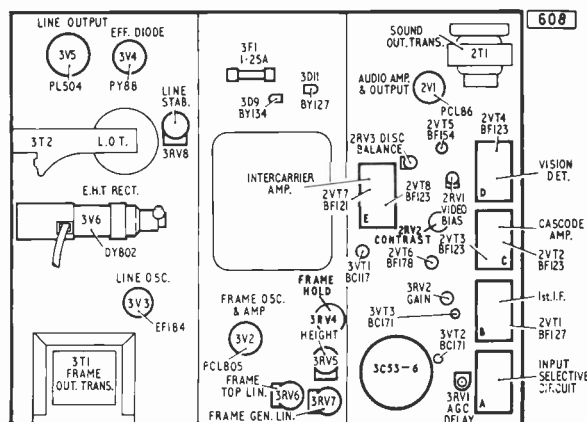


Fig. 2: Chassis layout, component side.

poor reception, or the BF181 stops oscillating resulting in no signal at all—particularly at the low-frequency end of the tuning range. While not difficult, replacement of these transistors does require a delicate touch and is not a job for the heavy handed or the long sighted.

The TV195 series uses a different type of tuner (three transistors with varicap tuning and a separate control unit). Whilst we have had our share of trouble with the original two-transistor tuner used, we have not as yet had reason to dismantle the varicap type and cannot therefore comment upon the ease or otherwise of servicing this unit.

General Notes

A point to watch is the retaining lead and clip which prevent the panel being fully lowered until the clip is released. The lead also earths the outer coating of the tube and must therefore be connected to the chassis when the set is operating (don't leave it dangling).

Several modifications have been made during production to improve the performance or reliability and the following differences may be encountered:

2C59 was left out to reduce hum at low volume (PCL86 cathode electrolytic).

A capacitor (3C60) has been added across the tube heater to prevent damage to 3D6/3D7 in the event of c.r.t. flashover.

3C40 changed to 100pF to improve line linearity adjustment.

3R6 and 3R7 have been replaced by a 1k Ω variable resistor (3RV9) the slider of which is taken to 3R8 (now 100k Ω). This change was made to obtain maximum gain under low-signal conditions.

3R6 (12 Ω) fitted in the emitter lead of 3VT2 to reduce the effects of adverse chassis currents on a.g.c. operation.

3C1 changed to 0.47 μ F to improve sync.

3RV7 changed to 1M Ω .

2R21 changed from 8.2k Ω to 6.8k Ω to improve the range of the video bias.

2VT5 changed to BF154X to provide higher gain.

A plug and socket replaces link 2 in the HT1 feed to the line output stage to remove the feed when the scan coils are disconnected.

3C34 changed to 420pF.

3C32 changed from 0.0047 μ F to 0.004 μ F plastic


NEW TEST EQUIPMENT

Avo have introduced a new transistor tester, type TT169, which is specifically designed for simple go/no-go in-situ testing of npn or pnp signal or power transistors, diodes and thyristors. In addition to saving time it will avoid the possibility of accidental damage to boards and components. The tester is battery operated and is small enough to be hand held: front panel indicators light up to identify satisfactory or faulty devices. Testing is said to be easy even on crowded printed circuit boards. The UK trade price including leads, connections and case is £15, plus VAT.

Digital multimeters seem to be all the rage just now. Following our report last month on the new Sinclair meter we now hear that Advance have intro-

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*Full details and entry
forms in the June issue*

duced a lightweight, dry-battery operated instrument, the Advance Alpha, which is priced at £55 plus VAT.

2C36 deleted.

3R29 changed to 180k Ω to improve field lock.

2C60 (0.01 μ F) fitted between the junction of 2R25/2R27 and chassis to decouple the 20V line.

3VDR3 changed from type E298CD/A258 to type E299DD/P354.

Link added between the positive side of capacitor 3C56 (+295V line) and pin 4 of plug and socket P/S1 to enable a varicap u.h.f. tuner power unit to operate.

Some cases of audio hum have been traced to the plug P/S4 where the clip is on the plastic instead of the screening, of the cable (thanks Alf!).

duced a lightweight, dry-battery operated instrument, the Advance Alpha, which is priced at £55 plus VAT. The advantages over analogue multimeters are greater accuracy, better resolution, freedom from ambiguity and increased robustness. The Alpha has 24 ranges giving d.c. voltage readings from 1mV to 1kV; a.c. voltage readings from 1mV to 500V; current, both a.c. and d.c., from 1 μ A to 1A; and resistance from 0.1 Ω to 10M Ω . The maximum reading is 999 (over-range useable to 1200). A custom designed m.o.s. l.s. i.c. is used to carry out the digital operations and l.e.d.s are used for the display. The input impedance is 10M Ω and maximum continuous overload 350V on the 1V range and 1kV on the other voltage ranges. Power can be from a single 9V (PP9 or equivalent) dry battery (battery life up to 300 hours in normal use), an optional rechargeable battery supply or an optional a.c. mains unit.

Transistor IF PREAMPLIFIER

R. MacCLAY

IMPROVED u.h.f. performance from dual-standard models fitted with a valve u.h.f. tuner can be had by replacing the u.h.f. tuner with a modern two-transistor one. If this course is adopted it is often desirable to remove the v.h.f. tuner as well and convert the set to single-standard operation. The trouble is that in most such sets the v.h.f. tuner is used to provide a stage of i.f. preamplification. The loss of this can be overcome however by fitting a transistor i.f.

preamplifier. A number of the preamplifiers featured in this article have been built and have proved invaluable when converting chassis such as the BRC 850 to single-standard operation.

The two circuits given (Figs. 1 and 2) enable either a pnp or an npn transistor to be used. In both cases the transistor is operated in the grounded-base mode and a +12V supply is required. This can be obtained from the same source as the u.h.f. tuner supply. A suitable circuit for this supply is shown in Fig. 3 and can be constructed on tagstrip as shown in Fig. 4.

A simplified version of the coupling between the i.f. preamplifier and the main i.f. strip is shown in Fig. 5: the circuit is a bottom-coupled (C_c) band-pass one. C_c is actually the capacitance of the coaxial lead between the preamplifier and the i.f. strip plus any padder used there. The full transistor collector load/coupling circuit is shown in Fig. 6. L_1 is tuned by C_3 and C_4 while the choke L_2 makes the tuning of L_1 less dependent on the i.f. strip circuitry (a resistor of about 27Ω could be used in place of L_2). R_4 provides a d.c. supply for the collector of the transistor while C_5 provides a d.c. block to prevent any d.c. from the i.f. strip getting into the preamplifier.

Full-size printed circuit layouts for the preamplifiers are shown in Figs. 7 and 8. The tuning coil L_1 is wound on a small ($\frac{1}{8}$ in./4mm. diameter) former using 38 s.w.g. wire. The winding should be close-wound at the base of the former. The choke L_2 is

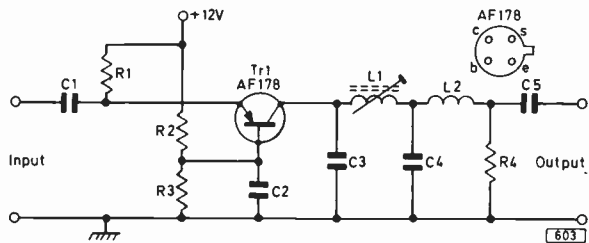


Fig. 1: Circuit using pnp transistor.

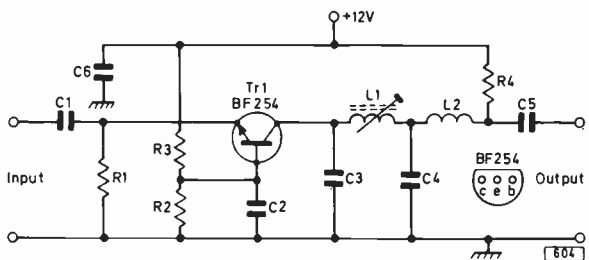


Fig. 2: Circuit using npn transistor.

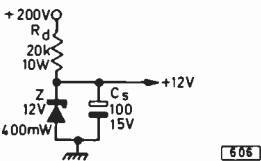


Fig. 3: 12V supply.

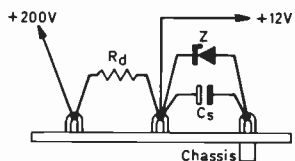


Fig. 4: Layout on tagstrip.

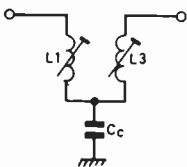


Fig. 5:

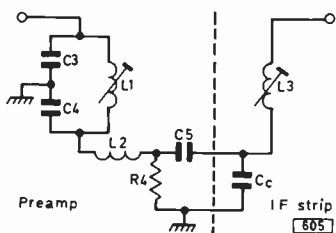


Fig. 6:

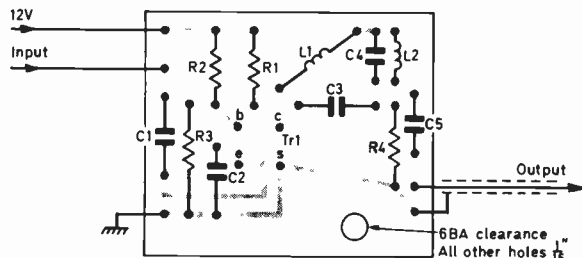


Fig. 7 (above): Layout using pnp transistor.

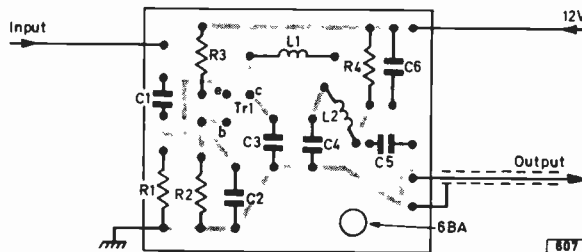


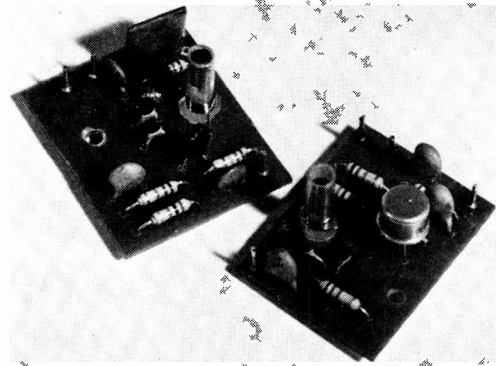
Fig. 8 (below): Layout using npn transistor.

★ components list

C1 1000pF ceramic 500V	R1 1k Ω
C2 2200pF ceramic 500V	R2 5.6k Ω
C3 10pF ceramic 63V	R3 12k Ω
C4 10pF ceramic 63V	R4 560 Ω
C5 1000pF ceramic 500V	All $\frac{1}{4}$ W 5%
C6 0.1 μ F ceramic 35V	
L1 15 turns on 4mm. diameter former with core	
L2 10 turns 38 s.w.g.	

close-wound on a 7/64in. drill, a smear of Bostik being used to hold the windings in place. There are only four connections to the board which can be fastened to the u.h.f. tuner with a single 6BA screw. A very useful pen for drawing the printed circuit board is the Decon marker.

The tuning coil L1 is best adjusted on a test card for maximum gain. The adjustment is fairly flat and no difficulty has been experienced in obtaining the optimum position.



A couple of assembled preamplifiers.

The preamplifier is very effective and being separate from the i.f. strip no instability problems have occurred. ■

FAULT FINDING GUIDE

—continued from page 305

The audio valve V8A can develop interelectrode faults. The cathode resistor R96 can be damaged when a heater-cathode leak occurs, and the cathode bypass capacitor C134 can dry up and lose value.

Loss of volume on 625 lines only can be caused by a break in the oscillator coil L47 while a dry-joint between the coil and the associated damping resistor R94 can give intermittent sound due to the circuit Q altering.

On 405 lines distortion or loss of sound can be due to a faulty detector (GR2) or noise limiter (GR3) diode. A quick check of the front-to-back resistance values of the diodes will prove this one way or the other. It is also worth checking the noise limiter circuit bias resistors R84 and R85 for increase in value.

625-line reception intercarrier buzz which appears after a time is usually caused by drift in a coil or transformer tuned to 6MHz, e.g. the oscillator coil L47 or the take-off coil L46 (not shown) in the cathode circuit of the video amplifier V5A. Core adjustment to tune out the buzz must be done care-

fully: if no improvement can be obtained return the core to its exact initial position.

The anode load resistor R89 of the EH90 is fed from the screen grid resistor (R63) of the video amplifier, the electrolytic C93 (32 μ F) which is mounted on the chassis behind the video amplifier forming a common decoupling element. Should C93 go open-circuit the most common symptom is evident on sound as persistent vision-on-sound buzz. This unusual arrangement is common to all these groups of models—the later ones which use a PFL200 video amplifier and the earlier ones with a PCL84 video stage. In earlier models this electrolytic is designated C51 and in one case where the sound and vision signals could not be tuned in together the cause was failure of C51. A 'scope check showed that sound signals were reaching the video amplifier while vision signals appeared at the EH90 anode. Faults of this nature emphasise the need for careful and correct diagnosis of the apparent symptoms. Vision-on-sound buzz or separation of the sound and vision signals might suggest tuner unit faults leading to the temptation to try twiddling a core or two with doubtful consequences.

As with most faults if close inspection of the chassis reveals no visible clues such as discoloured resistors replacement valves should be tried first.

THE CROFTON CCTV CAMERA

—continued from page 310

reliable u.h.f. modulator that converts the camera to give video and r.f. outputs (both outputs can be used simultaneously).

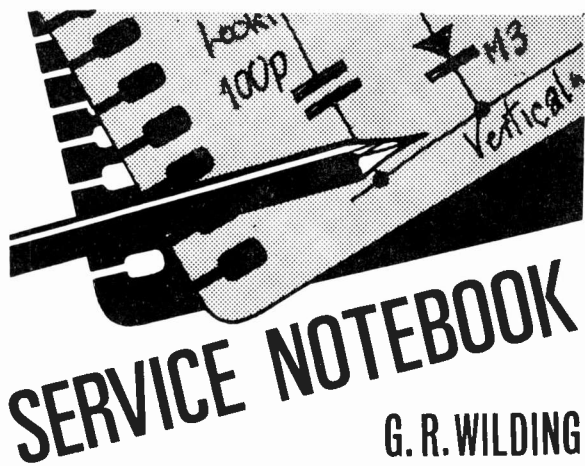
Although the camera appeared to work well from "switch on" (without recourse to any test equipment) a closer inspection with an oscilloscope revealed a few points that needed attention to get an output suitable for a videotape recorder. Due to transistor gain spreads the blanking mixer had to be doctored a little and a resistor value had to be modified to produce a text book waveform. A similar problem was encountered in the video/sync mixer stage. As the video level did not exceed 250mV it was

impossible to obtain a 1V 70/30 video-to-sync ratio until one resistor value in the grounded-base mixer stage was altered. When this had been done the camera, coupled directly to a Shibaden $\frac{1}{2}$ in. videotape recorder, gave excellent results.

Horizontal resolution (prior to recording) was better than 400 lines and it is a sign of confidence that Crofton provide a useful test card for accurate alignment.

The only item of importance missing from the kit (which is basically designed for educational purposes) was a detailed description of the principles of operation. This should be rectified by a Mullard publication due out shortly.

Enquiries about the kit should be directed to Crofton Electronics and not to Mullard. ■



No EHT

THE complaint "no e.h.t." figures prominently amongst the servicing queries we receive. In most cases the cause is simple and the best procedure after removing the e.h.t. can is to note how the line output valve and boost diode warm up, keeping an insulated screwdriver to hand for drawing arcs. If the boost diode anode starts glowing red at the centre, the glow tending to spread, while the line output valve doesn't appear to be under too great a strain the almost certain cause of the trouble is heater-cathode breakdown in the boost diode. If the line output valve anode glows most noticeably red the cause of the trouble is lack of drive to the line output valve—failure therefore to develop the usual high negative grid voltage: direct attention to the line oscillator circuit, trying a new valve and then checking voltages. While you are making voltage checks the line output valve and boost diode will of course be under strain, as also will be the h.t. rectifier, surge limiting resistors and so on. Thus if testing is prolonged it is advisable to substitute an old, low-emission line output valve. In a particularly difficult case it may even be worthwhile temporarily using a higher value line output valve screen feed resistor.

If only the screen grid of the line output valve glows the usual cause is an internal disconnection in the boost diode, or alternatively an open-circuit choke mounted on either of the top cap connectors—in both cases the line output valve anode is robbed of h.t. On rare occasions a break in the line output transformer primary winding causes this trouble.

If there is a slight but well below normal spark at the anodes of the line output valve and the e.h.t. rectifier remove the boost diode top cap and note if this results in an increased spark size. If it does the boost capacitor is short-circuit. This component is readily identifiable even without the aid of a service manual since it is near the line output transformer and having a high voltage rating is generally of above average physical size.

If a normal size arc can be drawn from the e.h.t. rectifier anode but there is no or very little e.h.t. from the lead connector to the c.r.t. the rectifier itself is almost certainly faulty although there is a chance that a dry joint in the valveholder is preventing the valve fully warming up. In many models

there is a low-value resistor in series with the heater supply and this can go open-circuit.

On occasion the c.r.t. develops an internal short between its final anode and an earthed point. When this happens there will be no e.h.t. at the c.r.t. connector until it is unclipped although there will be considerable a.c. at the e.h.t. rectifier anode. Sometimes the e.h.t. rectifier develops an anode-cathode short thus putting a.c. on the c.r.t. final anode and resulting in no picture. Sometimes when this happens a limited current passes during the negative e.h.t. pulse excursions, in effect superimposing an a.c. component on the high-voltage d.c. output. The most noticeable symptom with this is constant sparking and brushing between the aquadag coating of the c.r.t. and its earthing springs.

When the line output pentode runs cool and there is h.t. on its anode though no noticeable spark can be drawn the screen feed resistor is almost certainly faulty.

Line output transformers rarely fail in modern receivers: thus before this expensive component is condemned every other possibility should be checked and rechecked. They do however fail in older receivers—probably because the set has been working with an incorrectly set mains adjustment or with reduced value surge limiters etc. so that the h.t. and therefore the e.h.t. is well above the correct figure.

The desaturating choke used in many GEC/Sobell models tends to develop shorts, giving the impression that the line output transformer is at fault.

A common cause of no e.h.t. in BRC receivers is breakdown of the e.h.t. multiplier—the "rectifier tray". This is often characterised by a pungent smell.

Finally a word about drawing arcs: these should always be kept to the minimum and *they should never be drawn in transistorised receivers*. The arc length depends greatly upon the insulating quality of the screwdriver handle: it is best therefore to keep to one type of screwdriver so that a good assessment of the voltage can be made.

Band III Fade

"BBC always good but ITV sometimes goes dark" was the complaint with a 23in. Band I/III Ekco model. During our visit both stations were equally good however. We cleaned the tuner contacts and although it made only a marginal improvement replaced the 30L17 since cases of weak Band III but normal Band I reception are usually caused by the r.f. amplifier. The set worked well for about a week when ITV went very weak though BBC remained at full strength. This time the fault remained till our arrival when we found that changing the 30C17 frequency changer permanently restored Band III gain.

No Colour

THE complaint with a set fitted with the BRC 3000 chassis was no colour. With this fault the best action in any colour set is first to override the action of the colour killer—to ensure that the chrominance channel is operative. In many colour sets this can be done simply by connecting a resistor of about

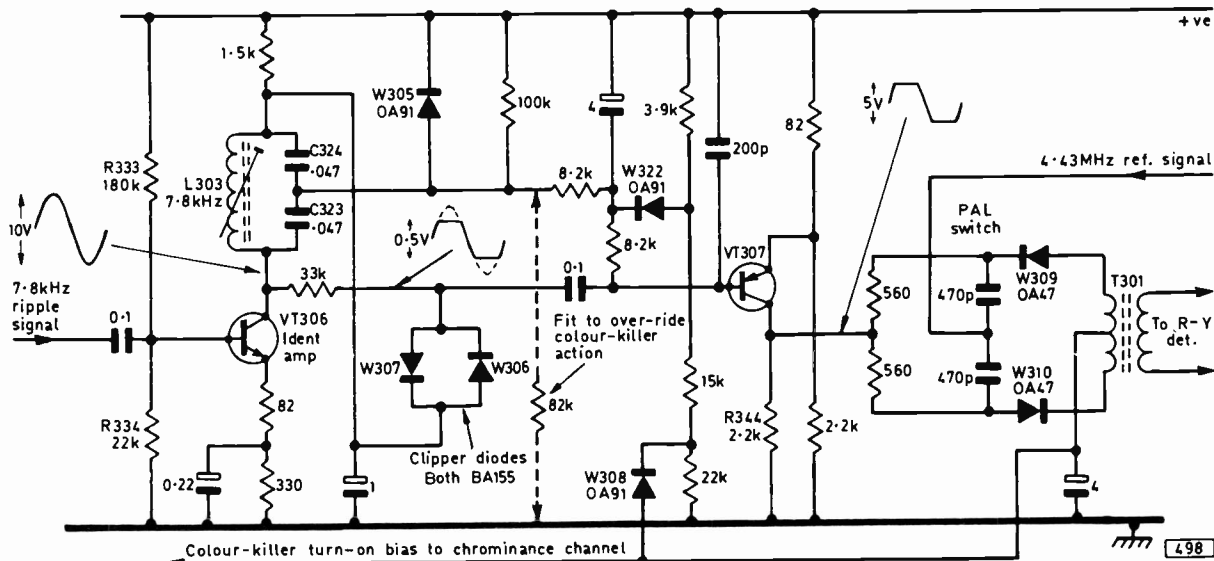


Fig. 1: The ident/PAL switch circuit used in the BRC 3000 chassis. The numerous diodes in this circuit can be confusing. W305 rectifies the ident signal to provide a turn-on bias (negative with respect to h.t.) for the switching waveform amplifier VT307. W307 and W306 clip the positive and negative peaks of the ident signal to generate the squarewave signal required to drive the PAL switch. W309 and W310 form the PAL switch in conjunction with T301. W322 clamps VT307 base bias, preventing it falling below the voltage at W322 anode. W308 also acts to stabilise VT307's base bias: if VT307's collector voltage rises beyond a certain point W308 begins to conduct, stabilising the bias through feedback action.

22k Ω between the l.t. rail and the base of the colour-killer-controlled stage in the chrominance channel. BRC's recommendation with their 3000 chassis however is to connect an 82k Ω resistor between the junction of C323/C324 (Fig. 1) and chassis. These two series-connected capacitors tune the collector coil of the ident amplifier VT306 the output from which on colour drives the PAL switch driver stage VT307. Standing bias for VT307 is obtained on colour by W305 which rectifies the signal feed to its base. As a result VT307 is non-conductive on monochrome but on colour when the ident signal is present it is brought into conduction and an average voltage of 27V appears across its collector load resistor R344. The colour-killer turn-on bias is produced in the PAL switch circuit when VT307 comes into operation.

The result of overriding the colour-killer action was a strongly coloured picture but with severe Hanover bars. This is the classic symptom of an inoperative PAL switch, generally caused by a fault in the bistable circuit which drives it. In this chassis however a bistable circuit is not used, the driver stage VT307 producing a squarewave output suitable for operating the PAL switch. This squarewave output is produced by severely clipping the high-amplitude ident sinewave on its positive and negative excursions. The ident signal is then used to drive the PAL switch and to provide the colour-killer action and the presence of the two faults no colour, and Hanover bars on overriding the colour-killer action, strongly suggested an ident stage fault. Voltage tests on the ident amplifier VT306 showed that its collector voltage was almost that of the supply rail (30V) instead of the 19V quoted in the service manual, so obviously it wasn't conducting. The emitter voltage was zero instead of the correct

figure of 2.5V but the voltage at the junction of the base potential divider R333/R334 was just over 3V. Clearly the base-emitter junction of the transistor was open-circuit and a resistance test with an ohmmeter confirmed this. On fitting a replacement transistor normal results were obtained.

Careful tuning of the ident amplifier coil L303 is essential to obtain correct phasing and output amplitude, and it is worth noting that cases of incorrect colouring at the extreme left- or right-hand side can be caused by the coil moving on its former. The drill then is to reduce the width so that both picture extremes are visible, reposition and secure the winding and make a final core readjustment.

Poor UHF Reception

"Picture wavering in and out" was the call from a new Sony colour set owner and on arrival this was found to be a fair description. On removing the aerial plug a tolerable colour picture still remained. This was due to direct pick-up of course, the wavering being caused mainly by vehicles passing along the adjacent main road in the direction of the nearby transmitter. It was clear that the aerial was giving very little signal and that as a result the set was not developing any worthwhile a.g.c. and was operating at peak sensitivity. A correct type aerial had just been installed by the owner in the loft, but on investigation it was found to be vertically instead of horizontally mounted. Turning the aerial by 90 $^\circ$ produced a perfect picture, the strong a.g.c. then produced removing the fluctuating effects of the direct pick-up.

Since this u.h.f. transmitter opened we have had numerous calls from owners of dual-standard receivers who for one reason or another have found

625-line reception poor or completely impossible. Poor reception is in most cases due to inadequate aerial input, low-emission tuner valves or to the separate u.h.f. sensitivity preset used in some models being incorrectly set. In sets which use sync-tip a.g.c. on 625 lines the preset must not be too far advanced or the result will be cross-modulation and impaired sync on strong signals due to sync pulse crushing (the sync pulse represents maximum signal amplitude on 625 lines).

We came across an instance of this latter trouble recently in a dual-standard Bush receiver. After installing the correct aerial we obtained good BBC-1 reception but on the stronger BBC-2 signal there was a constant field bounce—ITV was not at the time available. The trouble was not due to a fault in the sync separator or field generator circuits but simply to the very strong signal which lead to pulse crushing. As a result the a.g.c. amplifier produced less than normal a.g.c. voltage, accentuating the trouble by permitting the i.f. stages to operate at high gain on an already strong signal, this in turn impairing the sync separator operation. Reducing the setting of the u.h.f. sensitivity preset removed all signs of field bounce and greatly improved the picture tone.

Another common complaint is fading on u.h.f. once the set has warmed up, v.h.f. remaining OK. Many people immediately suspect the tuner, but if a PFL200 is used as the video amplifier/sync separator this valve will usually be found to be the cause of the trouble: as it is generally d.c. coupled to the vision detector on 405 but a.c. coupled on 625 any tendency for it to pass grid current will result in a u.h.f. fade.

When the set appears to be completely dead on u.h.f. check that the system switch is applying the l.t. or h.t. required to the tuner and that the switch slider is correctly moving over to make on all 625-line contacts.

Intermittent Loss of Colour

Intermittent loss of colour was the complaint with a single-standard Bush colour receiver. Colour could always be restored by over-riding the colour-killer action: on this chassis the procedure for doing this is to link test point 3TP14 to the l.t. rail at test point 3TP11, the resulting voltage across 3R72 (see Fig. 2) providing the necessary chrominance turn-on action. On monochrome the base-emitter voltage of 3VT11 is insufficient to switch it on, its collector

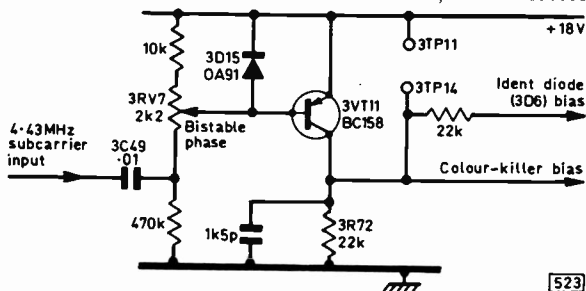


Fig. 2: 3VT11 in the RBM single-standard colour chassis provides both colour-killer and ident bias. Intermittent colour can be due to this transistor being faulty.

voltage resting at chassis potential: on colour however the reference oscillator—which on this chassis is of the passive type and is brought into operation only when (a) the bursts are present and (b) the PAL switch bistable circuit is operating in correct phase (the action of this circuitry was explained in Gordon J. King's *Colour Receiver Circuits* series in July 1972)—provides an input to 3VT11 via 3C49. This is rectified by 3D15 so that 3VT11 conducts: the resulting voltage across 3R72 activates the chrominance channel and by reverse biasing the ident diode 3D6 maintains the correct bistable switching phase.

The preset control 3RV7 which is labelled "bistable phase" must be set so that 3VT11 remains cut-off on monochrome but continues to be conductive on colour at even the lowest saturation level selected by the viewer. Incorrect adjustment of 3RV7 could cause colour failure therefore by failing to keep 3VT11 on during signal fades. Similarly if 3D15 was faulty it would cause the same symptom by failing to develop sufficient d.c. to keep 3VT11 on. After further test running however the colour went off and stayed off: resistance tests on 3VT11 then revealed that its collector-base junction was open-circuit. After replacing this transistor no further colour intermittency was experienced.

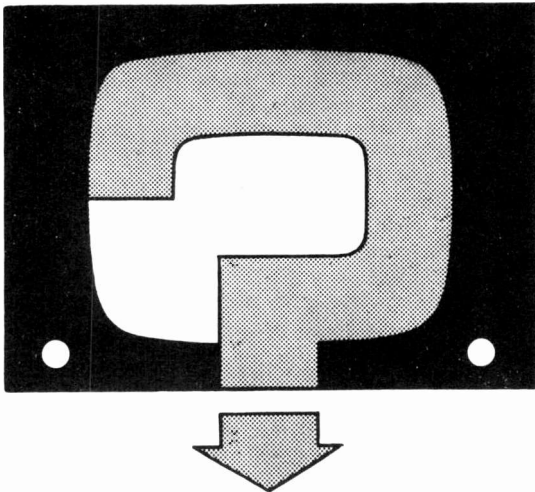
Unusual Case of Lack of Height

THE raster on a 19in. Dynatron model (Pye 11U series chassis) was of normal width but only about 5in. high, consisting of no more than about 20 to 30 widely spaced lines somewhat resembling a Lissajous pattern. The height control had little effect and the field hold control none, and as may be expected this most unusual raster was not altered by replacing the valves in the field timebase. All voltages were about right but it was found that by shunting an equivalent value capacitor across one of the field multivibrator cross-coupling capacitors (C79, 0.01 μ F) a normal raster was obtained. The raster remained correct after the test capacitor was removed but on switching off and on again the original fault returned. The suspect capacitor was then replaced and a perfect raster which continued throughout a long soak-test was obtained.

Failure of one of the time-constant setting cross-coupling capacitors usually results in failure of a multivibrator type generator stage to oscillate. In this case however it resulted in the stage oscillating at about twenty times the correct frequency. The temporary cure effected by stabbing an equivalent across the faulty capacitor indicated that the defect was almost certainly a high-resistance internal connection (healed by the initial voltage surge) between the foil and the lead-out wire.

LETTER: Lack of Line Drive

Many thanks for the excellent series by John Law on fault finding. In connection with the ITT/STC line timebase article I would like to add that on several occasions we have found lack of line drive to be due to C121 which couples the oscillator circuit back to the control grid of the PCF802 pentode section being faulty. This fault can be intermittent, making trouble-shooting more difficult.—J. Thomas (London W4).



YOUR PROBLEMS SOLVED

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RGD 626

There is no e.h.t. and no line whistle in this set (STC VCI chassis). I replaced the line output valve, boost diode and e.h.t. rectifier. On switching on all valves except the e.h.t. rectifier lit up. The boost diode started to light up very brightly and before the set could be switched off the 4 μ F electrolytic connected between its anode and the chassis blew up. C117 also broke in two.—D. May (Hunstanton).

C125 (the 4 μ F electrolytic mentioned) usually blows when the boost diode develops a heater-cathode short. This could be caused by the line output valve drawing excess current due to the ECC81 line oscillator being inoperative. This latter condition would occur if C117, which tunes the oscillator coil, was defective. So, replace C117, C125 and the PY801 boost diode and check whether the line whistle is still absent. If it is switch off quickly and replace the ECC81. All should then be OK but the width circuit resistors R143-R146 in the boost diode anode circuit should be checked as they may have been damaged by the fault conditions.

MARCONIPHONE 4714

Cramping at the bottom of the screen and slight loss of height were corrected by adjusting the linearity 1 and height controls. The picture remained perfect for a week after which field hold was lost. The field could not be locked by adjusting the hold-control and when the slipping was slowed down by adjusting this control the picture brightness went very low and images appeared to have a ghost to the right—the line scan was also slightly reduced.—F. Upton (Wigan).

The trouble appears to be in the supply circuitry, the stabilised 30V line going down or being overloaded. The voltage at 1/13 on the power panel should be 30V. This line supplies the brightness control, video, chrominance and sound stages in addition to the field oscillator and driver. If the line is less than 30V disconnect in turn 2/10 (field and sound), 2/13 (brightness), 2/12 (video) and 2/11 (chrominance) to see which if any feed is overloading. If the voltage remains low check the stabiliser transistor VT601 and the smoothing electrolytic C624 for this feed.

FERRANTI TC1122

There is an excellent raster on both 405 and 625 lines but neither sound nor vision. All likely valves have been replaced and the voltages checked, all being within 5% of the nominal values. As the system switch seems to be operating without fault we are uncertain how to proceed.—T. Davies (Bristol).

It is simplest to check the receiver on 405 lines since it is then easier to sort out the vision and sound stages. Make a careful check of the voltages at the common vision and sound i.f. stage V5 (EF183): at the screen (pin 8) you should find about 100V, at the anode (pin 7) about 170V and at the cathode (pin 1) a small voltage (not very much). If these voltages are correct you should get some response when you disturb pin 2 (control grid). If this is so the fault is almost certain to be in the mixer stage in the v.h.f. tuner (first check that the tuner supply is present). This means a careful check of the PCF801 mixer valve circuit. Ensure that the preset contrast controls have not been damaged or set back too far. (Pve 11U series.)

FERGUSON 506T

There is a bright narrow line across the centre of the screen and immediately above this a 4in. high raster with the lines opening out towards the top. The PCL82 field output valve and its cathode resistor appear to overheat but no improvement has been obtained by replacing them. When one end of the linearity feedback capacitor C98 is disconnected a coarse raster with the lines $\frac{1}{2}$ in. apart fills the entire screen: in addition the lower half of the screen is then brighter than the top half which is dark. All voltages seem to be within limits. The ECC82 in the field timebase and the output stage decoupling electrolytic have also been replaced.—T. Martin (Darlington).

The trouble is due to a faulty capacitor in the field timebase. Change C97 (0.01 μ F) in the linearity feedback loop and the multivibrator cross-coupler C92 (0.03 μ F).

GEC 2048

The field hold is poor when the set is first switched on. The hold settles after 10-15 minutes but slips if the incoming picture turns for example to a night scene. It is difficult to set the hold control, slight movement making the picture roll. The field timebase and sync separator valves have been replaced.—F. Binfield (Glasgow).

The problem seems to be due to a faulty capacitor. The likely ones which should be checked are C131 the electrolytic which decouples the video amplifier screen grid, C238 the field charging capacitor, C208 the field sync pulse integrating capacitor and C202 in the oscillator triode grid circuit.

BUSH TV161

There is vision-on-sound, more pronounced on u.h.f. When the brilliance control is advanced the problem increases in intensity and the picture enlarges to some extent. Tuning has no influence on the fault. When switching from u.h.f. to v.h.f. the picture height increases approximately 1in. top and bottom. Also after a period of working the line sync tends to become unstable. The flywheel sync discriminator diodes have been replaced with some improvement. The width/e.h.t. stabilisation control 3RV3 is in the maximum position.—J. Harcourt (Winchester).

Vision-on-sound normally occurs if there is excessive signal, an a.g.c. circuit fault or incorrect alignment. Since the fault occurs on both standards the alignment is unlikely to be incorrect. We suggest therefore that the effect of the contrast control is checked, followed by a general check of the a.g.c. circuit if necessary. The variation in height which occurs on changing systems points to a weakness in the line output stage: this tends to be confirmed by the fact that 3RV3 is set at maximum. The PL504 line output valve and PY88 efficiency diode should be checked therefore, also the 1M Ω resistor 3R24 in series with 3RV3 and the 3.3M Ω resistor 3R21 connected to its slider. For the line sync fault we suggest checking that the flywheel sync circuit feedback (integrating) resistor 3R2 is 47k Ω and remains so, then if necessary replace the oscillator valve 3V1 (PCF80).

FERGUSON 3639 JUNIOR 12

Full line and field scan are obtained after warm up but it is almost impossible to control the field hold and after a short period the field collapses. The 30PL14 field timebase valve, also the hold control and its series resistor, have been replaced without altering the situation.—R. Wright (Coventry).

With these receivers (Thorn/BRC 980 chassis) the first thing to do when a field fault is experienced is to check the heater circuit rectifier W9. As the bias to the field output pentode (applied to its grid circuit) is derived from the heater chain (via R85) there will be no field hold and no field output stage bias in addition to excessive heater current if this diode shorts. So first check W9 and the bias smoother C61 then direct attention if necessary to the capacitors in the field timebase circuit, in particular the cross-coupler C54, the field sync pulse coupler C53 and field sync pulse shaper C56.

PHILIPS G24T300

There is intermittent line pulling on the picture in a narrow band about a third from the top of the screen. Sometimes the fault does not appear for an hour or so, at other times it keeps on happening, particularly with change in programme content, e.g. to advertisements. Reducing the contrast setting does not improve matters. Otherwise the picture and sound are excellent.—H. Greenford (Leicester).

Examine the picture for signs of ghosting which if present could under some circumstances promote the fault: resite the aerial if necessary to overcome this. Then listen carefully with the volume turned down for hum; if this is present add further chassis connection to the main smoothing block at the right-hand side and tighten the top clamp. Then if necessary check the PFL200 video amplifier/sync separator valve and the rear ECC82 flywheel sync valve: also check the 27k Ω resistor (R2144) connected to pin 6 of this ECC82. Finally check the BA144 d.c. restorer diode (X2194) in the grid circuit of the PFL200 (mounted immediately to the left of the valve).

SOBELL 1000

The height is OK and the picture excellent but there is loss of width—about 1in. on each side of the picture. The line timebase valves have been replaced, also the line output pentode screen grid components, without making any improvement. The main electrolytics have also been checked and found to be OK.—J. Bailey (Edmonton).

We feel that the v.d.r. in the e.h.t. stabilisation/width circuit is at fault. Check by connecting an 0.5M Ω resistor across it. If this results in increased line scan replace the v.d.r. (Mullard type E298ZZ/05). If not check R125 which feeds the set boost control P11.

FERGUSON 3654

The contrast can only be turned up half way: if it is turned up further the picture is disturbed and there is a distinct buzzing on sound—the set is operated on u.h.f. This buzzing also occurs when anything white appears on the screen.—R. Jefferson (Derby).

There is a small hole at the bottom left of the main panel through which the local-distant control R11 can be adjusted. With the contrast adjusted for normal viewing turn this control to reduce the buzz. Check all the vision valves (EF183, 30FL14 and 6F28) if necessary: then turn attention to the a.g.c. line components. (Thorn/BRC 1400 chassis.)

MARCONIPHONE 4602

There is arcing inside the c.r.t. giving off a sound like a series of clicks. The arcing can be seen in the tube neck. Thinking that the tube was shorting we fitted a new one but the problem remains. As the new tube is a known good one we are at a loss.—T. Forton (Grimsbey).

Certainly there is nothing wrong with the set. These "clicks" can occur with any tube whether it is old or new. If they don't interfere with the picture too much they can be ignored. If they do the new tube should be returned to the suppliers.

PYE 43

The set starts all right from cold but after a few minutes the line hold drifts badly—on both u.h.f. and v.h.f. The line timebase valves have been replaced, also the flywheel line sync diodes and most of the components in the line oscillator and line oscillator control stages. But still the problem remains.—T. Andrews (Birkenhead).

The symptom indicates that the flywheel sync circuit is not operating correctly. The flywheel sync diodes are capacitively fed from the anode and cathode of the line sync pulse phase splitter stage V16B via C102 and C103, both 150pF. Leakage in either of these two capacitors can cause the trouble. (Pye group 368 chassis.)

FERGUSON 3642

The width control track blew out about three months ago. The control was replaced and the set worked normally until the width control burnt out. This has been replaced and now we get three complete pic-

tures side-by-side with an inch blank at each side of the screen. The sync and line timebase valves have been checked and found to be up to specification.—R. Cork (Bordon).

R133 (330k Ω) in series with the width control appears to have changed value: when it looses value the current passing through the width control is heavy enough to burn it out in a short time. Replace R133 therefore and check the other components in the width circuit, R130 (2.2M Ω), R131 (1.8M Ω), the v.d.r. and C106 (100pF 2kV pulse). (Thorn/BRC 950 chassis.)

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TELEVISION MAY 1973**TEST CASE****125**

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

? A dual-standard Pye receiver worked perfectly on both standards for about thirty minutes after switch on. There then gradually appeared in the top right-hand corner of the screen a curious, twisted-rope-like interference which slowly unfolded to form eventually a vertical, brightish line about $\frac{1}{4}$ in. thick and about 1in. from the right-hand side from the top to the bottom of the picture. This tended to increase in intensity with time and sometimes bulged out like a balloon half way down. On occasion it drifted slowly towards the centre of the picture. The effect was most noticeable on the Band I channel, was just about visible on the Band III channel and was completely clear on the u.h.f. channels. The sound was not affected in any way.

No sparking or corona could be detected around the line output transformer or e.h.t. circuits when viewed in a darkened room and a test of the line output valve and boost diode indicated that their emission was well up. The line oscillator valve was found to be low emission and was replaced but the only effect this had was to alter the locking position of the hold control.

It was then discovered that the severity of the interference could be altered by moving the coaxial aerial cable about at the rear of the set and at one critical position the symptom was almost completely removed.

Component checks in the line oscillator and output stages failed to reveal any shortcomings. Before changing the line output transformer however it was decided to try another line output valve. This completely cleared the trouble. Why was this, in view of the normal emission of the original one and the apparent freedom from internal flashover?

See next month's TELEVISION for the solution and for a further item in the Test Case series.

SOLUTION TO TEST CASE 124

Page 282 (last month)

When the colour on the screen is slightly displaced from the luminance a good clue is given that the signal delay in the luminance channel is incorrect. It will be recalled that the bandwidth of the luminance channel is greater than that of the chrominance channel and as signals travel faster through wideband than narrowband circuits it is necessary to introduce delay in the luminance channel in order to compensate for the resultant time difference between the chrominance and luminance signals (which also get out of step in the tuner and i.f. circuits). If the delay is incorrect the chrominance information will arrive at the tube a fraction of a second after the luminance information. This was the cause of the displacement described last month.

In the case in question it was eventually discovered that the delay line terminating inductor was badly soldered (this inductor controls the phase and hence the precise delay time).

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EM80/1 40p	PCL86 32p	U25 62p	30L15 75p	
EM84 40p	PFL200 55p	U26 60p	30L17 70p	
EY51 45p	PL36 52p	U191 60p	30P12 70p	

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TELEVISION TUBE SHOP

BRAND NEW TUBES AT
REDUCED PRICES

A28-14W (A28-13W) ...	£12.75
A31-18W	£12.50
A47-11W	£9.95
A47-13W	£12.50
A47-14W	£8.25
A47-26W	£10.75
A50-120WR	£12.50
A59-11W	£12.95
A-59-13W	£13.50*
A59-15W	£9.95
A59-16W	£13.50*
A59-23W	£14.75
A61-120WR	£16.50
AW36-21, 36-80	£5.75
AW43-80	£6.95
AW43-88, 43-89	£6.75
AW47-90, 47-91	£7.50
AW53-80	£7.50*
AW53-88, 53-89	£8.25
AW59-90, 59-91	£9.00
C17LM, 17PM, 17SM	£6.50
CME1201	£12.50
CME1601	£10.50
CME1602	£12.00
CME1702, 1703	£6.75
CME1705	£7.75
CME1713/A44-120	£14.50
CME1901, 1903	£7.50
CME1906	£12.50
CME1908	£7.75
CME2013	£12.50
CME2101, 2104	£8.25
CME2301, 2302, 2303	£9.00
CME2305	£14.75
CME2306	£13.50*
CME2308	£9.95
CME2413R	£16.50
CRM171, CRM172	£6.50
CRM211, CRM212	£7.50*
MW36-24, 36-44	£5.50
MW43-69	£6.75
MW43-80	£6.75
MW53-20, 53-80	£7.50
TSD217, TSD282	£14.00†
13BP4 (Crystal 13)	£14.00†
190AB4	£9.25
230DB4	£11.25

* These types are fully rebuilt.

† Rebuilt tubes also, at £7.00 plus carriage and old bulb.

COLOUR TUBES	NEW		R/B
	£	£	
A49-15X	35	-	
A49-120X	45	-	
A56-120X	72	48	
A61-15X	78	52	
A63-11X	-	52	
A66-120X	82	55	
A67-120X	85	-	

SPECIAL OFFER TO EXPERIMENTERS
New 90° Colour Tubes 19", Suitable for "Television" T.V., Unprotected £25.

Add Carriage and Insurance: Mono-chrome 75p, Colour £1.50.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD,
LONDON, S.W.11. BAT 6859
WE GIVE GREEN SHIELD STAMPS

PHILIP H. BEARMAN (VALVE SPECIALISTS)

NEW valves by Mullard, Mazda, Telefunken etc.,

IMMEDIATE POSTAL DESPATCH, LISTS S.A.E., DISCOUNT PRICE
PRICES FROM 1.4.1973 (INCL. V.A.T.)

DY86/7	33p	PC88	61p	PCL86	53p	6/30L2	80p	30PL13	95p
DY802	37p	PCF80	43p	PL36	70p	6BW7	66p	30PL15	95p
EB91	23p	PCF86	53p	PL81	62p	6CD6	88p	etc. etc.	
ECC81	40p	PCF801	53p	PL84	53p	6F23	85p		
ECC82	37p	PCF802	55p	PL500/4	70p	6F28	60p		
ECL80	43p	PCF805	73p	PY81	40p	20L1	88p		
EF80	37p	PCF808	70p	PY800	40p	20P4	88p		
EF183	49p	PCL82	41p	PY801	40p	30C15	84p		
EF184	49p	PCL83	53p	U25	80p	30FL1/2	60p		
EH90	46p	PCL84	49p	U26	80p	30L15	84p		
EY51	60p	PCL85	53p	U191	80p	30L17	84p		
EY86/7	33p	PCL805	53p	U193	40p	30P12	84p		
GZ34	63p	PCL805 (non	U193	40p	30P12	84p			
PC86	61p	BVA) 44p	U251	83p	30PL1	66p			

POST FREE OVER £3, BELOW THIS add 3p per valve

Large PCF80 30p. Sorry, no 10C1, X78, X79 or 12AH8.

See separate Component, CRT and Transistor Lists. Many obsolete types available.

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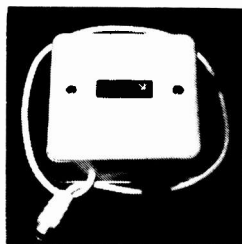
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(Suppliers to H.M. Govt., etc.)

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THE NEW UM4 "COLOURBOOSTER"

UHF/625 LINE



CAN PRODUCE
REMARKABLE
IMPROVEMENTS IN
COLOUR AND
PICTURE QUALITY
IN FRINGE OR
DIFFICULT AREAS
WITH SIGNIFICANT
REDUCTION IN
NOISE (SNOW).

HIGH GAIN—VERY LOW NOISE
FITTED FLY LEAD—INSTALLED IN SECONDS
HIGHEST QUALITY COMPONENTS
IVORY PLASTIC CASE 3½ x 3½ x 1½ CORK BASE
CHANNELS: Group A, Red code 21-33
Group B, Yellow code 39-51
Group C-D, Green code 52-68

EQUALLY SUITABLE FOR BLACK AND WHITE

Also the M4 DUAL BAND VHF UNIT
BOOSTS ALL BAND III and ANY SPECIFIED
BAND I CHANNEL SIMULTANEOUSLY
NOMINAL GAIN 16-18 DB BOTH BANDS

PRICES BOTH TYPES:

£3.75 Battery model or £5.87 Self-contained mains version

Postage and Packing 13p

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<p>Branded TTL I.C.'s</p> <table style="font-size: small;"> <tr><td>7400 29p</td><td>7475 55p</td><td>7410 34p</td></tr> <tr><td>7413 30p</td><td>7478 55p</td><td>7411 35p</td></tr> <tr><td>7418 30p</td><td>7480 75p</td><td>7412 35p</td></tr> <tr><td>7421 40p</td><td>7481 75p</td><td>7415 50p</td></tr> <tr><td>7424 40p</td><td>7483 75p</td><td>7416 80p</td></tr> </table> <p>I.C. Sockets Dual-in-line or Zog-Zag 14 and 16 pin Our Price 1p per pin.</p>	7400 29p	7475 55p	7410 34p	7413 30p	7478 55p	7411 35p	7418 30p	7480 75p	7412 35p	7421 40p	7481 75p	7415 50p	7424 40p	7483 75p	7416 80p	<p>VDR's & Thermistors</p> <table style="font-size: small;"> <tr><td>A15B 75p</td><td>GL23 £1 00</td><td>VA1005 15p</td></tr> <tr><td>CZ1 15p</td><td>R53 £1 32</td><td>VA1026 13p</td></tr> <tr><td>CZ4 13p</td><td>R54 £1 46</td><td>VA1033 13p</td></tr> <tr><td>CZ13A 13p</td><td></td><td>VA1040 10p</td></tr> <tr><td>E298 ED/A258 10p</td><td></td><td>VA1053 10p</td></tr> <tr><td>E298 ZZ/06 10p</td><td></td><td>VA1055S 10p</td></tr> <tr><td>GL16 £1 21</td><td></td><td>VA1034 10p</td></tr> </table>	A15B 75p	GL23 £1 00	VA1005 15p	CZ1 15p	R53 £1 32	VA1026 13p	CZ4 13p	R54 £1 46	VA1033 13p	CZ13A 13p		VA1040 10p	E298 ED/A258 10p		VA1053 10p	E298 ZZ/06 10p		VA1055S 10p	GL16 £1 21		VA1034 10p	<p>Potentiometers</p> <table style="font-size: small;"> <tr><td>5KΩ</td><td>50KΩ</td><td>500KΩ</td></tr> <tr><td>10KΩ</td><td>100KΩ</td><td>1MΩ</td></tr> <tr><td>25KΩ</td><td>250KΩ</td><td>2MΩ</td></tr> <tr><td colspan="3">log or lin less switch (& 1KΩ lin)</td></tr> <tr><td colspan="3">log or lin with switch</td></tr> <tr><td colspan="3">dual less switch</td></tr> <tr><td colspan="3">dual with switch 10K, 100K & 1M</td></tr> <tr><td colspan="3">log only</td></tr> <tr><td colspan="3">10K log - 10K antilog less switch</td></tr> </table>	5KΩ	50KΩ	500KΩ	10KΩ	100KΩ	1MΩ	25KΩ	250KΩ	2MΩ	log or lin less switch (& 1KΩ lin)			log or lin with switch			dual less switch			dual with switch 10K, 100K & 1M			log only			10K log - 10K antilog less switch			<p>Capacitors</p> <table style="font-size: small;"> <tr><td>Ceramic plate</td><td colspan="2">63V (C333)</td></tr> <tr><td>1-8pf</td><td>8-2pf</td><td>33pf</td></tr> <tr><td>2-2pf</td><td>10pf</td><td>39pf</td></tr> <tr><td>3-3pf</td><td>12pf</td><td>47pf</td></tr> <tr><td>3-9pf</td><td>15pf</td><td>56pf</td></tr> <tr><td>4-7pf</td><td>18pf</td><td>68pf</td></tr> <tr><td>5-6pf</td><td>22pf</td><td>82pf</td></tr> <tr><td>6-8pf</td><td>27pf</td><td>100pf</td></tr> <tr><td colspan="3">all 5p. each</td></tr> <tr><td>mylar film</td><td colspan="2">100V</td></tr> <tr><td>1000pf 2p</td><td>01μF 3p</td><td>0.08μF 4p</td></tr> <tr><td>2000pf 2p</td><td>0.02μF 3p</td><td>0.1μF 4p</td></tr> <tr><td>5000pf 2p</td><td>0.04μF 3p</td><td>0.2μF 5p</td></tr> <tr><td></td><td>0.05μF 3p</td><td></td></tr> <tr><td colspan="3">metallised polyester 250V (C280)</td></tr> <tr><td>01μF 3p</td><td>0.08μF 3p</td><td>0.47μF 8p</td></tr> <tr><td>015μF 3p</td><td>1μF 4p</td><td>0.68μF 11p</td></tr> <tr><td>0.22μF 3p</td><td>1.5μF 4p</td><td>1μF 13p</td></tr> <tr><td>0.33μF 3p</td><td>2.2μF 5p</td><td>1.5μF 20p</td></tr> <tr><td>0.47μF 3p</td><td>3.3μF 6p</td><td>2.2μF 28p</td></tr> <tr><td colspan="3">metallised polyester 400V (C281)</td></tr> <tr><td>01μF 4p</td><td>0.47μF 6p</td><td>2.2μF 10p</td></tr> <tr><td>015μF 4p</td><td>0.68μF 6p</td><td>3.3μF 14p</td></tr> <tr><td>0.22μF 4p</td><td>1μF 7p</td><td>4.7μF 15p</td></tr> <tr><td>0.33μF 5p</td><td>1.5μF 8p</td><td></td></tr> <tr><td colspan="3">mixed dielectric 600V</td></tr> <tr><td>01μF 7p</td><td>0.47μF 7p</td><td>2.2μF 16p</td></tr> <tr><td>0.22μF 7p</td><td>0.68μF 8p</td><td>4.7μF 24p</td></tr> <tr><td>0.33μF 7p</td><td>1μF 8p</td><td>1μF 33p</td></tr> <tr><td colspan="3">mixed dielectric 1000V</td></tr> <tr><td>1000pf 6p</td><td>6800pf 9p</td><td>1μF 12p</td></tr> <tr><td>2200pf 6p</td><td>01μF 9p</td><td>2.2μF 22p</td></tr> <tr><td>3300pf 6p</td><td>0.22μF 9p</td><td>4.7μF 30p</td></tr> <tr><td>4700pf 6p</td><td>0.47μF 12p</td><td></td></tr> <tr><td colspan="3">Ceramic</td></tr> <tr><td>12KV.d.c.</td><td>8KV.d.c.</td><td>HI-K 750V.</td></tr> <tr><td>10pf 9p</td><td>200pf 9p</td><td>1000pf 5p</td></tr> <tr><td>15pf 9p</td><td>220pf 9p</td><td>1500pf 5p</td></tr> <tr><td>22pf 9p</td><td>250pf 9p</td><td>2000pf 5p</td></tr> <tr><td>68pf 9p</td><td>270pf 9p</td><td>3000pf 5p</td></tr> <tr><td>82pf 9p</td><td>300pf 9p</td><td>5000pf 5p</td></tr> <tr><td>100pf 9p</td><td>750V DISC</td><td>10,000pf 5p</td></tr> <tr><td>120pf 9p</td><td>470pf 5p</td><td>feed-</td></tr> <tr><td>140pf 9p</td><td>1000pf 5p</td><td>through</td></tr> <tr><td>150pf 9p</td><td>5000pf 5p</td><td>5p</td></tr> <tr><td>180pf 9p</td><td>10,000pf 5p</td><td>1000pf 5p</td></tr> </table>	Ceramic plate	63V (C333)		1-8pf	8-2pf	33pf	2-2pf	10pf	39pf	3-3pf	12pf	47pf	3-9pf	15pf	56pf	4-7pf	18pf	68pf	5-6pf	22pf	82pf	6-8pf	27pf	100pf	all 5p. each			mylar film	100V		1000pf 2p	01μF 3p	0.08μF 4p	2000pf 2p	0.02μF 3p	0.1μF 4p	5000pf 2p	0.04μF 3p	0.2μF 5p		0.05μF 3p		metallised polyester 250V (C280)			01μF 3p	0.08μF 3p	0.47μF 8p	015μF 3p	1μF 4p	0.68μF 11p	0.22μF 3p	1.5μF 4p	1μF 13p	0.33μF 3p	2.2μF 5p	1.5μF 20p	0.47μF 3p	3.3μF 6p	2.2μF 28p	metallised polyester 400V (C281)			01μF 4p	0.47μF 6p	2.2μF 10p	015μF 4p	0.68μF 6p	3.3μF 14p	0.22μF 4p	1μF 7p	4.7μF 15p	0.33μF 5p	1.5μF 8p		mixed dielectric 600V			01μF 7p	0.47μF 7p	2.2μF 16p	0.22μF 7p	0.68μF 8p	4.7μF 24p	0.33μF 7p	1μF 8p	1μF 33p	mixed dielectric 1000V			1000pf 6p	6800pf 9p	1μF 12p	2200pf 6p	01μF 9p	2.2μF 22p	3300pf 6p	0.22μF 9p	4.7μF 30p	4700pf 6p	0.47μF 12p		Ceramic			12KV.d.c.	8KV.d.c.	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TV94
TV95 or C
TV96 or C
TV97
TV98C
TV99 or C
TV100C
TV101C
TV102C
TV103 or D
TV105 or D or R
TV106
TV107
TV108
TV109
TV112C
TV113
TV115 or C or R
TV118
TV123
TV124

From model TV123 to TV139 there have been two types of transformer fitted. One has pitch overwind, the other has plastic moulded overwind. Please state which type required as they are not interchangeable.

BAIRD
600 628 662 674
602 630 663 675
604 632 664 676
606 640 665 677
608 642 666 681
610 644 667 682
612 646 668 683
622 648 669 685
624 652 671 687
625 653 672 688
626 661 673

Please quote part No. normally found on tx. base plate; 4121, 4123, 4140 or 4142.

COSSOR
CT1700u CT1975a CT1962-77*
CT1910a CT1976a CT1954-77*
CT1911u CT2100u CT1964-78*
CT1921a CT2310a
CT1922a CT2311a
CT1935a CT2321a
CT1937a CT2331a
CT1938a CT2372a
CT1972a CT2373a
CT1973a CT2375a
CT1974a CT2378a

*Two types fitted one has pitch o/w, the other has plastic moulded overwind—please state which type required as they are not interchangeable.

KB
PVP20 QV30 (90°) WV90
WV05 QV30FM (110°) MV100/1
KV001 QV30-1 OF100
KV002 30 PV100
KV005 NV40 KV101
KV006 NF60 KV105
RV10 RV60 KV107
O15 WV60 I15
TV15 XV60 I17
O17 NF70 or FM I19
QV20 PV70 KT400A } VCI or VC2
WV20-1 QV70 } VC1 or VC2
RV20 RV70 KT405A } VC1 or VC2
TV20 VV70 by chassis No.—
WV20 WV70 VCI VC4 VC52 VC200
QVP20 WV75 VC2 VC5 VC53
QV30 QF80 VC3 VC51 VC100

MURPHY
V310 V430 V520 V879 or C* V789 V201555
V310A V430C V530 V923* V153 V20165
V310AD V430D V530C V939 or L* V159 V20175
V310AL V430KL V530D V973C* V173 V2310
V310CA V440 V539 V979* V179 V2311C
V320 V440D V540 V653X V1910 V2414D
V330 or D V440K V540D V659 V1913 V2415D
V330F or L V470 V649D V683 V1914 V2415S
V410 V480 TM2 Chassis V739 V2014 V24155S
V410C V490 V843* V753 V20145 V2416D
V410K V500 V849* V783 V2015D V2416S
V420 V510 V873* V787 V20155 V24175
V420K V519

*Two types fitted. One has pitch overwind, the other has plastic moulded overwind. Please state which type required as they are not interchangeable.

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900 960 981 5 stick £3.70 each
911 970 982
950 MKI 1900
£3.00 each £3.70 each £3.00 each
When ordering, model number and series must be quoted.
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Direct BRC replacement, will clip into existing transformer.

PYE
1
2
3 or u
11u Series
12u State Pt. No. required—
13u AL21003 or 772494
14u
15u
20u
SP17 62
21f or uf 63
22uf 64
23uf 68
24uf 75
31uf 76
35uf 77
36 80
37 81
40f 83
48 84
49 85
52 86
58 95
59 96
60
61
PV110 State Pt. No. required—
V110 771980 or 772013
V210 or A
V220
V410 or A State Pt. No. required—
V420A 771927 or 771920
V430A
V510
V530

V200 or LB
V300s
V310 or s
V400
V600
V620
V630
V700 or A or D
V710 or A or D
V720
V830A or D or LBA

State Pt. No. required—
772444 or 771935

PHILLIPS
1768u
1792u
1796u
2168u
2192u
2196u
2197u
17TG100
17TG102
17TG106
17TG200
17TG306
19TG100u
19TG111a
19TG112u
19TG114u
19TG116u
19TG121a
19TG178
19TG179
19TG122a
19TG123a
19TG125a
19TG133a
19TG142a
19TG148a
19TG152a
19TG154a
19TG155a
19TG156a
19TG158a
19TG164a
19TG170a
19TG171a
19TG172a
19TG173a
19TG175a
19TG176a
19TG177a

21TG100u
21TG102u
21TG106u
21TG109u
23TG107u
23TG111a
23TG113a
23TG121a
23TG122a
23TG131a
23TG142a
23TG152a
23TG153a
23TG156a
23TG164a
23TG170a
23TG171a
23TG173a
23TG175a
23TG176a
23FG632
G19TG210
G19TG211
G19TG212
G19TG213
G19TG214
G19TG215
G20T230
G20T231
G20T236
G20T238
G20T300
G20T301
G20T302
G20T306
G20T307
G20T308
G23T210
G23T211
G23T212
G23T213
G24T230
G24T232
G24T236
G24T238
G24T300
G24T301
G24T302
G24T306
G24T307
G24T308

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BT303 BT315 BT322 BT337 BT450 2001 2017 2023 2044 2065
BT304 BT316 BT324 BT342 BT451 2010 2018 2032 2047 2066
BT305 BT318 BT326 BT346 BT452 2012 2019 2033 2048 2082
BT308 BT319 BT328 BT347 BT453 2013 2020 2038 2063 2083
BT312 BT320 BT329 BT448 BT456 2014 2021 2039

DECCA
DR20 DR34 DR71 DR505
DR21 DM35 DR95 DR606
DR23 DM36 DR100 666TV-SRG
DR24 DM39C DR101 777TV-SRG
DR29 DR41 DR121
DR30 DM45 DR122 MS1700
DM30 DR49C DR123 MS2000
DR31 DM55 DR202 MS2001
DR32 DM56 DR303 MS2400
DR33 DR61 DR404 MS2401

SOBELL
T24 ST284 or ds 1010dst 1033
SC24 ST285 or ds 1012 1038
TP5173 ST286 or ds 1013 1039
TPS180 ST287 or ds 1014 1047
ST195 or ds ST288ds 1018 1048
ST196 or ds ST290ds 1019 1057
ST197ds ST291ds 1020 1058
SC270 ST297ds 1021 1063
T278 1000ds 1022 1064
ST282 1002ds 1023 1065
ST283 1005ds 1032 1066

EKC
TC403 TC437 TS13 531 1075 TC1122 1163 1155 1175
404 T442 514 TS32 1080 1123 1164 TC1157 1176
406 T500 515 533 1081 1124 1165 1158 T1181
T418 TC501 520 535 1082 1125 T1174 1159 T1182
TC419 T502 521 536 1083 TC1126 T1175 TC1160 T1185
T420 503 524 540 1093 1137 TC1135 1162 T1186
TC421 504 525 541 1094 T1154 1136 1163
T422 505 526 1095 T1155 1137 T1164
433 506 527 1096 1157 1138 T1165
434 510 528 1097 1159 1140 1173
TC435 511 529 1121 1160 T1154 1174
T436 512 530

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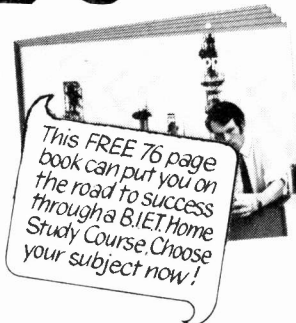
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<input type="checkbox"/> ELECTRICAL &	<input type="checkbox"/> Jig & Tool Des.	<input type="checkbox"/> Hydraulics
<input type="checkbox"/> ELECTRONIC	<input type="checkbox"/> Tech. Drawing	<input type="checkbox"/> Inst. of Builders
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