TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

25p

AUGUST 1974

component Distribution Survey

also:

SERVICING THE TCE/BRC 1590/1591 CHASSIS

LINE OUTPUT STAGE PROTECTION CIRCUIT

"Two line scan transistors can save you time, trouble and money.

Straight away."

A message from your Best girl

Best has taken a hard look at line scan transistors from your point of view.

We have come up with just two transistors which cover the vast majority of your line scan transistor requirements.

This means that you can

(1) Cut your stock investment

(2) Reduce the number of different parts you need to keep in stock

2 SC643A covers BU105, BU105/02, BU204, BU205, BU206, R2265

2 SC1172-Y covers BDX32, BU108, BU208

The 2 SC643A costs **£1.64** each.

The 2 SC1172-Y costs **£3.08** each.

To Best Electronics (Slough) Ltd.,
Unit 4, Farnburn Avenue, Slough, Bucks. SL1 4XU.
Tel: Slough 39322

☐ Please send me the new Best Line Scan Transistor Wall Chart.
☐ Please send me ______ 2 SC643A transistors at **£1.64** each.
______ 2 SC1172-Y transistors at **£3.08** each.

Add 18p for carriage (on orders under £5) and 10% V.A.T.
I enclose £

Name______________________

Company______________________

____

Address______________________

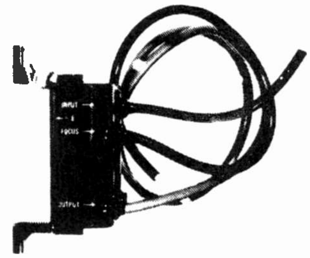
____

____

BEST

T8/74

COLOUR 25 KV TRIPLERS



£1.70+17p V.A.T.

REPLACEMENT TRIPLERS

PYE CT72 SERIES 691, 693, EKCO CT103, CT120, CT105, CT125, CT121, CT122. GEC 2028, 2029, 2030 SOBELL 1028, 1029, TS25, 11TAZ	**£3.00**+30p V.A.T.
DECCA CS1730	**£1.00**+10p V.A.T.
E.H.T. RECTIFIER STICKS X80/150D	**10p**+1p V.A.T.
PYE TRANSISTOR TUNER UNITS VHF, UHF. *No* push button assembly	**£1.50**+15p V.A.T.
PHILIPS UHF UNIT	**£1.50**+15p V.A.T.
6 OR 4 PUSH-BUTTON UHF TUNER UNIT PYE	**£3.00**+30p V.A.T.
UHF AERIAL ISOLATING CO-AX SOCKETS & LEAD	**30p**+3p V.A.T.
22 MFD, 315V/W Condensers 25 MFD, 300V/W, 470MFD 35 V/W 10 MFD, 250 V/W, 1000 PF 8Kv	**10p**+1p V.A.T.
200+100 325 V/W	**30p**+3p V.A.T.
100 W/W Resistor	**£1.00**+10p V.A.T.
300 Mixed Condensers	**£1.00**+10p V.A.T.
350 Mixed Resistors	**£1.00**+10p V.A.T.
40 Mixed Pots	**£1.00**+10p V.A.T.

COLOUR T/V COMPONENTS
MANUFACTURERS DISCARDED MATERIALS

VHF or UHF Varicap Tuners	**£1.20**+12p V.A.T.
Line o.p. Panels	**£1.20**+12p V.A.T.
Decoder Panels	**£1.00**+10p V.A.T.
G8 Type Yoke	**50p**+5p V.A.T.

Money returned if not completely satisfied

SENDZ COMPONENTS

2 WOODGRANGE CLOSE
THORPE BAY, ESSEX

P.P. PAID U.K. ONLY

Reg Office Only—No Personal Callers Please

TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 24 No 10
ISSUE 286

AUGUST 1974

POLITICAL CRYSTAL BALL

Amongst major items in the budgets of most households are domestic electrical and entertainment equipment. Of particular prominence is the television receiver. During 1973 the demand for colour sets and small monochrome second sets was a record. Trading this year has shown a substantial decline however.

There is an interesting side-effect to all this. The momentum produced by heavy demand was brought to a rapid stand-still. The net result is that UK setmakers have satisfied the bulk of outstanding orders and are now looking for ways of continuing production. A seller's market is now becoming a buyer's one. BREMA have been quick to see this change and have been campaigning recently to "sell" colour television once more to the public in order to keep member companies' production lines going.

The success of such a campaign will be difficult to assess. What will be rather more interesting to see is how the industry will adapt itself to the new technical developments which are now upon us. They could hardly have come at a more awkward time for the set-maker, who could find himself forced to change to new i.c.s, c.r.t.s and tuner units just when he has invested heavily in the production of the present generation of receivers.

BREMA's campaign is at any rate timely, and it probably needs to be emphasised that from the consumer's point of view the technical changes already coming in will make very little difference.

One area where a firm policy line speedily adopted would be welcome is with the Ceefax and Oracle type of TV news service. A development which is likely to take a step backwards in the current situation is domestic video recording.

There are still many engineers who choose not to partake in the current mood of gloom—there are enough technical developments in the pipeline to keep one's spirit up whatever the present difficulties on the commercial side. Nevertheless technical advance depends on some degree of market stability. It would be a comfort to think that this message may at last be getting through to the politicians who create the basic conditions that determine day to day trading.

M. A. COLWELL—*Editor*

THIS MONTH

THE NEXT ISSUE DATED SEPTEMBER SHOULD BE AVAILABLE ON AUGUST 19

Cover: The components shown on our cover this month were kindly lent to us by Forgestone Components—they are all used in the Forgestone 400 colour receiver kit.

Late Publication: We apologise to readers for late publication of this and the previous issue due to an industrial dispute within the printers.

TELETOPICS

MORE NEW COLOUR CRTs

Following our survey of the new breed of colour c.r.t.s. in June comes news of two further tubes of the in-line gun variety and of the first sets to be introduced using the new tubes—see Radio and TV Show Report. The latest tubes come from Sylvania and Mitsubishi.

Sylvania's 110° in-line gun, slotted mask, striped screen tube is a 26in. thick-neck type. The advantages claimed are that it can be used with conventional saddle- or toroidal-wound deflection yokes and that it is compatible therefore with existing TV chassis designs. This is because unlike most other tubes of the in-line gun type the scanning fields required are homogeneous instead of astigmatic. In consequence the deflection coils can be wound using existing coil-winding techniques and the tube/yoke combination is easily interchangeable with combinations at present in use. The convergence circuitry is simplified, with only some six-seven controls.

Mitsubishi's Diatron SSS range consists of factory preconverged tube-plus-yoke assemblies. These are understood to be available already for use in small screen receivers. The tubes themselves seem to be akin to the RCA/Thorn PI tube (see June 1973 TELEVISION) but the yoke is semi-toroidal—saddle-wound for horizontal deflection and toroidally-wound for vertical deflection. Once again the guns are in-line, the shadowmask slotted and the phosphors deposited on the screen in vertical stripes.

The growing variety of non-compatible in-line gun colour tubes must present something of a headache to set designers—one which the service trade is likely to have to share in due course.

REPORT ON THE TRADE SHOWS

In commenting on the annual Radio and TV Trade Shows this time last year we reported the first tentative steps by UK setmakers towards the introduction of new chassis featuring 110° colour tubes. The situation has remained very much the same ever since. Thorn's 4000 110° chassis is still regarded by them as an export chassis, there have been very few models announced fitted with the Pye group's 731 110° colour chassis, while RRI's Z179 110° colour chassis which was also announced last year is still in relatively small scale production. During the boom conditions last year when every set that could be produced was immediately snapped up there was no cause to change to 110° tubes; and now that demand has fallen substantially and there is plenty of recently installed capacity to produce 90° sets there is no very good reason to change over either. With the new types of colour tube and the simplified circuitry that goes with them in the offing there is in fact every reason to wait. It looks increasingly as if the "first generation" type of 110° colour set will be largely missed out so far as UK setmakers are concerned—a loss that few will take to heart. Several early 110° chassis from the continent, from even the most respected names, have in the event turned out to be rather troublesome.

The big event this year from the TV point of view was the announcement of the first models fitted with the new types of colour tubes—the ones that can be loosely referred to as self-converging. **Thorn** were showing the Ferguson Model 3722 which uses the 20in. Mazda PIL (as Thorn now seem to have decided to call it in preference to the previously recommended "PI") tube. A new chassis, the 9000 chassis, has been designed to go with this and features seven i.c.s. **Grundig** were showing their 14½in. colour transportable Model 1510 which is fitted with the Toshiba RIS tube and features a modular chassis with 12 plug-in modules. The only new "conventional" 110° chassis announced was the **Philips** G9, but this does not seem to be in quantity production. In fact it is important to bear in mind the difference between showing a model to the trade and going into large scale production/distribution: the former exercise is quite frequently a matter of testing the reactions of trade buyers. It certainly seems likely that it will be some months before much more is heard of these chassis/models.

Philips have now released on the domestic market their N1500 videocassette recorder—they also showed a combined VCR/CTV console. **Siemens** have announced a VCR to the Philips standard—the Videocord FM101. And **Brown Brothers** announced that a monochrome videotape recorder (Model MD75) is to be added to the Russian produced Rigonda range "next year".

An ultrasonic remote control system—giving remote control of on/off, volume, brightness, colour and selection of up to six channels—is a feature of the latest range of **Dynatron** colour receivers. The basic chassis used in these is the Pye group 731 chassis.

That apart there is little to report. It is clearly going to be a standstill year. There were a few more smaller screen mains-battery and mains only monochrome portables, and Japanese colour receivers are being generally up-dated. But we can't see very much happening until the tube manufacturers and their setmaker clients are ready to switch over to the new types of tube on a large scale and until chassis featuring some of the new i.c.s under development appear—probably at much the same time. It is worth mentioning that i.c.s, even those specifically designed for TV set use, are often around for two-three years or more before they get phased into regular production chassis—due both to the time it takes to rearrange set production and also to the difficulties that i.c. manufacturers often experience in getting satisfactory yields (i.e. the proportion of those that work to those that don't) with new devices.

There is speculation that Japan's largest setmaker, Matsushita (National Panasonic), is considering setting up manufacturing plant in the UK—following the lead by Sony whose Bridgend, Glamorgan plant is now in production. This seems to have arisen as a result of enquiries from Matsushita about TV component supplies from UK sources.

NEW GENERATION OF UHF TUNERS?

We have been accustomed in recent years to relatively simple u.h.f. tuner circuits using npn transistors. It could be however that a change is on the way. For a start it is strongly maintained in some quarters that silicon pnp transistors offer useful advantages over npn types at u.h.f.—SGS-Ates certainly think so. Their conclusions are that silicon pnp transistors are quieter at u.h.f., that because of the constructional geometry (the base width for the same noise performance can be wider) reliability is increased, that performance is more consistent and that with T-pack layout stray inductance is reduced.

A further suggestion being made is that improved performance can be obtained by using the a.g.c. potential to attenuate the signal at the tuner input by means of a pin diode network rather than using it to control the gain of the r.f. amplifier transistor by varying its bias. PIN diode attenuators operate on similar principles to the diode colour (saturation) control arrangement used in many PAL decoders—by varying the bias and hence the conduction of the diodes the signal level is controlled. By using this technique the r.f. amplifier transistor can be operated under optimum conditions while the a.g.c. controls, via the pin diode attenuator network, the level of signal fed to it.

These two changes could therefore lead to a new generation of u.h.f. tuners with improved noise performance and greater reliability.

A further point put forward by SGS-Ates is that their BF479 silicon pnp transistor is highly suitable for driving the acoustic wave type of i.f. filter mentioned last month (page 402). A silicon pnp tuner driving a further silicon pnp transistor which is coupled to an i.f. integrated circuit by means of an acoustic wave filter is suggested by them as being the possible future receiver section of a TV set.

A NOTE TO SONY—AND OTHERS

We were interested in the reports of the joint RTRA/Sony conferences held earlier this year. Martin Morcom, Sony's technical training manager, made the very relevant point that if receiver reliability is increased faults become more random, in turn calling for greater skill in fault finding. Sony are willing and able to help dealers in training their engineers he commented. Sony's service manager Tony LaCroix enlarged on this theme: some of the enquiries Sony received from puzzled engineers seemed to indicate a fundamental lack of knowledge of the basic principles of television and especially of the modern colour chassis he said. Well now that's all very well but we've an alternative explanation to offer and a simple suggestion to make. It so happens that we know engineers who have worked on and are familiar with Sony colour receivers. They generally know what stage is at fault and go straight to it. The circuit has the voltages—printed in a second colour—alongside each transistor lead so that nine times out of ten the fault can be quickly cleared. But what about the tenth time, which could be when the puzzled engineer gets in touch with Sony? This could be when the simple steps outlined above fail to reveal the fault and the circuit diagram must be consulted to see what else could cause the trouble. And this is where we feel a lot of the difficulty arises. Messrs Morcom and LaCroix, your circuit diagrams are a diabolical mess, a maze of spindly lines criss-crossing all over the place, of components plonked here there and everywhere regardless of their function in the circuit, and with the whole thing laid out in an utterly confusing manner: you deserve to have your 'phones buzzing day in and day out with angry engineers for perpetrating such a mishmash. To be fair however Sony are by no means the worst offenders in this respect—some Japanese and continental circuits are fiendish. Nevertheless since Sony use some unique circuitry the onus is surely on them to make everything doubly clear.

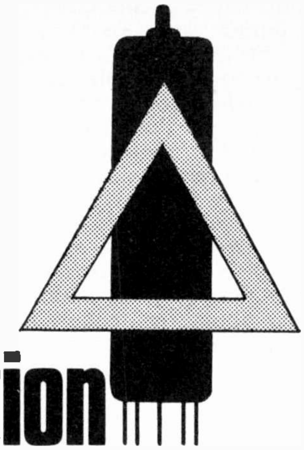
It is about time there was a campaign to do something about this problem of circuit diagrams. Why is the modern draughtsman incapable of laying out a circuit so that d.c. feeds and signal paths can be easily followed, so that rectifiers aren't confused with clamps, so that filters can be clearly seen to be what they are, so that decoupling points are made plain and so on and so on. One possible reason is that senior draughtsmen are not regarded by firms as the key men they are. If they are not fully briefed on circuit operation but simply regarded as producers of "finished artwork" the sorts of results all too common are only to be expected. An improvement on many continental circuits would be simply to clear out all those tints and multi-coloured effects that some firms seem to love: a circuit which is not easy to follow in the first place is made much worse when it has been plastered with multi-tone tints and symbols.

If circuits are clearly laid out so that circuit operation is immediately obvious it is likely that a lot of training seminars would prove to be unnecessary–a glance at the circuit would reveal all. Likewise servicing would be much simplified. So get cracking someone, please.

CIRCULAR POLARISATION

An interesting experiment is being carried out by the American Broadcasting Corporation at WLS-TV, Chicago to determine whether circularly polarised TV transmissions using a new aerial developed by RCA can give a significant improvement in reception in heavily built-up areas. During the tests transmissions will alternate between circular and horizontal polarisation. The use of circular polarisation is expected to improve reception by viewers using set-top aerials, particularly of the bisquare type.

Line Output Stage Protection CIRCUIT



K. CUMMINS

FOR years television engineers have been familiar with the unhappy sequence of events which can follow a quite simple initial breakdown in the line timebase. The problems arise because the line output valve is biased negatively at its grid only as the result of grid current flow derived from the drive waveform. Thus in the event of failure of the line drive the valve is left unbiased and conducting heavily. This large current flow can cause damage to the line output valve and boost diode before a fuse or thermal trip finally disconnects the power supply. It is possible therefore for failure of the line oscillator to result in the need to replace both the line output valve and the boost diode. Heavy current flow can also damage the line output transformer if the fault condition remains on for too long a period.

Another condition that can cause damage to the valves is a short-circuit in either the scanning coils or the line output transformer. The driven line output valve then operates into a much lower impedance than is normal and the current drawn is again excessively high, resulting in glowing anodes and other signs of circuit distress.

Now is all this necessary? I suspect that thousands of line output valves have been destroyed unnecessarily because no circuit has been employed to prevent such occurrences. It is simpler to use the conventional circuitry of course, but a protection circuit does not have to be extremely complicated.

When first confronted with the thought that something could be done to improve the basic line output circuit I felt that if a simple addition could be made, capable of protecting the receiver against the majority of faults listed below, this would be well worth while.

Basic Requirements

The basic requirements of the circuit were as follows. First, in the event of line oscillator failure the line output stage should be cut off. Secondly, if the boost diode should fail by becoming open-circuit the current in the output valve's screen grid circuit (now that the anode voltage has been removed) should be held to a safe value. Thirdly, in the case of the boost diode, line output transformer or scanning coils developing a short-circuit the current should still be held down to a safe value.

As regular readers may well have surmised, the protection circuit was put to the test in the 625-line receiver. The output valve used in this is now a PL504 instead of the original PL36.

Operation of the Protection Circuit

The protection circuit is shown inside the dotted line in Fig. 1. The heater circuit for the series valves has been modified so that the transformer is earthed at one end instead of earthing the centre point of the heater chain. By this means a 75V a.c. supply is made available for the protection circuit. It will be seen that the new circuit is an addition to the original which does not have to undergo any substantial changes. Under normal conditions the voltage dependent resistor rectifies the asymmetrical pulses fed via C35 from the line output transformer. The negative bias developed in this way is cancelled to the required degree by the positive feed from the boost rail to the width control. The resultant bias applied to the grid of the output valve determines its working point. It will be seen however that in comparison with the original circuit the VDR is now connected to capacitor C3 instead of to earth, the output valve grid being returned via R51 and R3 to the upper end of the VDR. C2 provides decoupling, and diode D2 is called the protection diode.

When the receiver is first switched on the 75V a.c. supply is peak rectified by D1 to produce nearly −100V d.c. across C1. This is applied via R2 to the VDR, protection diode D2 and C3. The VDR's impedance is very high at this relatively low voltage and the negative voltage at D2 cathode causes it to conduct thereby producing a large negative bias at the grid of the line output valve.

As the valves warm up the line drive waveform appears and is applied to the grid of the line output valve. The positive part of the waveform drives the

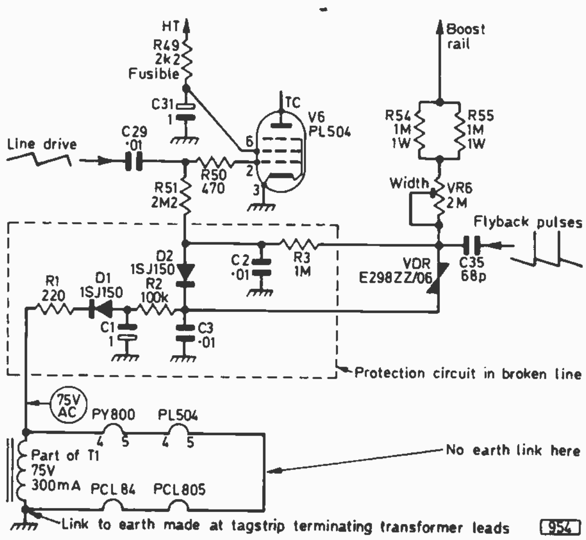


Fig. 1: Circuit devised to provide line output stage protection. Component ratings: R1-R3 ½W; C1 160V; C2 and C3 400V.

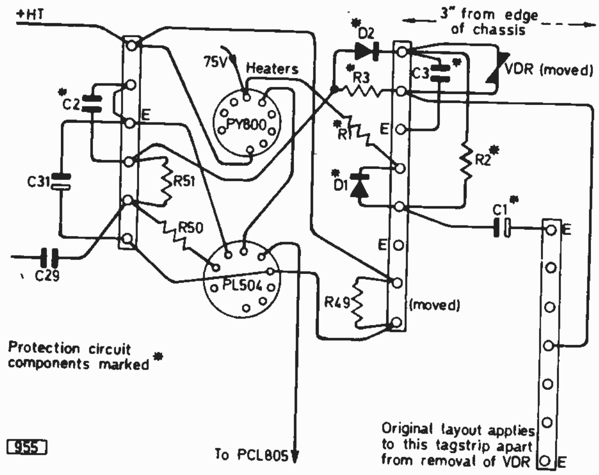


Fig. 2: Layout of the circuit as used in the "Television" 625-line receiver.

valve into conduction, and flyback pulses from the line output transformer are applied to the VDR via C35. These large positive pulses cause the VDR to conduct, thus charging C3 positively and off-setting the negative bias fed through R2. As a result D2 cathode moves positively towards earth potential. The VDR is also carrying out its normal function however so that from its upper end a negative stabilising bias is applied via R3 to the output valve grid circuit. Thus D2 is now reverse biased and non-conductive. D2 cathode assumes a level of 10 to 20 volts negative under normal conditions.

Practical Effects

Consider what happens should the line oscillator fail. No pulses are fed back from the line output transformer and in consequence the rectified bias at D2 cathode is not cancelled. Even taking into account the positive feed from the boost rail (which in these circumstances is below h.t. level) the bias at the output valve grid is around −80V, quite sufficient to turn it off.

Failure of the boost diode was simulated by removing its top cap. Under these conditions the boost rail voltage falls to zero and even with drive present the current in the line output valve was found to be below 40mA. The screen grid seemed to be quite tolerant of this situation, no unhealthy glow being present.

The final test involved shorting out the scanning coils. Under normal running conditions the line output valve's cathode current is 125mA. With the short-circuit applied this increased to 150mA. Disabling the protection circuit under these conditions (by shorting out C3) resulted in a current flow of over 400mA, and rising! Thus the action of the protection circuit was proved to be satisfactory.

Screen Grid Protection

As an added protection the PL504 screen grid feed resistor was changed to a fusible 2·2kΩ type. This will trip in the event of a screen to grid short developing in the valve. Should the valve develop a grid-cathode short the h.t. fuse will blow but there is still risk of damage to the boost diode.

Conclusion

This modification provides a high degree of protection against heavy current causing excessive damage—even fire—in scanning components. The width stabilisation action against mains voltage fluctuations is assisted since the negative bias decreases with falling mains, so tending to increase the output current flow.

The layout of the revised circuit as used in the 625-line receiver is shown in Fig. 2. The circuit can be applied to any receiver of course, but some component modification may be necessary. Where a series heater chain is fed directly from the mains supply 75V can be tapped off at an appropriate point along the chain.

The circuit provides little difference in terms of receiver performance but it is reassuring to know that potentially expensive multiple line output stage failures have been rendered an unlikely occurrence at the expense of pence only. ■

THREE IC PAL DECODER FROM MOTOROLA

A three i.c. PAL colour decoder design has been announced by Motorola. This uses two new i.c.s in conjunction with the now well-established MC1327 colour demodulator/PAL switch/RGB matrix i.c. The new i.c.s are the TBA395 and TBA396. The former incorporates most of the chrominance channel, including the a.c.c. and colour killer operations, along with the burst channel and the reference oscillator with its control loop. This particular i.c. has in fact been in use in Thorn's 4000 chassis for a while now. The TBA396 is referred to as a "luminance combination", containing the luminance channel and providing for contrast and brilliance control, beam limiting and black-level clamping, but also receives the chrominance signal from the TBA395, provides saturation control (which tracks with the contrast control) and drives the chrominance delay line. Simple RGB output stages without the need for feedback can be used. Few external components are required—there are no additional semiconductor devices anywhere—and the whole decoder can be built up on a board only 5 1/10 x 5 9/10in. Incidentally the MC1327 is now multi-sourced—as are several other Motorola i.c.s. Translating from the industry's increasingly vile jargon this means that other i.c. manufacturers now produce it under license to Motorola.

TV GAME

A TV game system known as Odyssey is now being distributed in the UK. Twelve games are supplied with the system, each having its own programme on a separate logic card. The unit is powered by a 9V battery and is connected to the TV set used as the display by means of a coaxial cable which feeds into the set's aerial input socket. The price is around £110 including tax.

SERVICING television receivers

L. LAWRY-JOHNS

TCE 1590/1591 CHASSIS

THE Thorn 1590 chassis is used in a series of 12in. mains-battery portable models with a circular aerial and an earphone socket among the features. Models include the Ferguson 3816, Marconiphone 4816 and Ultra 6816. A variation in a larger cabinet with a 14in. tube and different controls is the 1591 chassis used in the Ultra Model 6818 and also the Alba Model T14. A fair number of modifications have been made during production, mainly to the field timebase and the audio circuits.

These are nice little sets. They are generally quite reliable and given a reasonable signal input are capable of displaying a good, well defined picture. They do not have the gain of some other portables but give good results in most areas and bearing in mind their very reasonable price (less than most) represent good value.

Designed to receive u.h.f. signals only on 625 lines, the simple four-button tuner is the same as that used in larger screen models of the same vintage, i.e. the push-bar type where the bar rotates the tuning gang tensioned by a spring which resists the inward movement of the selected button spindle. The advantage of this mechanical system is its simplicity, the disadvantages being outlined later.

Apart from the four buttons the only other control on the front of the 12in. models is volume-on/off. This is not as simple as it looks as it has to do a bit of battery as well as mains switching. With the switch in the off position the tube cathode is returned to chassis to discharge the e.h.t. quickly and thus avoid a lingering spot. The larger model (1591 chassis) uses a somewhat different arrangement with a separate on/off button at the bottom and edge-type volume and brightness controls which peep through the top.

Access

1590: Cabinet removal involves pulling off the front volume control knob, laying the cabinet face down, removing the two bottom front screws and the two rear cabinet screws and feeding through the mains cable as you lift the shell off. This allows most parts to be got at without further dismantling but there are times when the panel has to be lifted out to expose the front end and in this event the front centre screw and the two side screws (securing the panel to the supporting struts) have to be removed. This is where an eye must be kept on the leads which are mainly of the wrap round variety except those to the VT21 voltage regulator transistor—these can part company with the pins but being in sleeving appear to be connected until the sleeving is pulled back.

1591: Lay face down, remove the two side screws and the top two and lift off. In fact it is not necessary to lay the set face down in order to clear the shell but it does seem to come off easier this way. The chassis can be swung up by removing the two screws securing the side angle struts.

When reassembling the 1590 do not forget to check that the insulators are fitted under the front end (the idea is to prevent the cabinet screws penetrating through to the printed board).

Power Supplies

These sets can be operated from the standard a.c. mains or from a 12V battery: d.c. mains cannot be used.

On battery operation correct polarity must be observed: reversing the supply will result in fuse F2 blowing. The battery supply lead has one wire marked with a red sleeve to indicate the positive connection. Diode W6 is connected from the fuse to chassis. This diode normally does nothing: should the supply be reversed however it conducts and fuse F2 fails thus protecting the rest of the circuit.

When used on mains the supply is taken via a 250mA fuse (F1) to the primary winding of the step-down transformer T1. The secondary winding is centre-tapped to chassis and supplies about 15V to the full-wave rectifiers W7 and W8. The rectified output of about 16V is fed to the battery supply socket switching and then to the 2.5A fuse F2 where it fills up the reservoir capacitor C85 and feeds the audio output stage direct while the rest of the set is fed via the regulator (VT21/VT22) which maintains the supply line at a little under 12V when correctly set up.

The series regulator transistor VT21 is an AD149 type fitted on a separate heatsink above the main panel since it normally runs quite warm. The voltage sensing transistor VT22 should not run warm. If it does check the setting of R104 and the value of R103 and R106. The voltage at VT22 base should be 5V. VT22 can become defective and completely upset the voltage regulation. In the event of the regulation being impaired check these points and zener diode W17 (D32) which we found to be at fault on one occasion.

Intermittent Supply Fault

Before leaving the subject of the power supply we

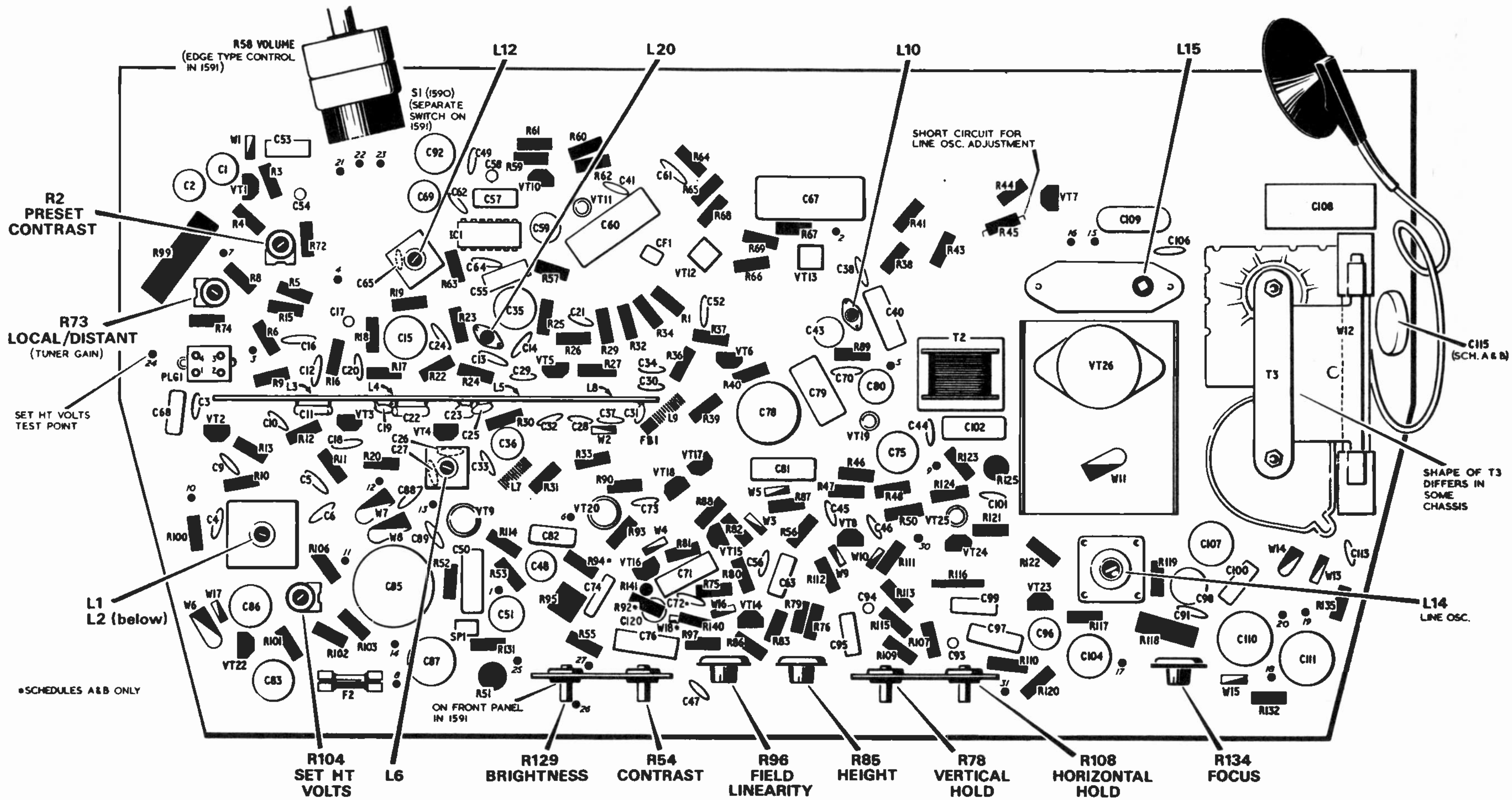


Fig. 1: Layout of the printed panel.

Service Notes: The c.r.t. has a 20mm neck with all-glass base. Take care when handling to avoid breaking the sealed-off tubing which projects through the centre of the base. Tube types: CME1220 (12in.), CME1420 (14in.). Correct line hold setting is when the picture is centred and free from foldover. R73 is normally set fully clockwise (maximum gain): back off if cross-modulation is experienced in strong signal areas. R104 is set for exactly 11.6V between tag 24 (HT1) and chassis. To tune the line oscillator short-circuit VT7 collector to chassis—the picture will then float—and adjust R108 for 4V at its slider. Then adjust L14 for a floating but resolved picture. Remove the shorting link. If necessary centre the picture with the shift magnets.

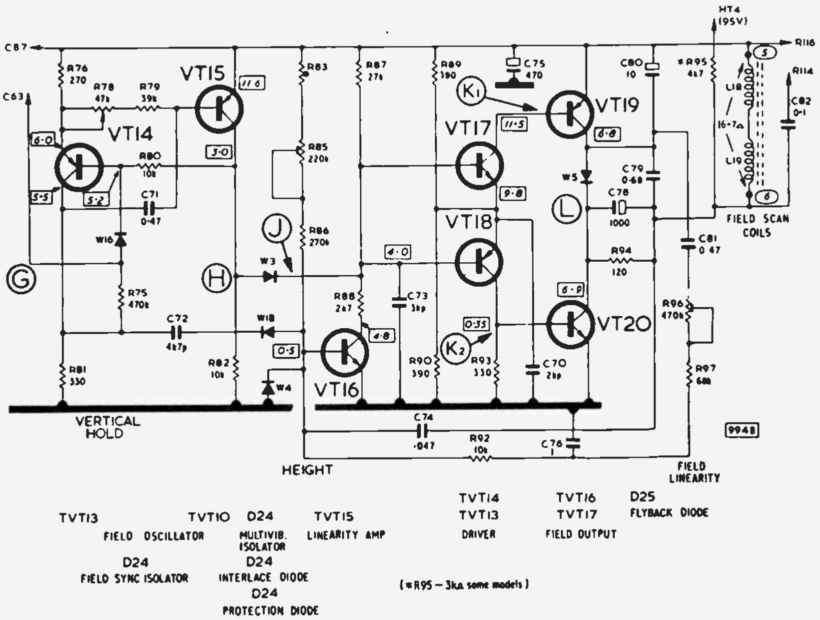


Fig. 2 (left): The field timebase circuit used in Schedule A and B versions of these chassis. The same basic circuit (the complete circuit diagram will be given next month) is used in later versions but with a considerable number of component modifications. R95 provides field d.c. shift, C79 provides field flyback tuning in conjunction with the scan coils, C73 damps the input to VT17/VT18.

would mention an intermittent fault condition which we encountered very recently. An Ultra 6818 was brought to us with the complaint that although it had been taken back to the original suppliers several times the same fault recurred following a short period of use after its return from them. The owner stated that the set would function for a certain period (which varied) quite well when suddenly the picture would distort and the sound would go "gurgly". We removed the cabinet shell and had an exploratory tap around with the set working. "That's it" shouted the owner as we gently tapped the main electrolytic C85.

We examined the print for dry-joints without finding anything wrong and concluded therefore that the capacitor's leadout tags were at fault. These were concealed by the panel and the base insulating washer of course. We removed the solder from the joints with desoldering braid (the sucker pump being less in favour of late) and lifted out the offender. A hammer and a disused screwdriver blade were employed on the leadout tags to improve the contact with the rivets and the capacitor was replaced in the set. No amount of tapping or rocking would subsequently disturb the well defined test card being displayed or the lively Spanish style music issuing from the small loudspeaker.

Breathing modestly on our finger nails and polishing them on our coat lapel we reassembled the shell and bid a cheerful farewell to the happy owner who promptly tripped ass over tip over our collie who had carefully laid immediately behind him. Ben (the collie) lost his haughty demeanour (which he had adopted ever since he saw an old "Lassie" film one Saturday morning) and fled yelping, leaving tuffs of fur all over the place. We put the set back on the bench but it was quite unruffled by the incident. "Just part of the test routine" we murmured brushing hairs off the poor fellow's coat."

A Case of Bent Verticals

In another recent case bent verticals could not be cured by checks on the smoothing capacitors or the line timebase. A new BC147 regulator control transistor completely cleared the trouble.

The Tuner Unit

As previously mentioned the tuner unit is a standard Thorn type, using an AF239 or equivalent r.f. transistor and an AF139 oscillator-mixer. Being simple in operation it does not give much trouble apart from one or two common failings.

The most obvious is a mechanical one which is easily remedied. When the channels received are at the low end (say 20 to 40) of the band the bar is pushed well back to the rear, thus stretching the return spring and exerting maximum strain on the bar which tends to pull out of its slots. Although it may pull out on only one side the tuning is completely lost. Sometimes the bar may be found hanging from the spring or even laying in the bottom of the cabinet. When it has been slotted back into position (the right way round) and soldered (and the tops of the slots closed) the spring may be stretched slightly to relieve the strain if the upper channels are not used. Stretching the spring is not such a good idea on a portable however since it may be used in several different areas, say London during the week and around Dover at the weekend, representing the two ends of the tuning range.

The necessity to retune the buttons frequently is often due to poor contact inside the tuner between the spindle leaf springs and the body of the tuner. The procedure required is to remove the several springs with a large soldering iron, clean thoroughly and replace. Squirting quantities of cleaning fluid on the inside of the tuner is no solution to the problem and in some circumstances can damage the tuner.

The usual remarks concerning faulty transistors apply of course. Weak and grainy reception in a situation where reception is normally good should direct attention first to the aerial and the feeder connections and then to the tuner, checking vane

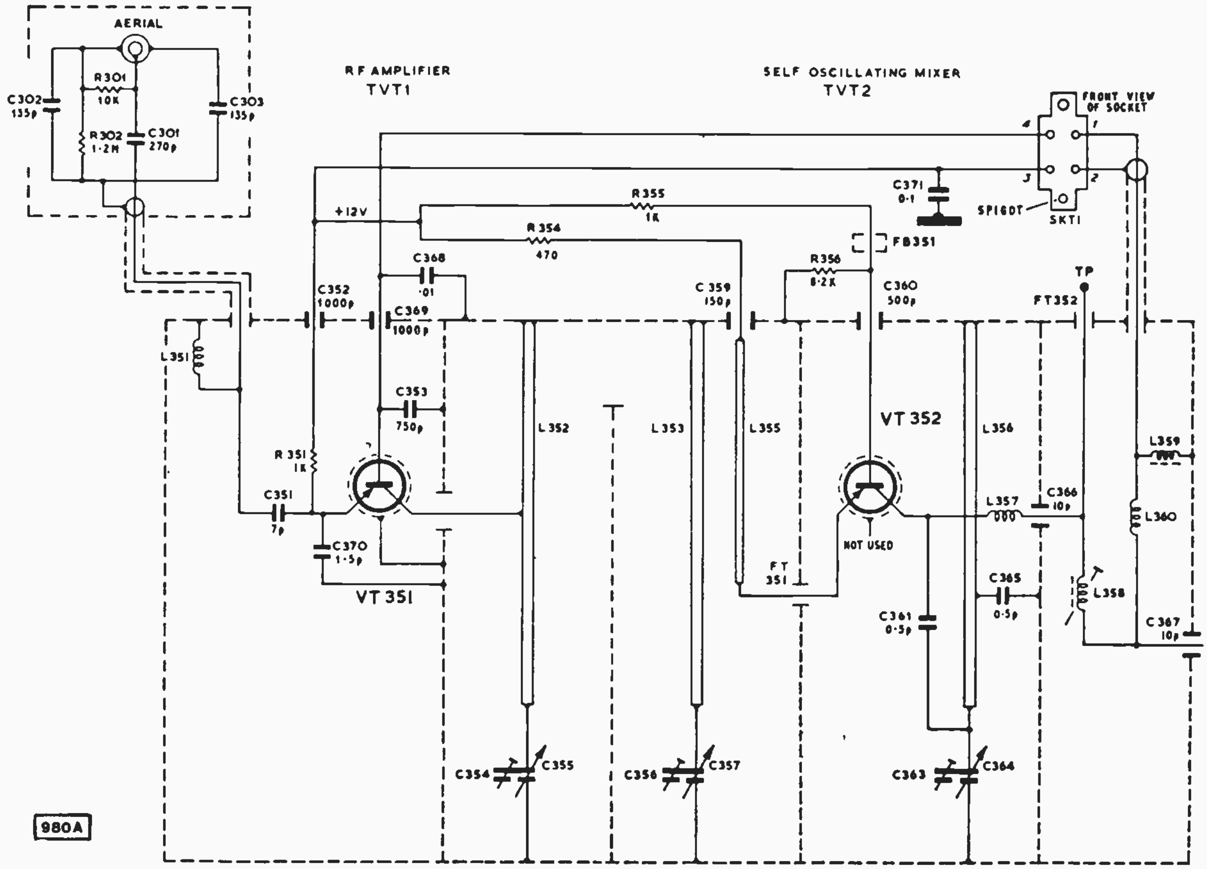
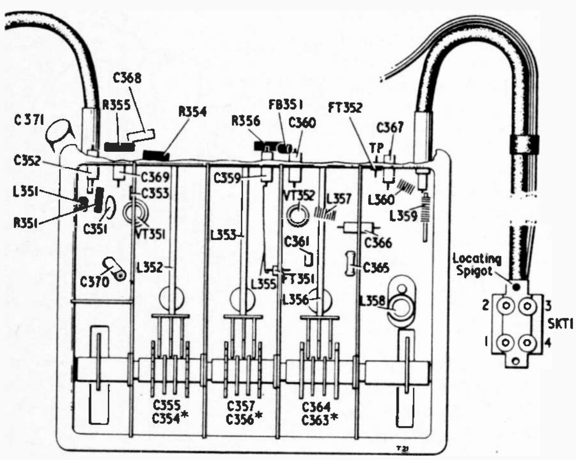


Fig. 3: Circuit of u.h.f. tuner type T21-200 used in the 1590 and 1591 chassis.



*Adjustable fins at rear of gang rotors

Fig. 4: Tuner unit component layout

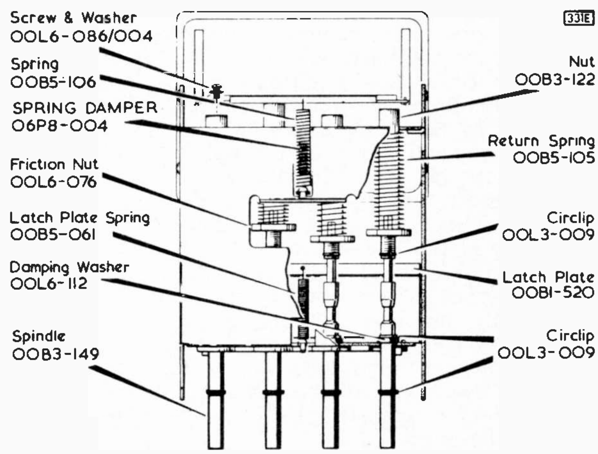


Fig. 5: Tuner push-button mechanism.

clearance etc. Check the base voltage of the r.f. amplifier at pin 4 of the socket and at capacitor C368 on the tuner where 9V should be recorded if the local-distant control is set to maximum. Variation of this control (R73) should affect the voltage across the emitter resistor of the r.f. amplifier transistor VT351. This resistor (R351, 1kΩ) should record the current passed by VT351. 12V at its supply end and the same at the VT351 emitter end indicates that there is no current passing and with 9V or lower at VT351 base offers a good case for suspecting the transistor which should then be checked by the usual back-to-front resistance tests with an ohmmeter. Replacement is not difficult in this type of tuner, using a small iron and the right type of tweezers. An AF239 can be used as a replacement for the Thorn TVT1.

CONTINUED—WITH FULL CIRCUIT—NEXT MONTH

CCTV

PART 5

Peter Graves

THIS article deals with some practical aids to setting up and testing CCTV equipment. They can be easily built and do not require elaborate setting up or calibrating. Three separate items are described—plug-in terminating resistors, a video switch box and a camera video amplifier gain checking and setting jig.

Plug-in Terminating Resistors

A coaxial cable which is used as a video or pulse distribution line must be terminated at the far end by a resistance equal to the cable impedance (for CCTV work 75Ω coaxial cable is most common though 51Ω cable is occasionally found). If the cable is incorrectly terminated or not terminated at all there will be a mismatch and some of the signal fed in at one end will be reflected back down the cable and interfere with subsequent signals. A full explanation, which we won't go into here, can be derived from transmission line theory. As an example, suppose we have a camera feeding two monitors (Fig. 1). The far end of the coaxial feeder is terminated in 75Ω—that is a 75Ω resistor is connected between the inner of the coaxial cable and its outer screen. The camera output stage is designed to work most efficiently when it "sees" a load of 75Ω connected to its output socket. Under the above conditions the terminated cable is correctly matched to the camera output and no unwanted reflections occur. This is a simplified explanation. Note that the input impedance of the monitor amplifiers is much greater than 75Ω (10kΩ is typical). They thus have negligible effect on the matching of the line—in the same way that a 'scope probe has little effect on the circuit being monitored.

Suppose we wish to set up the camera or fault find in the absence of the two monitors and the line. It is still necessary that the camera output "sees" 75Ω and this is done by inserting a temporary plug-in terminating resistor at the camera output. The camera is again correctly matched and setting up may be done.

If ghosting or low-level signals are experienced in a system look out for double termination—where the line has been accidentally terminated in two places. Signals of higher level than usual may mean no termination or an open-circuit terminating resistor.

Fig. 2 shows a cross section through a typical plug-in terminating resistor (or "stuffer" as they are loosely called) made up in a PL259 plug—a common type in CCTV work. The outer shell which screws the plug to the socket and completes the earthing has been omitted to simplify the diagram. To increase the usefulness of the device a short length of insulated wire is taken from the inner pin (wrap it round the resistor's lead, insert both together, then solder) and brought out of the rear of the plug. It is then stripped and the inner is formed into a small loop which is tinned to make it rigid—this forms a connecting point for an oscilloscope probe since inserting the plug may deny access to the output terminal. Take care that the construction is sound.

If desired the finished plug can be filled with liquid rubber or epoxy resin to keep out the moisture.

The basic idea can be adapted to any type of plug to suit the installation and one or two terminating resistors are an essential component of the CCTV engineer's tool box.

Video Switch Box

We saw one use of this item in last month's article—as an aid to setting the black levels in a multi-camera installation. Basically a video switch box is used to select the output of one of a number of cameras, for test purposes or for use in installa-

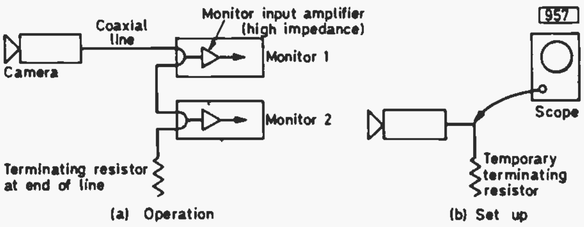


Fig. 1 (above): Examples of the use of terminating resistors. For clarity, the earth returns are omitted.

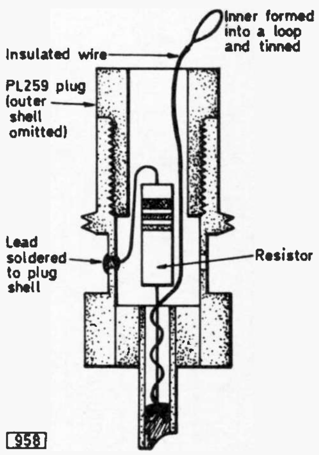
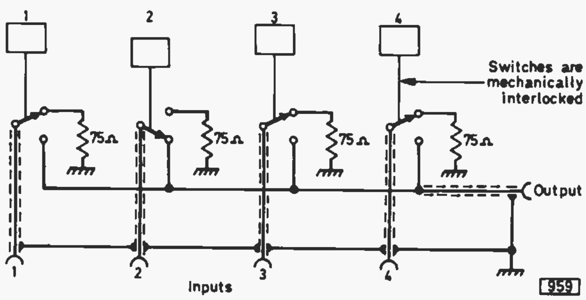


Fig. 2 (right): Cross-sectional view of an easily made plug-in terminating resistor with provision for making tests.

Fig. 3 (below): Circuit of a four-position video switch box. Shown with camera 2 selected.



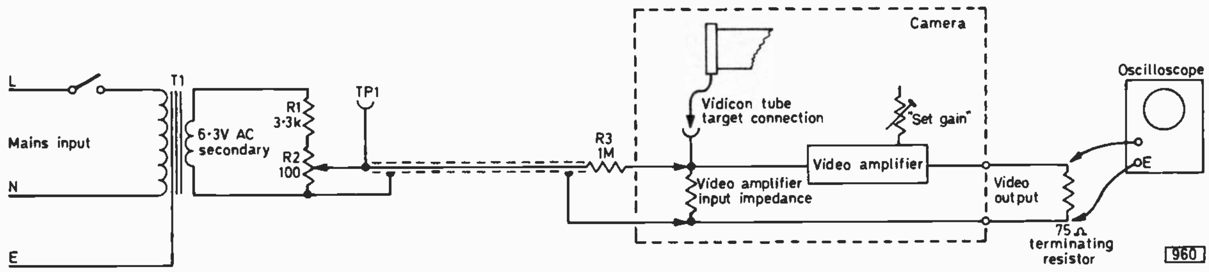


Fig. 4: Circuit and use of the gain test jig.

tions that do not warrant the more sophisticated (and more expensive) video mixer. For example a security surveillence system, say at a factory, with several cameras would be provided with a video switch box to allow the security guard to select the picture required.

As the circuit diagram (Fig. 3) shows, the unused video inputs are all terminated. This ensures that the output voltages of the unused camera output stages do not rise, as they would if they were off load, to the possible detriment of the components. The switches are mechanically interlocked, like the waveband selectors on a radio, so that only one can be depressed at a time. It is often possible to run a bus bar of tinned copper wire along the output contacts of the switch and another one along a set of unused contacts to act as a common earth for the terminating resistors. The input sockets are connected to the common switch connection of the appropriate switch with screened lead, the screens being earthed at the input socket. A diecast box is a convenient chassis and also provides complete screening for the unit.

Camera Amplifier Gain Test Jig

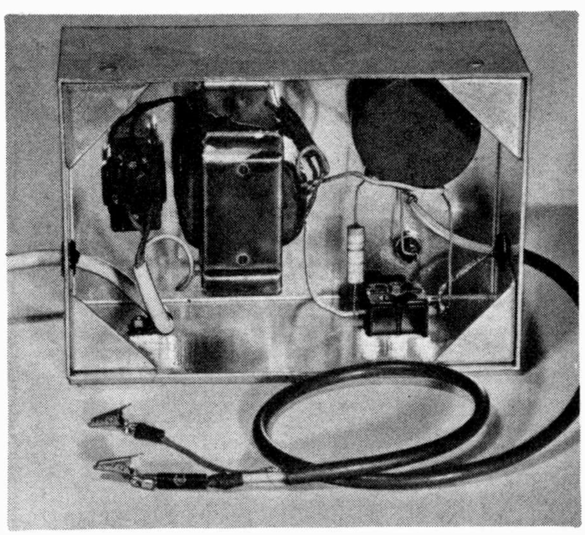
The level of the output signal from the vidicon target connection depends on many factors—such as target voltage, lens aperture, lens quality and cleanliness, scene illumination, vidicon quality and age, vidicon supply voltages, etc. It will be realised from this that unless all these factors can be kept under control and exactly specified it is not easy to set the video amplifier gain by observing the signal level at the video amplifier output when a certain scene is viewed.

What is needed is a test signal of known level that can be injected at the input of the camera amplifier: the output can then be monitored and the *gain* control set accordingly. The level of the test signal must be about the same as the signal we would expect to get from a vidicon in normal operation however—i.e. a maximum of 0·3μA peak-to-peak, a delicate and expensive equipment.
level we cannot measure directly without sensitive,

Fig. 4 shows how we can achieve the desired end with a reasonable degree of accuracy and simple gear. T1 is a standard 6·3V (r.m.s.) heater transformer. R1 and R2 form a potential divider across the secondary winding, their values being chosen so that approximately 500mV peak-to-peak (note peak-to-peak, not r.m.s.) appears across R2 which is variable. Thus the voltage at the slider of R2 (with respect its the "bottom end") can be varied from 0V to 500mV peak-to-peak. The slider connection is taken to a test point (TP1) and along a coaxial output cable (standard 75Ω type) whose screen is connected to the bottom end of R2. The inner of the cable—which is approximately 2ft long—is connected at its far end to a 1MΩ resistor, the joint being strengthened and insulated with a rubber sleeve. The other end of the resistor is connected to a miniature crocodile clip—or it may be more convenient to leave it as just a wire which is soldered temporarily to the amplifier input. This arrangement, with the resistor at the far end of the cable, minimises capacitive loading of the amplifier input. The cable screen is teased out to form a "tail" which is also connected to a crocodile clip—the tail should be insulated with sleeving to prevent accidental short-circuits.

If the input impedance of the video amplifier is substantially less than 1MΩ, as it usually is, then with the jig connected as shown in Fig. 4 300mV peak-to-peak—set by R2 and measured at TP1—applied across 1MΩ will give rise to a current of 0·3μA peak-to-peak flowing round the circuit and hence through the input of the video amplifier. 300mV is big enough to be easily measured with a 'scope. Thus we have provided the amplifier with a known input current and all that remains is to monitor the output and set the gain accordingly.

Fig. 5 shows the sort of output waveform that can be expected. The 'scope timebase should be set to approximately frame rate (50Hz). If the frame sync pulses are used to lock the 'scope and the frame timebase of the camera is not locked to the



Gain test jig made up by the author.

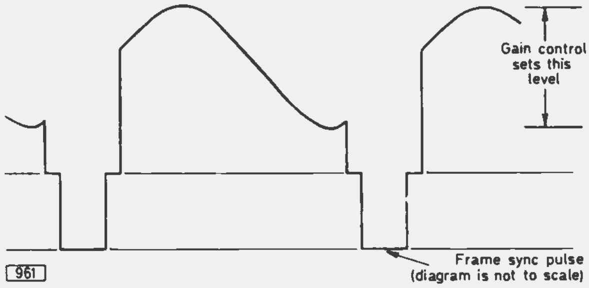


Fig. 5: Typical camera output waveform obtained when using the gain test jig.

mains then sinewaves will slowly drift through the picture.

A typical set up procedure is as follows.

Terminate the camera output, switch on and allow to warm up and become stable (say 15 minutes). Then set the h.t. rail voltage(s) where applicable. Switch off and remove the vidicon or disconnect the target connection. Reduce the target voltage to zero with the *target limit* control. Connect the jig to the chassis and to the target lead connection (video amplifier input). Switch on the camera and gain jig.

If a *peak white clipper* is fitted it should be adjusted for minimum clipping. With the 'scope probe of a calibrated oscilloscope on TP1 (earth connection to the camera chassis) set the voltage at this point to 300mV peak-to-peak with R2. Transfer the 'scope probe (changing range!) to the terminated output where a waveform of the type shown in Fig. 5 will be seen. If the base of the sinewave is clipped raise it up using the *black level* control (this does not affect the gain). Then adjust the *gain* control for the appropriate peak-to-peak level of the sinewave part of the output waveform. This should be 0·7V for a 1V overall composite output signal (from peak white to the start of the sync pulse—the sync and blanking levels are set separately) and 1·0V for a 1·5V overall signal.

Switch off, remove the gain jig, reinsert the vidicon and carry out the rest of the setting up. The *gain* control may now be sealed with a blob of wax or paint. It is a good idea to mark the position of the slider in some way so that if it is accidentally adjusted (say in mistake for something else, which is very easy to do) it can be reset without having to go all through this procedure again.

Some more sophisticated cameras have an auxiliary *gain* control on the front panel. This enables the video amplifier gain to be increased (at the cost of increased noise level) to compensate for low light conditions or vidicon ageing (or a combination of these). The main *video gain* control referred to above is hidden away as it is not adjusted very frequently. During normal operation or during setting up the auxiliary control is turned to its minimum gain position. Then if conditions require an increase of gain this control can be used: when returning to normal lighting conditions or when a new tube is fitted, reduce the control to its minimum setting again so that the gain is at its normal value. Always make sure that this potentiometer is at its minimum position (fully anticlockwise) before setting up the video amplifier gain.

CONTINUED NEXT MONTH

LONG-DISTANCE TELEVISION

ROGER BUNNEY

THE long awaited Sporadic E season has arrived at last and by all accounts is giving most enthusiasts excellent signals at high levels. The start of the season this year was for some reason delayed: there were several minor openings early in the month but by the middle of May things were beginning to swing. From reception observed so far long-hop signals seem to predominate, with a bias towards the South-East—Yugoslavia/Italy seem to be well favoured, also the USSR to the East. Shorter-hop signals—from Spain and Central Europe—are for the present missing. Several test card changes have already been noted and there has been the inevitable crop of mystery signals. Receptions of the latter type have been notable indeed!

Ian Beckett (Buckingham) received on May 17th at 1936BST on ch. E3 a coloured gentleman speaking in English with a medical programme. The signal was also present on ch. E2 on sound only (a local ch. B2 transmitter effectively obliterates E2 vision). The signal faded at 1959. For my part I noted earlier in the month on ch. E2 and 3 a long discussions group with coloured gentlemen, some dressed in traditional African costume. The signal again faded just before 2000. I feel that both these signals may have originated from RTP (Portugal) but please has anyone else seen such signals at these times on ch. E2/3?

JRT (Yugoslavia) was noted in several openings using the FUBK card with the indentification "JRT ZGB 1" across the central black area. SR (Sweden) has been seen using a simple type tuning caption: this consists of a central circle containing the head/shoulders of a young girl and beneath her but still in the circle a colour bar/grey scale. A further identification is carried in the top left-hand corner "TV 1" MT (Hungary) has made slight test pattern changes—the new identification carries the network, e.g. "MT 1 Budapest". The Telefunken T05 card is still around on ch. R1/E2a—it is used at times by ORF (Austria). On May 2nd I noted via MS (Meteor Scatter) a blockboard pattern similar to the PM5552 (as used by NOS Holland) but carrying a prominent white vertical bar at the bottom right-hand side. We can also now confirm that the PM5544 card with the darker background and less the side panels is in fact TVP (Poland).

Prolonged high-pressure systems over the UK gave a lift to the tropospherics during May 18-20th. Two new ORTF-2 transmitters were noted here and a rather startling find was the appearance of the PM5544 (again) on ORTF-2 during the afternoon periods—less the side panels and with the identification "ORTF" in the upper black rectangle. Is there no end to this card?

Since we have numerous news items to report this month I'll limit my log to the more important receptions . . .

2/5/74 Mystery blockboard pattern at 1306 on ch. E4 (see above).

7/5/74 Improved MS. DFF (East Germany) E4; TVP R1; CST (Czechoslovakia) R1; TVE (Spain) E2; Swiss E2. Also TVE E2, 4 via SpE.

10/5/74 Good SpE opening. JRT E3, 4; CST R1, 2; WG (West Germany) E2: ORF E4; RAI (Italy) IA.

14/5/74 Improved trops into ORTF.

15/5/74 Good SpE. JRT E3, 4; RAI IA, IB; WG E2.

18/5/74 Good SpE. JRT E3, 4; RAI IA, IB; TVE E2, 3, 4; plus unidentified signals.

19/5/74 Fair SpE. A mid-afternoon opening, mainly unidentified programmes plus TVE E2.

20/5/74 Excellent SpE. USSR R1, 2, 3, 4; SR E2, 3, 4; NRK (Norway) E2, 3; YLE (Finland) E2. Signals were maintained at high levels; there was a new R3 TSS (USSR) reception and a welcome visitor—YLE!

24/5/74 Good SpE. TVR (Rumania) R2, 3 (good signal on R3); TSS R1, 2; MT R1. TSS on R2 had a really strong CST electronic pattern with "EESTI" identification.

25/5/74 A fair SpE opening at 1800. TVP R1, 3; MT R1; 3; TSS R1; RAI IB.

26/5/74 Good SpE opening. TSS R1, 2, 3, 4; MT R1; CST R1; ORF E2a; JRT E3. Also many unidentified signals.

27/5/74 A good virtually day-long SpE opening. TSS R1, 2; CST R1; YLE E2; SR E2, 3, 4; NRK E2, 3, 4; JRT E3, 4; RAI IA. Also many unidentified signals.

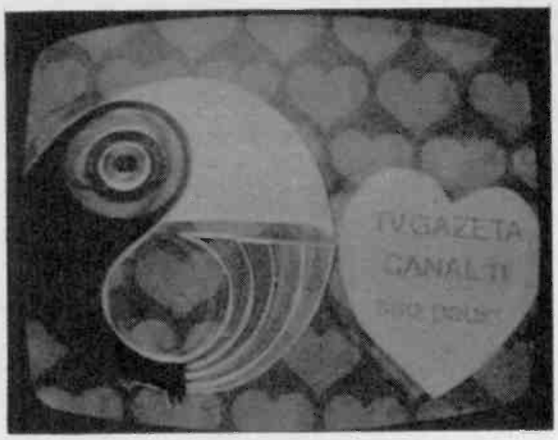
In addition to the above loggings there were the usual MS activities on most days, including my usual DFF (East Germany) signal on ch. E4 from Cottbus.

Over the Whitsun period (May 26th, 27th) I had the pleasure of a visit from Hugh Cocks, Keith Hamer and Garry Smith—all well known, active DXers. Many aspects of DX-TV were discussed. One thing which has often been noticed and came up again is that during SpE conditions the origin of signals received varies quite dramatically at different locations. When comparing similar logging timings it is found that completely different signals were often received—this has been noticed to a certain extent even over distances of a few miles. Thus signals from say CST will arrive at alternative locations at different times and in the case of two receiving sites say 250 miles apart the times of the openings vary while the signals received may be completely different!

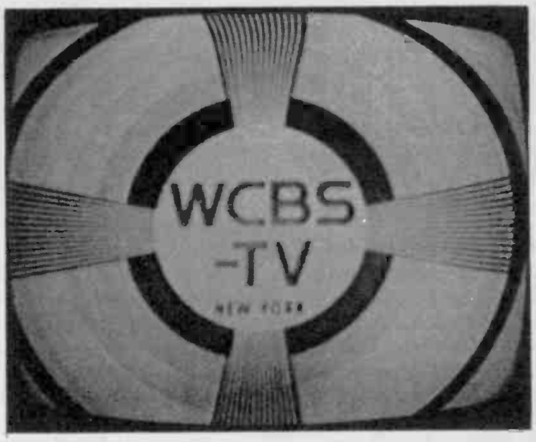
As will be seen we are concluding our report on the Hugh Cocks trip to North and South America with several shots of test cards/captions viewed on his travels. One interesting point that came out in our discussions is that all imported programmes in Brazil are censored —even the "Flintstones"! A certificate is screened (not unlike that of the UK Board of Film Censors) before each item of non-Brazilian origin. This is entitled "Federal Policia do Censuro". Hugh added that though he occasionally saw the PM5544 pattern "it isn't used much!"

News Items

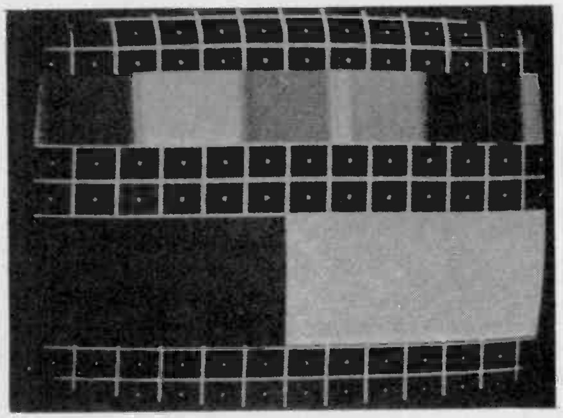
Space: The VOA announced recently that NASA intends to launch the ATS-F satellite at the end of this month. It will be in synchronous orbit initially, for test purposes, providing signals over the Alaskan/Rocky Mountain areas. It is intended to move the satellite to



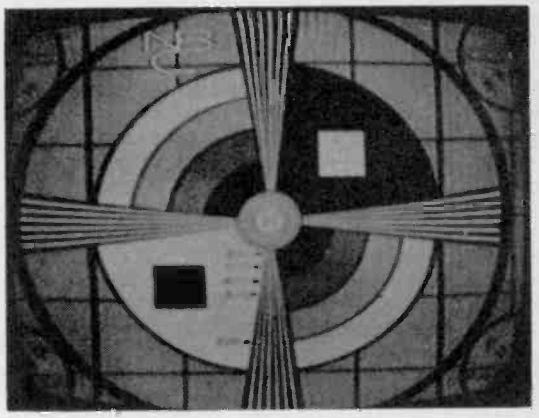
TV Gazeta, Sao Paulo, Brazil.



WCBS New York test card.



WNBC New York test pattern.



NBC test pattern.

WNYE TV, New York.

its final location over India (see this column November 1973 for full details) next year.

Cyprus: CBC has curtailed television transmission due to the energy problem: at the time of writing TV closes down at 2230.

France: The ORTF-1 819-line transmissions require a rather large bandwidth (14MHz—System E). Present French studies are considering the duplication of the first chain on 625 lines while phasing out the 819-line service. The idea would be to build a new u.h.f. network for the ORTF-1 625-line service and eventually to re-engineer the v.h.f. spectrum to provide a fourth 625-line network. A problem is that Tele-Luxembourg and Tele-Monte Carlo would have to change to 625 lines as well. The main problem however is the great number of 819-line only receivers still in operation—it will be many years before they are obsolete.

The Brest transmitter mast recently collapsed (aided by explosives). During the recent improved trops, good signals were noted from the temporary mast—at u.h.f. We have no information yet about the replacement structure.

USSR: We received recently an informative booklet on the TSS. Fifty million TV sets are in use and of every 100 families within range of the transmitters 98 have TV. The Ostankino TV centre is the largest in Europe, with 1500 dressing rooms. The four Moscow TV channels are in follows: TSS-1, a countrywide network national programme; TSS-2, a local Moscow channel (regional); TSS-3, an educational channel; TSS-4, given over exclusively to drama, classical/popular music shows, films and literature.

Canary Islands/Spain: We understand that the satellite programme taken by Canarias from TVE (mainland) carries an identification on the sound channel. This takes the form of two high-frequency tones sent consecutively at intervals of approximately four minutes.

Eire: 405-line transmissions from the Dublin and Sligo transmitters are to end within the next two years, also from certain relays in other parts of the country (Donegal.

Monaghan). The 405-line service will not come to an end however until a 625-line service is available in these areas. The present 405-line transmitters will then be available for re-engineering to provide a further channel. RTE are also conducting colour tests for 20 minutes on the first day of each month, with an engineering programme at 1600 BST.

New EBU Listings

France:

Pic de L'Ours	ORTF-3	1000/200kW e.r.p.	(S France) ch. E22.
Nantes	ORTF-3	1000kW	(SW France) ch. E26.
Rennes	ORTF-3	1000kW	(N France) ch. E42
Toulon	ORTF-3	100kW	(S France) ch. E54.
Verdun	ORTF-2	500kW	(E France) ch. E59.
Abbeville	ORTF-3	150/100kW	(NE France) ch. E60.

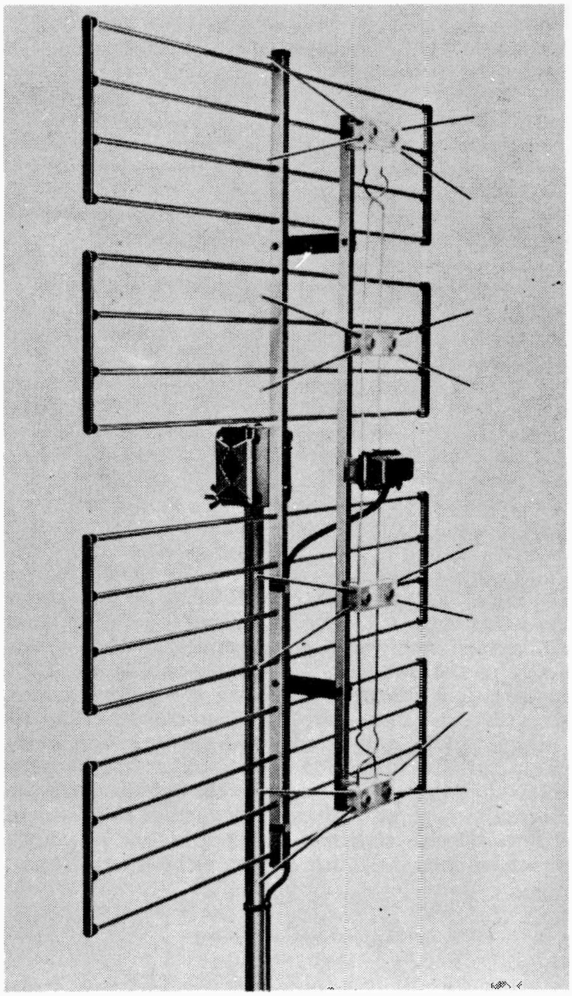
All transmissions are horizontally polarised.

Projected ORTF-3 Openings

The following list comes courtesy of Ian Beckett—from the magazine *Tele 7 jours*. Hyeres-cap-Benat E62 March; Grenoble E53 1st April; Mantes E61 30th March; Nice E61 30th March; Rouen E26 end April; Reims E40 mid-May; Mezieres E26 end May; Dijon-Nuits E65 end May; Gap-Mont E24 end May; Caen E28 end June; Le Havre E40 end June; Bayonne E61 end July; Perpignan E22 end July; Tarascon E49 end July; Lesparre E42 end July; Montpellier E53 August; Gex E24 end August; Brest E24 end August but possible delay due to sabotage —see above; Utelle E41 end September; Pignans E40 end September; Bar-le-Duc E54 end October; Angers E41 end October; Le Mans E21 end November; Dunkerque E45 end November; Saint-Flour E55 end November; Limoges E53 end December. All dates are 1974.

New UHF Array

During the bank holiday break I removed the large u.h.f. dish from the top of my mast and replaced it with a much smaller array, the Wolsey "Colour King". This wideband u.h.f. array was mentioned in the column last October. A new Wolsey amplifier, the Orbit, is being used with the array. Having replaced such a large, high-gain array with a much smaller one I anticipated a considerable drop in u.h.f. reception. The reduction has been much less than expected however. This is due I'm sure to the amplifier. The unit covers 460-860MHz with a gain of 16-18dB and a maximum noise figure of 2·8dB—in fact it's a high-gain, very low noise unit. As it is for masthead use the two-transistor amplifier is mounted on an enclosed steel chassis within yet another screw-over alloy cover—the overall size is that of a large baked bean can. The results obtained from this combination have been most encouraging—the wide bandwidth performance is excellent. Lille ch. E21 is received daily at similar strength to that obtained from the previous dish via a 10dB masthead amplifier. One unexpected improvement is that the ch. E43 Egem (Belgium) transmitter is now received daily, though with much noise. The forward acceptance angle is much wider (not unexpectedly) than with the dish. This presents a problem with ch. E25/E28 reception from Belgium because of the local Rowridge transmitter on ch. E24/E27. The electrical performance is certainly as quoted in the manufacturer's leaflet. For a mass-produced array the construction is good—the main connecting box contains a printed circuit matching section. It is most unusual for me to recommend any



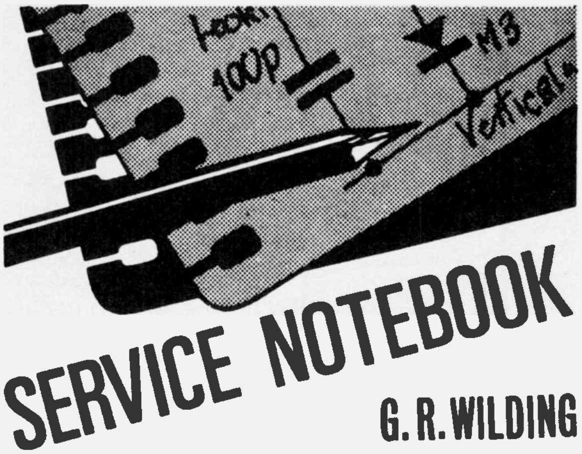
The Wolsey "Colour King" wideband u.h.f. array.

products in these pages but I feel that this unit/combination is extremely good value and is the answer to wideband u.h.f. reception at a reasonable price. Wolsey have kindly supplied a photograph; for the gain/VSWR details see the October 1973 column.

From Our Correspondents . . .

David James in Guyana, South America (actually located at East Coast Demerara) has written to tell us about the situation there. Guyana has no TV service, David's "local" transmitter being Paramaribo. Surinam at 210 miles! The WRTV handbook lists this as ch. A8 at 6kW. Signals with slow fading are received during the evening period between 1830 and close down (trop ducting). In addition signals are received on most nights from various Brazilian stations over 600-1,000 miles (SpE) and from Caracus, Venezuala on the low-band channels 2-6. The receiver used is a Sears 19in Model 5110—in conjunction with a Channelmaster "deep-fringe v.h.f. antenna". This is mounted at 63ft and a Channelmaster aerial amplifier is also used. The land is completely flat, there being no higher obstruction for several miles. Signals are seen so regularly now that

—*continued on page 459*



Erratic Line Oscillation

IF a colour or monochrome receiver which uses a valve line output stage occasionally or repeatedly blows the main h.t. fuse a few minutes after it is switched on and there is no evidence of a short-circuit in the receiver the almost certain cause of the trouble is failure of the line generator to start oscillating so that the line output valve draws excessive anode and screen grid current. The extra heater-cathode insulation given to a boost diode means that this valve is always the last to warm-up and become operational: in consequence the warmed up line output valve has screen grid but no anode voltage applied to it for a few seconds, sometimes resulting in the screen grid winding momentarily running hot.

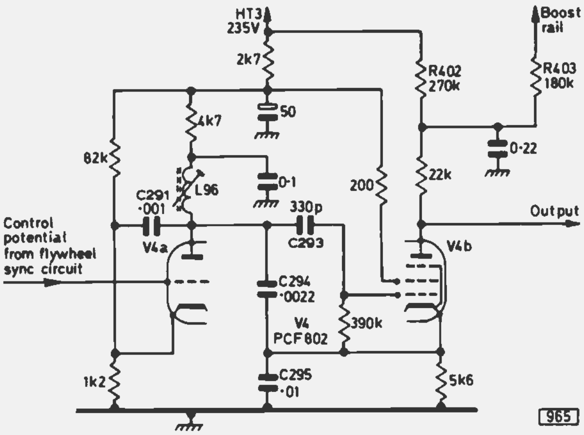


Fig. 1: Line oscillator circuit used in the ITT CVC5 chassis. L96 is tuned by C294, C295 and the capacitance presented by V4a. C291 provides quadrature feedback. The pentode is initially powered from the HT3 rail: when the boost supply appears it is powered via R403, increasing the amplitude of the drive waveform obtained from the stage. Main h.t. fuse blowing some minutes after switch on is commonly caused by failure of the stage to oscillate, often due to C291, C294 or C295 in this circuit being faulty. This results in the line output valve drawing excessive anode and screen grid currents. Poor line lock in PCF802 line oscillator circuits can be caused by a slight leak in the coupling capacitor—C293 here.

When a line generator fails to start oscillating but can be triggered into operation by changing channels, by operating the system switch in the case of dual-standard models or by applying a test prod to vital points in the circuit the odds are—provided the valve is in order—that a capacitor is faulty. In the ITT CVC5 colour chassis for example erratic starting of the PCF802 line oscillator circuit is often caused by C291, C294 or C295 (see Fig. 1) being defective. These were originally polystyrene types and should be replaced by metalised polyester types of equivalent value—not ceramics.

A Decca Model CS2230 (series 30 chassis) in which the line oscillator occasionally failed to come into operation from a cold switch on came our way recently: we found that touching the pentode section of the PCF802 circuit almost anywhere with the test prod would initiate oscillation. It is usually advisable to check electrolytics first since they tend to be defective more often than other types of capacitor and can be easily tested in circuit for loss of capacitance by simply shunting an equivalent or near equivalent across them. Leakage through electrolytics will of course produce voltage changes. There are three electrolytic capacitors in this Decca line oscillator circuit but all proved to be perfect. As none of the resistors were discoloured—which would have indicated changed value—we decided to start replacing the small capacitors in the circuit and after replacing C427 (470pF) which couples the triode anode to the pentode control grid line oscillation always started from switch-on.

In several chassis using a PCF802 line oscillator circuit poor line lock can be caused by a slight leak in the coupling capacitor (C293 in Fig. 1 for example) between the triode and pentode sections of the valve—this puts a slight positive voltage on the control grid of the pentode section.

Note that when a valve or transistor oscillator is not oscillating the voltages in the stage will be incorrect since such stages are self-biased—grid or base bias being produced by rectification of the oscillations normally present. If the stage is not operating therefore the anode or collector voltage(s) will be low as a result of the increased anode/collector current(s). Don't interpret reduced anode or collector voltage(s) as being the *cause* of the trouble therefore unless the reduction is really exceptional—the result possibly of a d.c. leak from the anode or collector circuit to chassis.

Transistor Testing

If the ratio of the forward to the reverse resistance across each junction of a small-signal transistor is found to be at least 20: 1 the transistor can generally be assumed to be able to function normally. Due to the low value feed resistors used, particularly in the base circuit, it is difficult to draw firm conclusions when such tests are carried out with the transistor in circuit however. It is usually far better to check the voltages in a particular stage against those given in the service manual, since a short across any junction or an open-circuit will always produce a marked change in voltage.

An internal disconnection to any region will result in zero collector current and zero or a very small

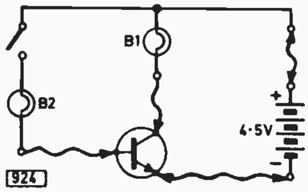


Fig. 2: Simple power transistor tester — connections shown apply with npn transistors. Reverse the battery connections when testing pnp transistors. B1 and B2 are 3.5V, 0.3A bulbs.

emitter current, the latter being present only if it is the collector connection which is open-circuit, the leakage current in modern silicon transistors being negligible. With an npn transistor operated from a positive l.t. rail an internal disconnection will result in a high collector voltage (rail potential unless the collector is fed from a potential divider junction), very low emitter voltage and if the internal disconnection is to the base or emitter a slightly higher than normal base voltage and zero emitter voltage. An emitter-to-collector short will result in the same voltage at these two points while a collector-base short will produce similar voltages at all three terminals and a base-emitter short will result in much the same base and emitter voltages and a high collector voltage. The base-emitter voltage should normally be about 0·2-0·3V for germanium transistors and 0·6-0·7V for silicon ones.

With many of the high-power transistors now used in timebase output stages, power supply stabilisation circuits and so on however the forward and reverse readings obtained with an ohmmeter are of little value because of their very low forward resistance and comparatively low reverse resistance. The only sure way of testing them therefore is with currents similar to those with which they are designed to operate. For a simple but very informative test we have found the method suggested by BRC very useful. Connect a 4·5V battery and a 3·5V, 0·3A bulb in series across each of the transistor's junctions in turn. The bulb should light in each case with the battery polarity one way round only. If the bulb fails to light whichever way the battery is connected the junction is open-circuit, while if it lights regardless of battery polarity the junction is short-circuit.

As a further test—which demonstrates the basic transistor action—hook up two bulbs and a battery as shown in Fig. 2. With the switch open bulb B1 should not light since there is no forward bias applied to the base-emitter junction: on closing the switch both bulbs should light since the base bias applied should result in a flow of collector current. If only B2 lights, the base-emitter junction is short-circuit while if neither bulb lights the transistor is open-circuit. This simple arrangement, using flying leads with crocodile clips, is very helpful for testing power transistors in a chassis—with the base and emitter leads disconnected of course.

Insufficient Height

Insufficient height but with good vertical linearity was the fault in a GEC Model 2065 (Series 1 chassis). Thus our suspicion, after changing the PCL85 field timebase valve without obtaining any improvement, was that the voltage at the anode of its triode (field generator) section was low. (If the raster had been cramped an open-circuit or reduced value cathode decoupling electrolytic in the output pentode section of the circuit would have been suspected, while if the cramping had got worse as the set warmed up the most likely cause would have been that the pentode's bias resistor had fallen in value.) Low triode anode voltage proved to be the case since it was only a fraction over 30V instead of the correct figure of 40V. The triode anode receives its supply from the boost rail via R230, the height control P201 and R201 (see Fig. 3), but shunting equivalents across these resistors only marginally improved matters whereas this action should have produced excessive height.

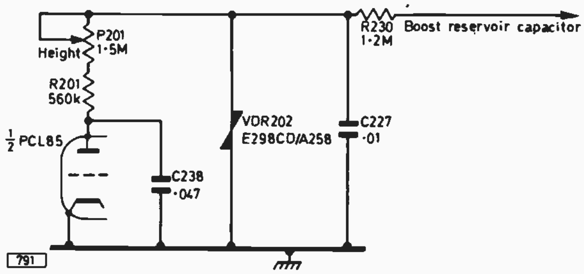


Fig. 3: Field charging circuit used in the GEC Series 1 chassis.

Since the boost rail voltage was only slightly below the correct figure of 890V it appeared that either the smoothing capacitor C227 or the field charging capacitor C238 was leaky or that the stabilising v.d.r. VDR202 was faulty. On inspection the capacitors appeared to be all right so we decided to uncouple the v.d.r. The height immediately increased excessively. Since it acts as a high-value self-adjusting shunt resistor the height will always increase when this component is disconnected: the extent of the height increase was clearly abnormal however. A replacement v.d.r. resulted in full height being obtained with the height control at its mid-position.

Wrong Colours

The complaint on a GEC 2040 single-standard colour set was a very blue picture. On test card reception it was noticed that what should have been the magenta bar at the top was as blue as the blue bar while the red one was brown and the green one muddy yellow: the green area in the centre circle was of no significant hue. This chassis uses colour-difference drive and the colour errors, particularly the almost complete loss of green as well as red, suggested loss of the R−Y signal in the preamplifier stage rather than absence of output from the R−Y pentode. In this model as in several others however the G−Y matrixing is carried out at high level, in the anode circuitry of the R−Y and B−Y output pentodes. The R−Y PCL84 was replaced therefore but the new valve did not produce any improvement. The anode load resistor was then found to be cold, indicating that either this, the screen grid or cathode resistor was open-circuit (zero screen grid voltage always reduces a pentode's anode current to a negligible figure or zero). The 100Ω screen grid resistor was eventually found to be the cause of the fault. It was noticed that the cathode resistor was discoloured and slightly low in value so as this and the faulty screen grid resistor could have been caused by an internal flashover in the original PCL84 the new valve was left in place.

COMPONENT DISTRIBUTION SURVEY

ALONG with the rapid growth of the electronics industry in recent years there has risen a very complex component distribution system. In fact there are so many manufacturers and suppliers operating with many different trading policies that it can be a difficult, time consuming and often frustrating business trying to find out what is the best course to adopt in seeking supplies, whether for one-off construction, servicing requirements or original equipment manufacture (OEM). The purpose of this survey is first to give a clear picture of how the whole system works at present, and secondly to list the trading policies and stock lines of a substantial number of suppliers who are likely to be useful to readers. We make no claim to providing a comprehensive directory however: that would clearly require far more space than we can devote to the subject. It has been necessary to restrict listing to suppliers generally accepted as being "in the trade", i.e. as wholesale or distributor outlets in the UK. As will be seen later however some of these firms provide a comprehensive service for almost any type of customer. Retail outlets—i.e. shops and mail-order supplies—have had to be excluded because of their number: readers interested in this aspect will find the special "Buyers' Guide" supplement to be published starting in the October issue of *Practical Wireless* of help. Since few suppliers and we feel readers restrict themselves exclusively to what goes into a television set the survey deliberately takes in electronic equipment in its widest sense.

It is helpful to start by making a broad classification of suppliers in terms of their principal trading policy: Fig. 1 shows the overall picture.

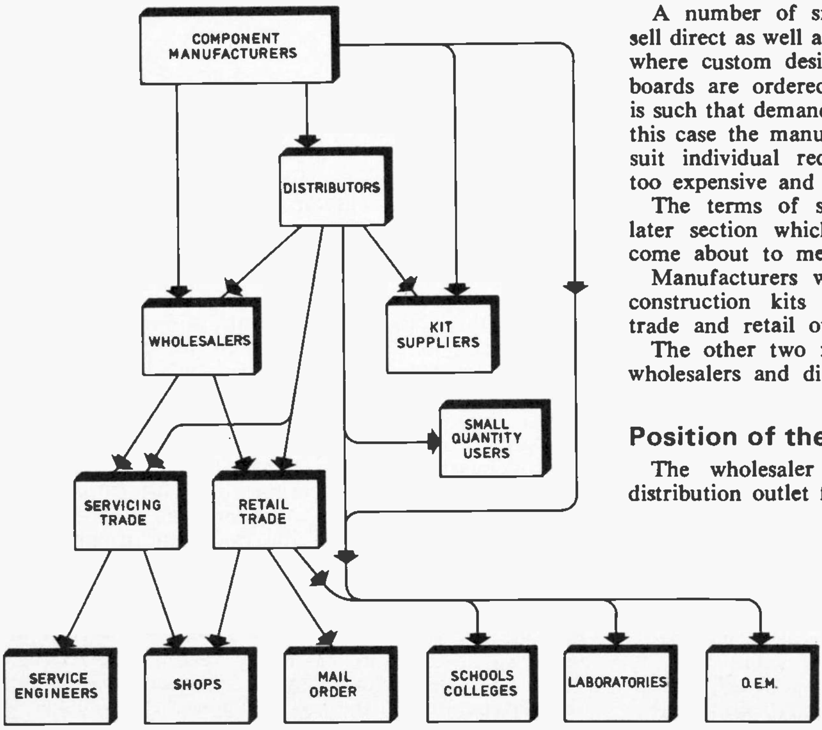


Fig. 1: The various routes from component manufacturer to the final user.

Dealing with Manufacturers

Manufacturers themselves can and sometimes do supply direct. Their trading policy tends to depend on the goods they make. In the case of components they will, unless the quantities required are of the order of thousands, usually exercise their option to refer orders to appointed distributors since this will have been agreed under distributors' franchise terms. Exceptions will be where the unit cost is fairly high—say over £10—or where orders are accepted to customers specific requirements, in which case distributors' stock lines are either unsuitable or unavailable.

A number of small manufacturers are prepared to sell direct as well as through other outlets—examples are where custom designed transformers or printed circuit boards are ordered. The nature of this type of trade is such that demand is usually on a more casual basis. In this case the manufacturer offers a customer service to suit individual requirements—such business would be too expensive and slow moving for distributors.

The terms of such transactions are outlined in a later section which highlights some trends that have come about to meet cash flow problems.

Manufacturers will also supply to firms that make construction kits available for sale through various trade and retail outlets.

The other two routes shown in Fig. 1 are through wholesalers and distributors.

Position of the Wholesaler

The wholesaler has been by tradition the main distribution outlet for the consumer side of the market,

—continued on page 458

DIRECTORY

In this directory of component distributors and wholesalers it has been necessary to abbreviate some of the information given to us by firms in order to conserve space. It has also been necessary to restrict the product types listed to those likely to be of most interest to readers. It does not necessarily follow that these are the only products stocked therefore. Readers who are interested in any particular sources are recommended to make further inquiries to establish the precise nature of the components offered; if possible ask for the current catalogue as the trading terms are more precisely given therein.

The following notes will help to explain how the directory has been compiled, so that quick reference is made easy. It is stressed that the survey has not excluded any particular firm deliberately and that it must not be taken as a complete guide.

(1) Where the company name is preceded with an asterisk (*) this firm is a member of AFDEC.

(2) The address given is the head office for enquiries. Branch office addresses can be obtained from these addresses or by consulting a local telephone directory. Many firms employ area representatives who will call to discuss supply problems. Manufacturers can usually supply your nearest stockist or franchised distributor.

(3) **TP** means telephone number; **TX** means telex number, head office only.

(4) **MOC** indicates where possible the minimum order charge.

(5) V.A.T. where appropriate is charged extra on most goods.

(6) **CP** indicates the approximate charge for carriage and packing, which is also subject to v.a.t. Note that these rates may vary according to the parcel weight, order value, or changes in postal rates. Those given are for UK deliveries; export charges may be extra, be subject to destination import duties, or changes in currency exchange rates.

(7) Orders are usually accepted by the methods stated. **CWO** means cash or cheque with order; **COD** means cash on delivery by the Post Office and subject to their c.o.d. charge. Monthly accounts can usually be arranged on acceptance of a satisfactory banker's plus two other trade references. Settlement of account varies and is indicated in most cases by the following abbreviations: **A/C 2**—by 20th of month following dispatch date; **A/C3**—by end of month following dispatch; **A/C20**—within 20 days; **A/C28**—within 28 days; **A/C30**—within 30 days of dispatch date.

It is stressed that in most cases payment is due immediately on receipt of goods.

Companies who specifically stated that they do not supply goods to orders from customers outside normal trade or industry requirements are indicated by the symbol †.

(8) Products are divided very roughly into two groups and are only an approximate guide for users in the television and video fields. **Product Group 1** lists components that are particularly useful for television or video applications; **Product Group 2** lists other component groups normally carried. Because of space limitations, these are broadly grouped; for further details refer to the appropriate catalogues.

(9) Manufacturers whose lines are stocked—whether in the Product Groups listed or not—are also in two groups. **Manufacturers Group 1** consists of manufacturers for which the firm holds an official franchise. **Manufacturers Group 2** lists other firms represented by stock lines.

Full manufacturers' names are not necessarily stated —indeed only a familiar trade name may be given.

BANDRIDGE LTD., 80a Battersea Rise, London SW11 1EH
TP 01-228 9227
MOC £10, **CP** extra.
†**Orders** by TP, post, call.
Payment CWO, cheque, monthly A/C30.
Product Group 1
Cable & wire, capacitors, connectors, printed circuit board kits, plugs & sockets, transistors and diodes.
Product Group 2
Aerials, battery holders & clips, component assembly boards, earpieces, knobs, adaptors, loudspeakers, panel meters, switches, transformers, vernier dials.
Manufacturers Group 2
Acos, Adastra, Amtron, Baker Reproducers, Bib, Bonella, Bulgin, Celestion, Davu, Eagle, Eekay, EMI, Foster, Gem, Koha, Kyoto, Linear, Mikron, Mullard, Omega, Rendar, TTC, Vero, plus several others.

***BEST ELECTRONICS (SLOUGH) LTD.**, Unit 4, Farnburn Avenue, Slough SL1 4XU
TP 0753 (Slough) 31700. **TX** 847571.
MOC none, **CP** add 18p for orders under £5
Orders by TP, TX, post, call.
Payment CWO, COD, cheque, Monthly A/C 3.
Product Group 1
Diodes & rectifiers, e.h.t. rectifiers, i.c.s linear, television tubes, transistors.
Product Group 2
Cable ties, diecast boxes, plugs & sockets, relays, thyristors and triacs.
Manufacturers Group 1
Adcola, ITT components, ITT semiconductors, Motorola, Plessey Semiconductors, own brand.
Manufacturers Group 2
Advance Electronics, Eddystone, Keyswitch Relays, Multicore Solders, Teledyne, Thomas & Betts, Westinghouse, Weller.

BLORE-BARTON LTD., Reedham House, Burnham, Bucks.
TP Burnham (Bucks) 5542. **TX** 847322.
MOC £1, **CP** extra 40p.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C3.
Product Group 1
Capacitors, potentiometers.
Product Group 2
Connectors, knobs, plugs & sockets, relays, light sensors, switches, transformers, voltage controllers.
Manufacturers Group 1
A.B. Electronic Components, A.B. Microelectronics, I.M.O./Omron, I.M.O. Precision Controls, Plessey Interconnect, Rendar Instruments, Western Components, S. Davall

***BLUELINE ELECTRONIC COMPONENT SERVICES LTD.**, Refuge House, River Front, Enfield, Middlesex.
TP 01-366 6371. **TX** 22196.
MOC none, **CP** extra at cost.
†**Orders** by TP, TX, post, call.
Payment monthly A/C30.
Product Group 1
Capacitors, diodes & rectifiers, transistors.
Product Group 2
Fans, microswitches, potentiometers, relays & counters.
Manufacturers Group 1
Advance Filmcap, Airscrew fans, Burgess, Bourns, ERG, Keyswitch Relays, Texas, Union Carbide.

***CELDIS LTD.**, 37/39 Loverock Road, Reading, Berks. RG3 1ED. (Also at Manchester, Glasgow, Italy, West Germany, France.
TP 0734 (Reading) 582211. **TX** 848370.
MOC none, **CP** extra approx. 50p.
Orders by TP, TX, post, call.
Payment CWO, COD, cheque, monthly A/C3.
Product Group 1
I.C.s linear, transistors, capacitors, resistors.

Product Group 2
Connectors, dials, diodes & rectifiers, heatsinks, i.c.s logic, lamps, potentiometers, relays, sockets, thyristors & triacs.
Manufacturers Group 1
Amphenol, Hewlett-Packard, International General Electric (USA), Intersil, Lemco, Motorola, Mullard, Papst, RCA, Redpoint, Thorn Electrical Components, Union Carbide, Welwyn Electric, Westinghouse.

COMBINED ELECTRONIC SERVICES LTD., 604 Purley Way, Waddon, Croydon, CR9 4DR. (Also at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Liverpool, North London, Manchester, Newcastle, Nottingham, Southampton, Southend, Stockton-on-Tees, Whitehaven.)
TP 01-686 0505. **TX** 262308.
MOC none, **CP** extra 40p on orders up to £10.
†**Orders** by TP, TX, post, call.
Payment CWO, COD, business cheque, monthly A/C30.
Product Group 1
Anti-corona fluid, hardware various, connectors, deflection coils, delay lines, diodes & rectifiers, doublers & triplers, i.c.s linear, loudspeakers, wire & cable, capacitors, replacement panels, transformers, transistors, valves, resistors, service aids.
Product Group 2
Batteries, cold cathode tubes, drive belts, fuses & fuseholders, indicators, knobs, dials, lamps & lampholders, plugs & sockets, potentiometers, reed switches, relays, speaker grilles, spindle locks, switches, telescopic aerials, terminals, thyristors, plus sundry other service aids.
Manufacturers Group 1
Arrow, Belling Lee, Celestion, Erie, Elac, Fane, Goodmans, Hamlin, May, Mullard, Osmor, Pye, Pye-TMC, Philips, Multicore, Piher, Vitality, Waycom, Weller, Wima, plus own brand goods.

COMWAY ELECTRONICS LTD., Downshire Way, Bracknell, Berks. RG12 1ND.
TP Bracknell 24765. **TX** 847201.
MOC £2.50, **CP** 25p.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C30.
Product Group 1
Capacitors, diodes & rectifiers, i.c.s linear, resistors, transistors.
Product Group 2
Connectors, fuses & fuseholders, heatsinks, indicator lamps, instrument cases, knobs, l.e.d.s, i.c.s logic, numerical displays, opto-couplers, potentiometers, relays, switches, wire & cable.
Manufacturers Group 1
A.M.P., Antiference, Arrow, Beckman, Beswick, Brand Rex, Dubilier, Fairchild, Greenpar, Hellerman, Keyswitch Relays, Radiatron, Sprague, Waycom, Wima.

***DISTRONIC LTD.**, 50-51 Burnt Mill, Elizabeth Way, Harlow, Essex.
TP 0279 (Harlow) 39701. **TX** 81387
MOC £3, **CP** extra.
Orders by TP, TX, post.
Payment CWO, COD, cheque, monthly A/C 3.
Product Group 1
Diodes, capacitors, i.c.s linear, potentiometers, resistors, microwave coaxial connectors, transistors.
Product Group 2
Coaxial cable, fans, lamps, microwave semiconductors, rectifiers, switches, thyristors, u.v. phototubes, i.c.s logic.
Manufacturers Group 1
Alpha Industries, Alps, British Brown-Boveri, General Instrument, General Semiconductor, Micro Electronics, Micro Systems International, Mostek, Omni Spectra, Rotron, SGC-ATES, Silec, Solid Power, Sprague, Stackpole, Sylvania, Solidev, Tadiran, Transitron, Uniform Tubes.
Manufacturers Group 2
Electrosil, Cerwistor, J. H. Associates, Morganite, Rayrex, Stewart-Warner.

***DTV GROUP LTD.**, 126 Hamilton Road, London SE27 9SG
TP 01-670 6166. **TX** 262415.
MOC add 30p to orders under £5. CP extra.
Orders by CWO, COD, cheque, monthly A/C3.
Product Group 1
Capacitors & clamps, diodes & rectifiers, i.c.s linear, resistors, transistors.
Product Group 2
Connectors, component assembly boards, fuses & fuseholders, i.c.s logic, indicators, lampholders, l.e.d.s, heatsinks, potentiometers, plugs & sockets, relays, switches, ultrasonic transducers, pressure transducers, transformers.
Manufacturers Group 2
Alma Components, Belling Lee, Bernstein, Broadcast Electronics, Bulgin, Erie, Electrolube, Electrosil, Emihus, Industrial Instruments, International Rectifier, I.M.O. Relays, Marex, Mullard, Omron, National Semiconductor, Plessey Capacitors, Raaco, Sensitron, Solidev, Weller.

ELECTRONIC COMPONENT SUPPLIES (WINDSOR) LTD., Thames Avenue, Windsor, Berks. (Also at **ECS** ,416 Ashton Old Road, Manchester, M11 2DT.)
TP 95-68101. **TX** 847573.
MOC none. **CP** extra.
Orders by CWO, cheque, monthly A/C30.
Product Group 1
Capacitors, diodes, i.c.s linear, resistors, transistors, variable capacitance diodes.
Product Group 2
Fuses & fuseholders, key switches, i.c.s logic, lamps & lampholders, plugs & sockets potentiometers, relays, switches, terminals, thyristors & triacs.
Manufacturers Group 1
AEG-Telefunken, Allen-Bradley, Emihus, Guest, International Rectifier, Keyswitch Relays, RCA, Seatronics, SGS-Ates.

ELECTROVALUE LTD., 28 St. Judes Road, Englefield Green, Egham, Surrey. TW20 0HB. Also at Manchester.
TP 078 43 (Egham) 3603. **TX** 264475.
MOC £1. Add 10p up to £2. **CP** extra.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C3.
Product Group 1
Capacitors, ferrite cores & bobbins, heatsinks, i.c.s linear, loudspeakers, resistors, transformers & transformer kits, variable capacitance diodes, coil formers, transistors.
Product Group 2
Boxes & cases, battery holders & clips, diodes & rectifiers, component assembly boards, cable & wire, suppressor chokes, connectors, crocodile clips, indicators, lamps & lampholders, fuses & fuseholders, thyristors & triacs, hardware various, suppressors, liquid crystal displays, switches, potentiometers, plugs & sockets, printed circuit materials, reed switches, terminals, thermistors, i.c.s logic.
Manufacturers Group 1
East Grinstead Electronic Components, Elremco-Wolf, Guest International, Henry & Thomas, Newmarket Transistors, Siemens (UK).

ERIE ELECTRONICS LTD., South Denes, Great Yarmouth, Norfolk. Distributor Division.
TP 0493 56122. **TX** 97421.
MOC £5 (manufacturing); £2.50 (distrib.) £10 per item for Toshiba products.
CP extra.
Orders by CWO, cheque, monthly A/C3.
Product Group 1
Aerial isolators, capacitors, i.c.s linear, resistors, spark gap devices, thick film devices, transistors.
Product Group 2
Filters (special order), l.e.d.s, potentiometers, 7-segment displays, thyristors, i.c.s logic.
Manufacturers Group 1
Erie, Toshiba.

***GOTHIC ELECTRONIC COMPONENTS LTD.**, Hampton Street, Birmingham 19.
TP 021 236 8541. **TX** 338731.
MOC £2. **CP** add 33p, Atlas or Securicor at cost.
Orders by TP, TX, post.
Payment CWO, COD, cheque, monthly A/C3.
Product Group 1
Capacitors, i.c.s linear, resistors, transistors.
Product Group 2
Batteries, connectors, diodes & rectifiers, industrial valves, fuses & fuseholders, i.c.s logic, knobs & dials, lamps & lampholders, potentiometers, relays, switches, terminals.
Manufacturers Group 1
A.M.P., Avo, Belling Lee, Birch Stolec, Bulgin, English Electric Valve, Evershed & Vignoles, Fairchild Semiconductor, Honeywell, ITT-STC Valve Div., Keyswitch Relays, Lucas Semiconductor, Mullard, M.O. Valve Co., Plessey Semiconductors.
Manufacturers Group 2
Arcolectric, Burgess, Colvern, Electrolube, Mallory, Weller.

GUEST ELECTRONIC DISTRIBUTION LTD., Redlands, Coulsdon, Surrey, CR3 2HT.
TP 01-668 7151. **TX** 946880.
MOC none, **CP** add 55p to orders under £5.
Orders by TP, TX, post, call.
Payment CWO, COD, cheque monthly A/C28.
Product Group 1
Diodes & rectifiers, capacitors, plugs & sockets, resistors, service equipment.
Product Group 2
Crocodile clips, indicators, fuseholders, knobs, l.e.d.s, potentiometers, relays, switches, terminals, thermal limiters.
Manufacturers Group 2
Apem, A.P.R., A.T.C., Cliff Plastic Products, E.I., Guest International, General Resistance, Heimann, Hybrid Systems, Iskra, Litronix, Micro Devices, Pozzi, Russenburger, Semiconductor Circuits.

HAWNT ELECTRONICS LTD., Firswood Road, Birmingham, B33 0TQ.
TP 021-784 2485. **TX** 338814
MOC £2. **CP** extra
Orders by TP, TX, post.
Payment CWO, cheque, approved monthly A/C3.
Product Group 1
Capacitors, diecast boxes, diodes, ferrite pot core assemblies, industrial valves & tubes, nylon pillars, rectifiers, regulators, resistors, transistors, vidicon tubes.
Product Group 2
Batteries, connectors, crocodile clips, fuseholders, i.c. connectors, knobs, meters, potentiometers, relays, p.v.c. boxes, 7-segment displays, switches, thyristors.
Manufacturers Group 2
Avo, Belling Lee, Brady, Bulgin, C.G.S., Colvern, Diamond-H, Dubilier, Eddystone, E.M.I., Erie, Ferranti, G.B., K.G.M., Mallory, Mullard, Multicore Solders, Sarel, SGS-Ates, T.M.K.

***ITT TELESPARES, STANDARD TELEPHONES & CABLES LTD.**, Edinburgh Way, Harlow, Essex, CM20 2DF.
TP 0279 (Harlow) 39791. **TX** 81146.
MOC £10 per line, **CP** extra.

Orders by TP, TX, post, call.
Payment CWO, COD, cheque, monthly A/C30.
Product Group 1
Capacitors, connectors, delay lines, colour crystals, e.h.t. trays, resistors, diodes & rectifiers, i.c.s linear, thermistors, transistors, thyristors, tuners, servicing aids various, valves.
Manufacturers Group 1
AEG-Telefunken, ITT, Newmarket Transistors, SGS-Ates.
Manufacturers Group 2
Advance Electronics, Belling Lee, Crescent, Berco, Kingshill, Lyons, Scopex, Smiths, Toshiba, Weir, Weller.

•LST ELECTRONIC COMPONENTS LTD., 7 Coptfold Road, Brentford, Essex.
TP Brentwood 2264 70. **TX** 99443.
MOC £1. **CP** extra approx. 40p.
Orders by TP, TX, post, call.
Payment CWO, COD, cheque, monthly A/C3.
Product Group 1
Capacitors, chokes, diodes & rectifiers, heatsinks, i.c.s linear, transistors, resistors.
Product Group 2
I.C.s logic, indicators, potentiometers, switches, thyristors & triacs, ultrasonic transducers.
Manufacturers Group 1
AEI Semiconductors, DOC Electronics, Henry & Thomas, Marston Excelsior, Newmarket Transistors, Siemens (UK).
Manufacturers Group 2
General Instruments (UK), RCA, SGS-Ates.

•PSP ELECTRONICS LTD., 228 Preston Road, Wembley, Middlesex, HA9 8PB.
TP 01-904 9521.
MOC £1, **CP** extra.
Orders by TP, post, call.
Payment CWO, COD, cheque, monthly A/C30.
Product Group 1
Cables, component assembly boxes, connectors, potentiometers, resistors.
Product Group 2
Adaptors, coaxial assemblies, crocodile clips, patch cords, relays, switches.
Manufacturers Group 2
Ambersil, A.B. Metal, Hellerman Electronics, ITT-Cannon, Kings, Permanoid, Reon Resistor, Vishay Resistor Products.

REL EQUIPMENT & COMPONENTS LTD., Croft House, Bancroft, Hitchin, Herts., SG5 1BU.
TP 0462 (Hitchin) 50551. **TX** 82431.
MOC none, **CP** extra approx. 20p.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C.
Product Group 1
Capacitors, chokes, delay lines, feed-throughs, i.c.s linear, inductors, insulators, resistors, transformers & transformer kits, transistors.
Product Group 2
Cables, capacitor clips, component assembly systems, connectors, diecast boxes, digital indicators, diodes, batteries & cells, i.c.s logic, lamps & lampholders, l.e.d.s, liquid crystal displays, jack adaptors, mounting pads, panel meters, potentiometers, printed circuit board, p.c. connectors, p.c. handles and holders, rectifiers, reed relays, 7-segment displays, sockets, switches, terminals, thyristors.
Manufacturers Group 1
Alma Components, Beckman, Belclere, Eddystone, Erma, Elremco, Lemco, Magnetic Devices, Mallory, Mostek, Mullard, Nytronics, RCA, Roxburgh Electronics, Sealectro, Tekelec-Airtronic, Thorn Electronic Components, Welwyn Electric, SGS-Ates.

RS COMPONENTS LTD., P.O. Box 427, 13-17 Epworth Street, London EC2P 2HA.
TP 01-253 1222. **TX** 262341.
MOC none, **CP** inclusive.
†Orders by TP, TX, post, call.
Payment CWO, monthly account, A/C2.
Product Group 1
Capacitors, connectors, diodes & rectifiers, e.h.t. trays, fuses & fuseholders, loudspeakers plugs & sockets, resistors, suppressors, thermistors, transformers, transistors, wire & cable.
Product Group 2
Battery holders, cable ties, cases & handles, circuit assembly boards, cold cathode indicators, crocodile clips, grommets, hardware various, i.c.s linear and logic, heatsinks, knobs & dials, lamps & lamp-holders, panel meters, potentiometers, l.e.d.s, light sensors, regulators, reed relays, other relays, diecast boxes, service aids, switches, tag strips, terminals, styli.
Manufacturers Group 1
—own brand goods.

•SASCO LTD., P.O. Box 2000, Crawley, Sussex, RH10 2RU.
(Also in Glasgow and Munich, West Germany.)
TP 0293 28700. **TX** 87131.
MOC U.K. £5. Export £25, **CP** extra 33p up to £10, 44p over £10.
Orders by TP, TX, post.
Payment CWO, account by arrangement only.
Product Group 1
Diodes & rectifiers, capacitors, ferrites, resistors, transistors, valves, i.c. linear.
Product Group 2
Cable ties & markers, connectors, fuses & fuseholders, heatsinks, i.c.s logic, i.c. sockets, knobs, lamps & lampholders, photo-devices, potentiometers, relays, rotary solenoids, silicon grease, silicon rubber, switches, terminals, thermistors, thyristors, triacs, uniselectors.
Manufacturers Group 1
Amphenol, Arrow Hart, Astralux, Belling Lee, Electrocon, Fairchild Semiconductor, Gresham-Lion, Hamlin, I.C.I., IERC, International Rectifier, Keyswitch Relays, Licon Electronics, Mullard, National Semi-conductor, Plessey Interconnect, Plessey (Titchfield), Pye Connectors, Pye Dynamics, Pye Ether, RCA, STC, Thomas & Betts, Thorn Electronics, Transitron, Union Carbide, Yellow Springs.

SDS COMPONENTS LTD., Hilsea Industrial Estate, Portsmouth, PO3 5JW.
TP 0705 (Portsmouth) 65311. **TX** 86114.
MOC none, **CP** extra.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C.
Product Group 1
Capacitors, diodes, i.c.s linear, resistors, transistors, valve top caps, variable capacitance diodes.
Product Group 2
Battery holders, crocodile clips, C-R suppressors, fuses & fuseholders, i.c.s logic, inductive couplers, knobs & dials, jacks, lamps & lampholders, plugs & sockets, potentiometers, rectifiers, reed switches, relays switches, thyristors & triacs.
Manufacturers Group 1
Bulgin, A.E.I., Emcap, Electrosil, Ferranti, F.R. Electronics, General Instruments (UK), General Instrument Microelectronics, Intel, International Rectifier, I.T.W., Paktron, Plessey Microelectronics, Signetics, Sprague, Texas, Weller.

•SEMICOMPS LTD., Northfield Industrial Estate, Beresford Avenue, Wembley Middlesex. HA0 1SD. (Also at Kelso, Roxburgh).
TV Mail order Division, S.C.S., Concord Road, Western Avenue, London W3 0SD.
TP (head office) 01-903 3161. **TX** 935243.
MOC £3. **CP** 50p under £3.
Orders by TP, TX, post, call.
Payment CWO, COD, cheque, monthly A/C.
Product Group 1
Capacitors, transistors & diodes, i.c.s linear.
Product Group 2
L.E.D.s, rectifiers, resistors, 7-segment displays, thyristors & triacs.
Manufacturers Group 1
Ferranti, General Instrument (UK), General Instrument Microelectronics, Lucas Semiconductor, Monsanto, Motorola, Mullard, RCA, Seatronics, Signetics, Welwyn Electric.

•SEMICONDUCTOR SPECIALISTS (UK) LTD., Premier House, Fairfield Road, Yiewsley, West Drayton, Middlesex. (Also at Livingstone.)
TP 089 54 (West Drayton) 46415. **TX** 21958
MOC none, **CP** inclusive.
Order by TP, TX, post, call.
Payment approved monthly A/C30.
Product Group 1
Transistors, diodes, i.c.s linear.
Product Group 2
I.C.s logic, thyristors & triacs, comprehensive listing of British & American devices.
Manufacturers Group 1
Augat, Birtcher, Delbert Blinn, Dickson, Fairchild, General Electric (USA), General Instrument, G.I. Microelectronics, Intersil, ITT, Microsystems International, Monsanto, Motorola, RCA, Signetics, Silicon Transistor, Siliconix, STC, Thermalloy, Texas, Westinghouse.

SPENCO ELECTRONIC SERVICES LTD., 7 Colvilles Place, Kelvin Industrial Estate, East Kilbride.
TP East Kilbride 36311. **TX** 778638.
MOC £2. **CP** extra 25p under £50.
Orders by TP, TX, post, call.
Payment CWO, cheque, monthly A/C30.
Product Group 1
Capacitors, p.c. connectors, resistors, transistors.
Product Group 2
Diodes, i.c.s linear & logic, i.c. sockets. l.e.d.s, multi-way connectors, panel meters, rectifiers, relays.
Manufacturers Group 1
Advance Filmcap, Diodes, E.H.T., E.I.C., LCC-CICE, Microsystems International, Morganite, Semitron, Sescosem.
Manufacturers Group 2
Erie, Souriau.

•TI SUPPLY LTD., 165 Bath Road, Slough, Bucks, SL1 4AD. (Also at Southampton, Birmingham, Manchester, Edinburgh and several overseas branches.)
TP 0753 (Slough) 33411. **TX** 84363.
MOC Add £1.50 to orders under £5.
CP extra 20p.
Orders by TP, TX, post, call.
Payment CWO, COD, cheque, monthly A/C30
Product Group 1
Diodes & rectifiers, transistors, thermistors, capacitors, resistors.
Product Group 2
Capacitors, connectors, i.c.s linear & logic, l.e.d.s, potentiometers, relays, thyristors & triacs.
Manufacturers Group 1
Texas Instruments, Amphenol, Beckman, C. P. Clare, Electrosil, Greenpar, ITT-Cannon, Ohmite, Plessey-TCC, Potter & Brumfield, Spectrol Reliance Superior Electric.

TTC DIVISION of EAGLE INTER-NATIONAL LTD., Precision Centre, Heather Park Drive, Wembley, Middlesex, HA0 1SU. (Also distributes through other outlets.)
TP 01-903 0144. **TX** 922131.
MOC none, **CP** extra.

†**Orders** by TP, TX, post.
Payment monthly A/C30.
Product Group 1
Loudspeakers, plugs & sockets.
Product Group 2
Battery holders & clips, cable & wire, connectors, crocodile clips, earpieces, knobs & dials, nuts, bolts, screws, panel meters, switches, terminals, transformers.
Manufacturers Group 1
Own brand goods imported.

WAYCOM LTD., Wokingham Road, Bracknell, Berks RG12 1ND.
TP 0344 (Bracknell) 22751. **TX** 848402.
MOC none, **CP** inclusive.
†**Orders** by TP, TX, post, call (through Comway Electronics).
Payment monthly A/C30.
Product Group 1
Capacitors, connectors, resistors.
Product Group 2
Lamps & lampholders, knobs, potentiometers, switches, heatsinks, wire & cable.
Manufacturers Group 1
Own brand goods.
Manufacturers Group 2
Wima.

WILLOW VALE ELECTRONICS LTD., 4 The Broadway, Hanwell, London W7. (Also at Paisley, Renfrew and Street, Somerset.)
TP 01-567 5400.
MOC £5. **CP** extra 25p.
†**Orders** by TP, post, call.
Payment CWO, cheque, monthly A/C2, special terms.
Product Group 1
Bases for valves & c.r.t.s, television tubes, aerials, capacitors, connectors, e.h.t. trays, i.c.s linear, scan coils, transformers, transistors, resistors, tuner drive assemblies, valves & tubes, service equipment.
Product Group 2
Adaptors, diodes & rectifiers, fuses & fuseholders, knobs, plugs & sockets, potentiometers, switches, earpieces, thermistors.
Manufacturers Group 1
Own brand goods.
Manufacturers Group 2
Antex, Eagle-TTC, Electrolube, Foster, ITT, Keynector, Mullard, Multicore Solders, Oryx, Pye-Labgear, Weller, Plessey, J-Beam, Avo.

SURVEY—continued from page 454

serving both the radio and TV servicing trade and retail outlets, whether shops or mail order.

The Distributor Network

In recent years there has been a phenomenal growth in the other route shown in Fig. 1, through the appointed distributor chain which has made available a much wider range of components.

The distributor network has not been set up in competition to the existing, well organised wholesale trade. Its purpose is to provide a supplementary service that enables almost anyone to obtain electronic components from the vast range that had previously been available to industry only. The result is that customers now have a far wider choice of sources and service than ever before. Rather than attempting to interfere with trading through the established routes the distributor network has been set up to provide components in almost any usable quantity at manufacturer's recommended selling prices, enabling wholesalers, retailers and end users to obtain components at a fair market price. This has had a considerable stabilising effect on component prices.

In effect the distributor operates as the manufacturer's sales office, bulk supply agent, small quantity outlet and adviser on component selection. Larger distributors in addition provide a comprehensive support service on behalf of manufacturers, often giving details of component characteristics and applications data. In acting as liaison between manufacturer and consumer distributors have generated an increasing awareness of the technical data originating from manufacturers' applications laboratories.

The distributor relies on a steady and consistent flow of stock from manufacturers and has to be able to support an enormous stock holding. This in turn means a large capital commitment and the necessity for fast turnover to give the required cash flow. It has been said that the average distributor must be able to turn over his entire stock three or four times a year in order to remain efficient and profitable. This involves the need to employ sophisticated stock and cash control methods. Difficulties arise therefore if customers delay settlement of accounts beyond the normally recognised 30 day limit. Indeed as a result of recent credit control problems many firms are insisting on cash with order or proforma invoice payment before delivery for relatively small orders.

Most distributors say they will supply in one-off quantities but in practice it depends on the unit price of the goods involved. Obviously distributors could not operate profitably if expected to handle numbers of small orders involving single items such as a 15p transistor. Retail outlets are better equipped to handle this type of business and the cost to the customer would in any case be higher after adding postal and packing charges. For this reason most distributors insist on a minimum value order (or charge). There are exceptions however and it is always worth making a telephone enquiry.

Catalogues

As a result of political factors and raw materials shortages there has been a great deal of uncertainty about the component supply situation since the beginning of this year. Demand for components remains strong however and in consequence prices are unlikely to fall. Catalogues tend to be out of date as soon as they are printed. This does not render them useless but means that they should be treated as a guide "subject to alteration". It takes about three months on average to compile and print a catalogue and clearly almost anything can happen during such a period to change the trading situation. Some distributors compile catalogues in the form of technical product data handbooks with prices issued either within the catalogue, as a supplement (renewable as required) or on application to the sales office.

Order Quantities

The stock situation can change rapidly. A single customer can order the entire stock of one product—a situation which does happen. It can then take several months to replace the stock. If one customer buys up the stock of one product line from several distributors it will take even longer to replenish the stock, especially as many components are not in continuous production but are "batch produced". Hence long delivery delays can be experienced on some items whilst others are still plentiful. The astute sales office clerk will not answer such questions as "how many do you have in stock?"—it is bad business to lay open the entire stock of one line to a single customer.

Between the two extremes of order size the most satisfactory policy for the distributor is to handle orders of value £10 and upwards as far as possible but to refer very large orders direct to manufacturers. It often happens however that to meet customers' immediate requirements a part delivery will be made from stock whilst the balance is placed in the hands of the manufacturer for delivery over an agreed period. This is often called "scheduling" and maintains a level of supply stability so that other customers are not "starved".

As far as the servicing trade and retail outlets are concerned this policy maintains fair stock distribution and reasonable delivery times; as far as manufacturing is concerned it enables production to be carried out at a steady rate and helps align production with demand.

Some distributors will handle very small orders on a cash with order basis, but it is wise to check first. Others impose a minimum order charge.

AFDEC

As can be seen from Fig. 1 the manufacturer and distributor have a wide range of customers to satisfy. To encourage certain agreed standards of practice many distributors have joined together to form a kind of trade association called AFDEC (Association of Franchised Distributors of Electronic Components) which lays down minimum membership requirements. These include a specified minimum franchised stock holding, forward ordering to maintain stocks and service to customers, and a minimum turnover value. If a wholesaler or distributor is not a member of AFDEC however this should not be taken as indicating inferior service—he may have a long established trading policy which does not include franchising. Membership shows that a company has agreed to adopt the above mentioned stock holding and service policies.

Prices

Prices of electronic components in the past seven or so years have not only remained fairly stable but have in some cases fallen. With the more erratic demand of recent times however prices are tending to rise. Distributors act on an international basis and in consequence fluctuations are nowadays frequently brought about by international trading problems—such as changes in exchange rates and import duties—or shortages of raw materials.

The directory section gives examples of the availability of components from various distributors. As mentioned earlier the procedures to be adopted are not the same with all goods or suppliers. Ascertain according to your requirements the most appropriate source of supply and then ask for catalogues, trading terms and prices.

Ordering

If you are not in a position to purchase direct from a manufacturer or distributor you should check with retail outlets—it is useful to study magazine advertisements and retailers' catalogues, but always check on prices and availability. One point often overlooked is that retail outlets have access to distributors' stocks at manufacturers' prices and can often obtain common components within 24 hours. Special products such as television tubes and hardware, coils and transformers, circuit modules and tuner units may have to be obtained by them through other channels or by special order from the manufacturer.

Some advertisers in this magazine are examples of these sources: others in the directory of suppliers can often help you too. We would again say that in a brief survey of this type it is not possible to list every type of component available from a particular source so that further investigation may be necessary.

In most cases accounts can be opened on acceptance of a banker's and two trade references. Settlement is usually expected within 30 days (or as otherwise indicated in the list).

It is the customer's responsibility to find the most suitable supplier and having done so present a clear order, preferably on headed paper or an official order form. Full details including full description of goods, quantity required and stock number where appropriate will speed delivery. If you order by telephone you will be expected to furnish the distributor with full details, order number and account reference: confirmation in writing can lead to duplicated deliveries unless it is clearly stated to be a confirmation, giving the order number and date.

DX-TV

—continued from page 451

upwards of 300 people have invested in receivers—some colour—with varying degrees of success.

Another distant letter comes from Doug McFadyen of New Zealand (Raurimu) who reports excellent and sustained SpE conditions during their Summer just passed. Over the New Year period very short-skip signals were received—DNTV ch. 1 at 500 miles followed later with the PM5544(!) on chs. 2, 3. This card originated from AKTV-2 and CHTV-3. AKTV (Auckland) which is only 175 miles North and CHTV (Christchurch) 300 miles South were the only centres with colour at that time. The AKTV signal was received in short strong bursts, the direction being completely random. The weather was fine, hot and humid with thundery clouds present. A later opening included ch. 3 Sydney with their excellent weather map—this includes much of the Indian Ocean, all Australia, the Tasman Sea and NZ.

Two letters have come from Holland. Jan Hubach (Goes—location of famous TV transmitter) is a fluent Finnish speaker and has provided new information as yet not listed. There are several new transmitters in operation—Pyhavuori TV2 E10 20kW; Lapua TV2 E24 1000kW (320m mast); Pihtipudas TV1 E10 70kW (300m mast); Kuopio TV2 E36 600kW. During the past winter considerable problems were experienced with icing on the masts—ice in excess of 3 metres on high lattice structures and up to 50cm on guy wires!

Ryn Muntjewerff (Beemster) received another first during the April tropospherics. On April 9th an unidentified ch. R7 signal was received from TSS—commencing with the test card and programmes. From the comments in the letter I would assume this to be some form of elevated duct. The transmitter most likely is Kaunas (no power listed) about 70 miles NE of the Polish border. The TVP outlet on ch. R24 was also received during this opening—our congratulations to Ryn on this magnificent reception.

New Address

The Europese Testbeeldjagers has moved to a new address—PO Box 30, 3822 Klundert, Holland. The subscription to this excellent DX-TV club—including its monthly bulletin—remains at 12.50 DFL.

transistor circuits
LINE TIMEBASE
Part 3: LT SUPPLIES

S. GEORGE

In the design of a solid-state television receiver the power supply circuits and the line output stage have to be considered together—first because picture width is dependent on the main supply rail voltage which must therefore be stabilised, and secondly because windings on the line output transformer generally provide any additional supplies required in the set.

In most mains/battery portables a conventional full-wave mains rectifier is used, with the rail voltage stabilised on both mains and battery operation by means of a series stabiliser circuit. The higher voltages required for the video output transistor and for the tube's first anode, focus and e.h.t. electrodes are provided by separate rectifiers fed from additional windings on the line output transformer.

Boost Rail

In some chassis a boost rail of the type found in valve receivers is used. As we have seen a separate efficiency diode is not essential in a transistor line output stage since the collector-base junction of the output transistor acts as a shunt efficiency diode following the flyback pulse. Using the line output transistor in this way gives no problems where the stage is operated from an h.t. rail, but where as in small-screen portables the stage is operated from an l.t. rail the voltages across the output transistor during this time result in non-linearity on the left-hand side of the screen. It is common therefore to find a separate efficiency diode in shunt with the line output transistor in small-screen portables. Alternatively the diode may, as in the TCE/BRC 1590/1 chassis and GEC Junior Fineline, be connected as a traditional series efficiency/boost diode. The circuit used in the 1590/1 chassis is shown in Fig. 1 where W11 is the boost diode. The 14·2V charge developed on the boost capacitor C107 is added to the 10·8V rail voltage to provide a 25V boost rail which is used to supply the line output and driver stages, the video driver and sync circuits, the i.f. strip and the intercarrier sound i.c.

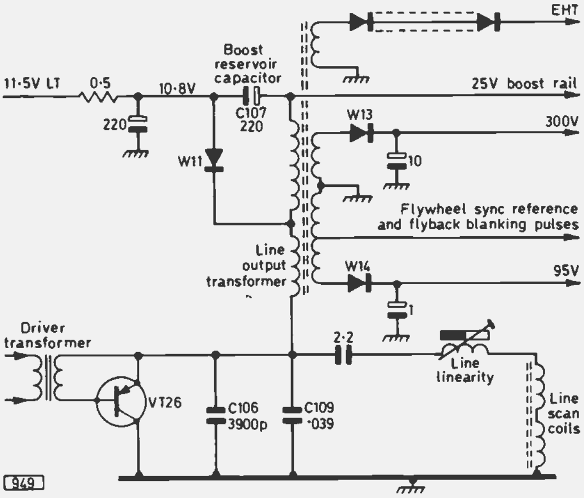


Fig. 1: Line output stage used in the TCE 1590/1591 chassis. The series efficiency diode W11 charges the boost reservoir capacitor C107 to provide a 25V boost rail. C109 tunes the transformer; C106 (270pF in the 1591 version) provides flashover protection.

Large-screen Monochrome Sets

In large-screen solid-state monochrome receivers a stabilised h.t. supply provides power for the line and video output stages, with the l.t. supplies required for the other sections of the receiver obtained as in small-screen models from windings on the line output transformer. The tube first anode/focus supply is also derived from the line output transformer.

Fig. 2 shows the line output stage of a typical modern large-screen monochrome receiver—the Philips 320 chassis. This is based around the BU105 transistor and as will be seen follows the arrangement outlined in Part 1. The low-value (56Ω) resistor R4465 in series with the stabilised h.t. feed to the line output transformer primary winding provides flashover protection and largely eliminates picture breathing; the e.h.t. is developed across an overwinding; and the scan coils are fed via a linearity coil, s-correction capacitor (C2470) and a coil which can be short-circuited giving a two-position width adjustment.

An unrectified feed from pin 6 on the line output transformer provides heater current for the c.r.t.; the feed from pin 8 is rectified by D2616 to provide 34V across its reservoir capacitor C2615 and a stabilised 12V supply at the junction R2614/C2612/D2611; and for the c.r.t. first anode and focus electrodes D2469 rectifies the flyback pulses at pin 3 to produce 415V across its reservoir capacitor C2468.

Shunt LT Stabiliser

A rather different way of obtaining the l.t. supplies from the line output stage is used in the Bush/Murphy A816 monochrome chassis. The circuit features a shunt l.t. regulator which in addition provides indirect stabilisation of the h.t. rail. A

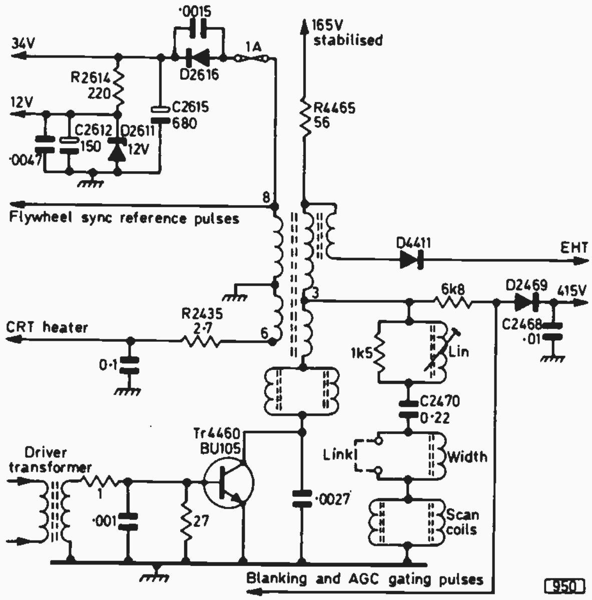


Fig. 2: Line output stage used in the Philips 320 large-screen monochrome chassis.

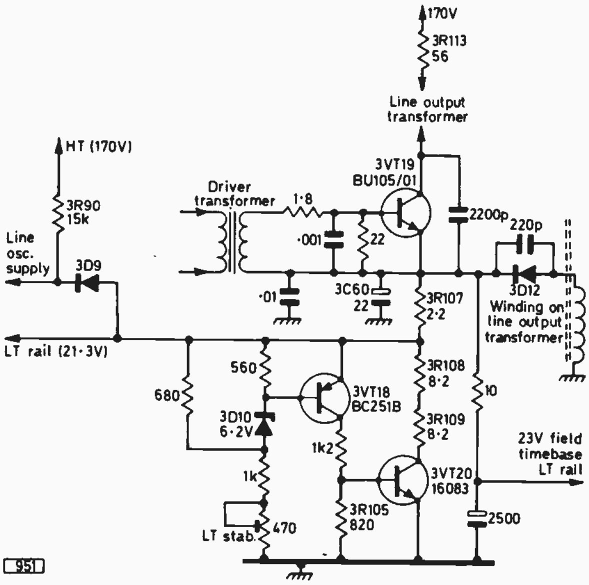


Fig. 3: The circuit used to develop the l.t. supplies in the RRI A816 chassis. The 21.3V rail is stabilised by the shunt regulator circuit which also indirectly stabilises the h.t. supply.

similar circuit—though operating in conjunction with a separately stabilised h.t. supply—is used in several recent colour chassis so it is worth examining in detail.

The arrangement is shown in Fig. 3. It will be seen that instead of being returned direct to chassis the emitter of the BU105/01 line output transistor is returned to chassis via 3R107, 3R108, 3R109 and 3VT20. Capacitor 3C60 is the l.t. reservoir capacitor. The voltage developed across this capacitor is produced in two ways: by the rectifier 3D12 which is fed from a winding on the line output transformer, and as a result of the current through the line output transistor. Stabilisation is effected by 3VT18 and 3VT20—the former sensing variations in the l.t. supply and the latter acting as the shunt stabiliser.

Stabiliser Operation

Zener diode 3D10 holds the base voltage of 3VT18 constant, its emitter, connected directly to the l.t. rail, sensing l.t. line variations. If the l.t. voltage increases for example 3VT18, being a pnp transistor, conducts more heavily. The increased voltage across 3R105 then increases the current through the shunt stabiliser transistor 3VT20 so that the voltage at the junction 3R107/3R108 falls. The opposite action occurs if the l.t. rail voltage decreases. Resistors 3R108 and 3R109 are included to limit the current in 3VT20.

Performance

The circuit provides stabilisation against several contingencies. In addition to stabilising the l.t. voltage, since it effectively shunts the h.t. supply it provides stabilisation against mains voltage variations as well and since it monitors the e.h.t. current it compensates for variations in this. The loop gain of the circuit is such that the voltage at the junction 3R107/3R108 remains constant within a few mV. When the circuit is set up correctly 3VT20 passes 550mA; thus it is clearly able to absorb and cater for wide current demand variations.

Starting the Line Oscillator

As in many solid-state chassis the line oscillator l.t. supply is obtained from the line output stage, presenting the problem of how to start the oscillator before the line output stage comes into operation. In this circuit 3R90 is connected between the h.t. rail and the supply pin of the SN76533N i.c. which incorporates the line oscillator, providing the supply on switch on. When the line output stage comes into operation and the l.t. supply appears clamp diode 3D9 switches on to provide the correct line oscillator supply voltage.

LT Supplies for ICs

The l.t. voltage in receivers employing several i.c.s—as in this particular case—must be well stabilised since the current consumption of such units can vary widely from one sample to another of the same type. The supply source must therefore be able to sustain the stipulated voltage if all the i.c.s take a high current and also prevent the voltage rising to an excessive figure if they all take a low current.

110° Colour

Turning now to a 110° colour receiver design, Fig. 4 shows the circuit—simplified—used in recent Nordmende models. The arrangement is similar to that just described, using power from the line output stage and from a rectifier linked to the line output transformer—in this case one of the EW modulator pincushion distortion correction diodes—to develop the l.t. supply. The BU108 line output

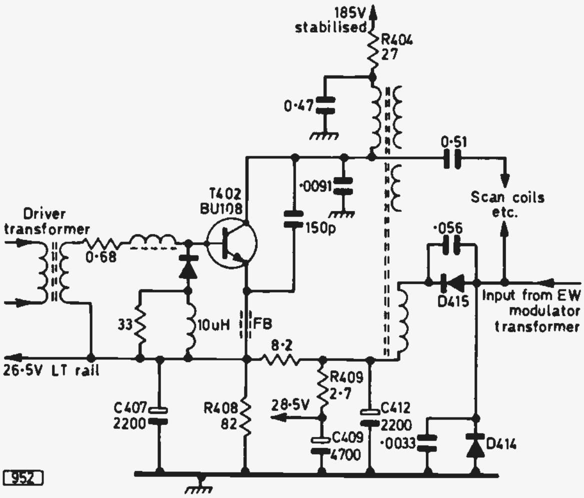


Fig. 4: A similar circuit is used to obtain the l.t. supplies in the Nordmende F IV 110° colour chassis.

transistor is fed from a stabilised h.t. rail while its emitter is returned to chassis via the 82Ω resistor R408 which is decoupled by C407 (2,200μF). In addition the EW modulator diode D415 develops 28·5V across C412. R409 and C409 filter this supply and feed the BU100A field output transistor. The 26·5V developed across C407 is used to supply the tuner, the i.f. strip, the decoder and the convergence circuits. The stable 12V supply required for the i.c.s used in the chassis is obtained from this line via a separate series regulator circuit.

The voltages obtained in this way are independent of the mains voltage and relatively stable against e.h.t. current variations—for as the beam current increases, thus increasing the loading on the line output stage and reducing its output voltage, any tendency for the l.t. voltage to fall is offset by the increased BU108 emitter current flowing through R408.

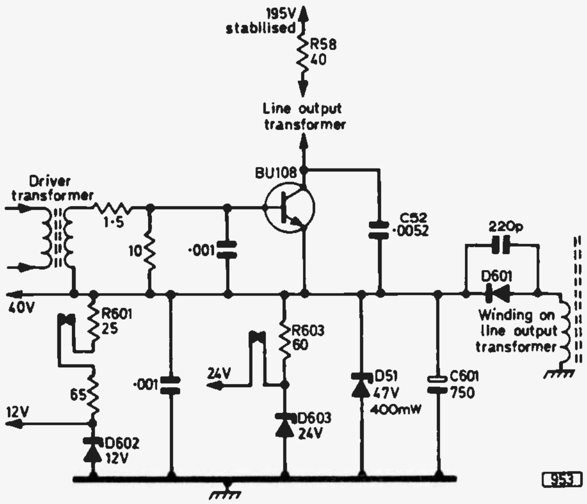


Fig. 5: Another variation on this theme: in the GEC C2110 series chassis the BU108 line output transistor sits on a 40V l.t. rail.

As the emitter of the BU108 is raised about 26V above chassis potential while its collector is fed from a 185V h.t. rail via the flashover protection/anti-breathing resistor R404 (27Ω) the transistor's net working voltage is about 145V—the value required to obtain the correct drive conditions for the deflection coils.

Anti-Boost Circuit

Similar reasoning applies to the BU108 line output stage (see Fig. 5) used in the current range of GEC colour receivers—the C2110 series. To obtain an optimum operating collector voltage of 140V from the stabilised 195V h.t. line the l.t. supply obtained at the emitter of the line output transistor is 40V and this in conjunction with the usual protection/anti-breathing resistor (R58, 40Ω) gives the required collector voltage. GEC refer to the l.t. production circuit as the "anti-boost circuit"—understandably since it reduces the line output transistor's working collector voltage whereas conventional boost circuits increase the supply voltage available for the line output stage.

The 40V l.t. supply developed across C601 is again produced in two ways—as a result of the output transistor current charging its emitter "reservoir" capacitor (C601), and the action of rectifier D601 which is fed from a winding on the line output transformer. In addition to the 40V rail, 24V an 12V supplies are obtained via fusible resistors and zener diodes. The 40V supply is used to power the field timebase, the 24V supply feeds the audio i.c. while the 12V rail supplies the tuner, i.f. strip, decoder and line oscillator. In the event of excessive current demand or a short-circuit across the 12V or 24V rails fusible resistor R601 or R603 goes open-circuit. The 47V zener D51 protects the entire l.t. system against an excessive rise in voltage: as long as the l.t. voltage remains below the breakdown voltage of this diode it remains non-conductive, but in the event of the l.t. voltage rising above 47V it goes short-circuit (it is rated at 400mW). The most common cause of this is C52 being defective.

Conclusion

In conclusion, in these three articles we have sought to highlight the many ways in which transistor line timebase techniques differ from valve timebase practice. ■

LETTERS

THE PHILIPS 210 CHASSIS

I would like to point out a slip in John Law's article on Philips Field Timebase Circuits (May, 1974) where it was stated that the drop-off resistors should be soldered to the underside of the tags using "high-temperature solder". Ordinary eutectic solder should be used of course otherwise in a fault condition the solder will not melt easily and the resistors will not drop off.

A peculiarity of the 210 chassis is that when both the field output valve cathode resistors drop off due to a faulty valve etc. the associated decoupling capacitor C4011 which is not normally rated above 50V finds itself with the full h.t. voltage across it. It explodes quite spectacularly, scattering bits of conductive paper all over the inside of the receiver. If this is not very carefully removed many odd symptoms are likely to arise.—**Richard S. Jones** (*Bontnewydd, Caernarvon*).

1500 CHASSIS FAULT

We have recently come across three cases of a fault which was not mentioned in your articles on the BRC 1500 chassis (August, September and December 1972, also Letters March and July 1973) and would like to pass this on for the benefit of other readers. When R79 goes open-circuit the bias to the video driver VT8 is removed and the picture lost. Unfortunately most viewers like to hear the end of the programme: the result, with HT6 rising to about 75V, is that VT7 and VT8 go short-circuit, taking nearly all the heater current and cooking R78. VT7 and VT8's emitter and collector resistors may also be damaged. The odd fact is that the sound is still audible even with VT7 and VT8 short-circuit. When one of these sets comes in now I always check the condition of R78—if discoloured a quick check on the far left section (R79) of the mains dropper reveals all.—**K. C. Alford** (*Wellingborough, Northants*).

AN UNUSUAL BUZZ

A service call was made to cure a case of reduced field scan with a Bush Model TV161. Replacing the PCL85 cured the fault and a quick visual check was made of the cathode resistor which appeared to be in order. On the following day a further call was requested with the complaint that there was a "loud buzz". This proved to be very true, with the buzz swamping the audio except when the volume control was at maximum. Another PCL85 made no difference and it was then discovered that the field hold was critical and that varying the field frequency altered the pitch of the buzz. Routine voltage checks around the PCL85 were started and it was found that when the meter was applied to the anode—at the field output transformer—the noise dropped considerably while when the meter was applied to the screen grid (at the valveholder) the noise stopped completely. Altering the dressing of the leads to the output transformer also affected the noise. A cold check and closer examination with dust removed revealed that the screen grid feed resistor 3R69 had fallen in value from 470Ω to about 30Ω. It must be assumed that the PCL85 was oscillating at supersonic frequency, with detection by the first audio stage and with the 50Hz modulation being amplified by the audio amplifier.—**L. Ingram** (*Amluch Port, Anglesey*).

YOUR PROBLEMS SOLVED

I would like to comment on your reply to the problem G. Harrison raised about a set fitted with the BRC 3000 chassis—no picture but with the e.h.t., sound and tube heaters working normally. Your view that the fault lies in the beam limiter circuit is certainly a possibility but one component fault suggested here, C902 being short-circuit, would have the opposite effect. By reducing the voltage at the base of the adder stage VT205 it would increase this transistor's collector voltage, increasing the luminance emitter-follower's emitter voltage, reducing the collector voltages of the RGB output transistors and thus increasing the brightness. If the beam limiter circuit is suspected of being the cause of this fault condition the easiest check is to disconnect plug 22 on the limiter board: if the fault is on this board the result will be uncontrollable brightness. If this action does not restore the brightness I suggest that the RGB output transistor collector voltages are checked. If they are correct—approximately 160V $\pm$ 10V or so—I would suggest checking the c.r.t. grid bias voltage which should be 0V but if R452 on the field timebase board is open-circuit could rise to a large negative voltage, and the first anode voltage which should be 1kV but will be absent if rectifier W505 is open-circuit. —**P. Pratt** (*Swindon, Wilts*).

In connection with G. Harrison's trouble with a set fitted with the BRC 3000 chassis I feel he is unlikely to have a beam limiter fault since apart from the preset brightness and limiter controls (R903 and R906) and the 1.5Ω resistor R907 which forms the line timebase earth return path this circuit has proved to be quite reliable. Assuming that there is no raster and that the e.h.t. is normal I suggest the video panel is checked as follows.

Remove the aerial lead and operate the set white switch, thus removing the sound and the field scan. Adjust the preset R221 in the collector circuit of the offset pulse generator stage VT204 to give 10.6V at the video test point (VT205 collector). If this voltage cannot be obtained replace VT204 and VT205. If the voltage at the video test point is correct adjust R230 in the video clamp circuit for 160V at VT212 collector (heatsink). If this voltage is incorrect check L205, R228 and C221.

If the voltages so far are correct connect the meter to the c.r.t. grids (pin 3) and with the set white switch still operated adjust the grid bias preset R450 on the field timebase panel for 0V, using the meter's 100V range. Then adjust the c.r.t. first anode presets (R726, R730 and R735) on the convergence panel so that the three coloured lines are *just* cut off. If these three lines cannot be made visible check rectifier W505 and its reservoir capacitor C523 on the line timebase panel. Finally, restore the set white switch to the normal position and check the settings of the preset brightness and beam limiter controls.

A. Warren's BBC sound-on-vision cannot be due to the defects suggested since there was no BBC oscillator core, a.g.c. circuit or preset gain control in the Murphy Model V230, which was released in late 1955. Assuming that the fine tuner range is correct, the trouble could be due to incorrect sound-to-vision ratio which could be caused by the use of an r.f. coil for the wrong channel or an aerial fault. Even though the ITV performance is normal the i.f. alignment could unfortunately be faulty: this may be almost impossible to cure as the i.f. cores are probably seized solid.—**D. Booker** (*York*).

Editorial comment: Our thanks to P. Pratt and D. Booker for their careful analysis of the BRC 3000 chassis fault. Our comments on the sound-on-vision trouble were meant as general guidance and we must confess we hadn't checked up on the points revealed by Mr. Booker. It turns out that the circuitry used in the Murphy Model V230 was unusual in quite a number of respects. For example, the volume control acted on the sound i.f. amplifier stage; a single-valve line timebase was used with feedback to the screen grid; and the boost diode produced a –150V line which was used for the field timebase, the c.r.t. biasing, the audio amplifier and the vision interference suppression (video amplifier suppressor grid) circuits as well as being applied to the line output valve cathode to increase the line output stage working voltage.

THE SERVICING PROBLEM

A recent correspondent revealed that service engineers, disillusioned by conditions, are leaving the trade for the better wages and conditions offered in the various electronic industries. The loss is serious and as one who has worked in the radio and TV servicing trade for some 24 years I think the reasons are obvious. What was once a reasonably congenial job is now (with colour TV) hard, exacting work. Nevertheless I feel that many engineers in the service trade stay in it for no better reason than that the job is interesting. As your correspondent says, wages are not the draw. For about 25 years viewers paid a modest £70 or so for a 17in.—later 20in.—monochrome set. Viewers now pay £200-600 for a colour set and I am sure many engineers will agree with me that the customer with a broken down new TV set at this price is not the nicest of people to meet. The colossal weight of some console (and table) colour sets is another problem and I understand that new students in service courses are asked if they are prepared to do some humping when they enter the trade! Perhaps the RTEB examiners will include a weight lifting course next year?!

There are a few enlightened employers who provide reasonable wages and conditions, but much damage to recruitment of the right type of technician is done by bad employers. One small dealer group known to me ordered their engineer to work at three branches in one day, deliver white goods and carry out TV, radio and electrical repairs etc. both inside and out at all branches. He had to supply all tools and equipment and work in flooded and rat infested workrooms. Needless to say this firm no longer services colour TV sets. This type of shop was eager to cash in on the colour boom but is not willing to spend anything on good equipment or workshop facilities. Fortunately not many firms like this stay in business, but enough of them do and drive potentially good engineers away, a loss the trade can ill afford.—**J. A. Mercer** (*Hayes, Middx.*).

How wholeheartedly I agree with K. Farrant of Preston, Lancs writing to you on the servicing problem in the March issue. The points he makes are all absolutely true in respect of most TV dealers here in the south and indeed London. I worked for 15 years studying one such dealer as engineer on appalling wages, and was expected to service monochrome and colour receivers with an Avo 8, a tin of switch cleaner and a magic wand. The approach to real test gear by poor dealers is short-sighted, a lot of time and valuable customer good will being lost through not having bought adequate equipment. So far as firms advertising for qualified or skilled colour engineers are concerned there can be only very few of these left in the trade. Provided manufacturers keep on supplying repaired replacement panels the trade may get by with "panel pluggers" like the old "valve pluggers", but many customers are beginning to get worried about what will happen to their colour sets when they go wrong. If the trade continues in the way it has done over the past five-six years I can only say God help them—and urge them to kneel and pray that when the white coated engineer comes through their gate he'll have that look of confidence, good pay and test gear he can hardly carry.— **C. V. Eyres** (*Sidcup, Kent*). (Past TV engineer now recovering.)

I found the letter from K. Farrant in the March issue particularly interesting having spent ten years in the radio and TV trade since starting at the bottom at the age of eighteen in one particular rental company. Once initiated I discovered that I could progress more rapidly and gain more experience by frequently changing companies when the opportunity arose. I then spent a year in a retail shop repairing almost every conceivable make, model and vintage of receiver—customers bringing in ancient sets with obscure faults in their early gated a.g.c. or flywheel sync circuits and with a note attached saying "don't repair if over thirty shillings". I enjoyed the work but returned to TV rental because of the greater scope available to my greatest love, television.

There is a great deal to be said for the industry today, but the disadvantages and advantages should be carefully considered by any potential technicians and appreciated by many of the purist television amateurs who expect their mass-produced rental sets to give the performance of precision monitors. This latter comment is not meant to mock the amateur, for I can well remember the days when I would return home from school or the office to tinker with an aged receiver. But the price of gaining experience and earning one's living by doing what one loves most can lead to one becoming cynical and disheartened.

Basically, in spite of the impression created by those glossy advertisements in the Sunday colour supplements—". . . we build in that extra bit of quality to suit you . . ."—most companies exist to please their shareholders and safeguard their executives. So no matter what the dreams of the advertising managers high in their offices above factory floors or miles away from screaming subscribers in isolated rental showrooms the TV technican faces the real world of economics and problems at the end of the chain where he is the organisation's link with the customer.

The manufacturing industry is highly competitive and is still conscious of the time a decade or so ago when a credit squeeze, uncertainty about colour and line standards together with robust hand-wired sets stopped the sale of new receivers and caused the death of many setmakers, some of whose names survive as emblems on sets coming off the lines of a one-time competitor.

Does the ordinary man in the street look for quality first? Does he go for better picture quality or does he consider cost? I have experienced several cases of customers who have complained of difficulty in adjusting one notably fine make of set fitted with black-level clamping and who have shown no appreciation of the difference such refinements make.

In such a world manufacturers have to consider the average viewer. It is too costly to design and set up production lines to make sets to cater for minorities. Some compromise has to be found so that components readily and cheaply available can be used instead of those which are desirable from a reliability point of view. Taking all into consideration most sets are remarkably consistent and reliable, but a line must be drawn somewhere. Picture geometry is not always quite as it should be. Reject too many deflection yokes because of bowed sides and the cost of the sets soars. Use large 1000V capacitors instead of 600V types and again the cost rises. Exercise greater control over printed circuits to prevent dry-joints and the result is the same. The customer wants a low priced set that looks good, but if it goes wrong he looks to the technician and if something goes wrong after that he will blame the technician.

TV servicing in the past became as suspect as the secondhand car trade unfortunately, due to the easy money made by "valve-jockeys" and those who shorted mains droppers with pieces of wire. Those days are coming to an end because of delicate solid-state circuitry. The public must learn therefore that the TV engineer is highly skilled at his craft, deserves his wages and that his opinion is to be respected in the same way as that of a doctor. It is folly to disbelieve that an aerial is faulty just because it might cost a few pounds to rectify. One spends more on servicing a car which contains fewer delicate components than a television receiver.

Let's take a brief look at a typical television rental company and see how it works from a technician's point of view.

The workshop is situated behind the showroom, has seven technicians and serves a suburb of London. It has about 6,000 subscribers and is but a small part of a national company. It receives its spare parts on a "one for one" basis every week from the company's vast central stores. A large number of the sets on rent are low rental two- and three-channel sets, mainly in large council estates. There is a growing number of single-standard 625-line monochrome and colour receivers. Six of the technicians are classified as field engineers, each servicing about twelve sets per day. The remaining technician is the senior technician responsible—in theory at any rate—for issuing calls, ordering spares, workshop repairs, customer liaison and general "quality control" of the outside service.

Most of the technicians use a company vehicle of which private use is permitted and for which a fixed allowance is paid in the wages for supply of petrol for business use. Each carries a tool kit (mainly his own tools) and about seventy valves. A large selection of common small and large components is supplied and dependent on the technician's ability and the discretion of the senior technician possibly a selection of transformers and e.h.t. rectifier trays.

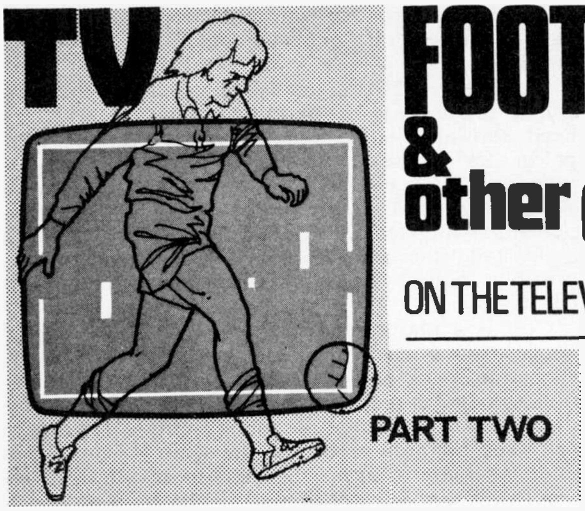
Cost is a major factor in operating such a large concern. Overheads such as showroom staff salary, shop and workshop upkeep, transport, administration and spares play a major role. On paper the cost of repairs to sets must amount to only a few pence per week per subscriber and the senior technician is under pressure from his superiors to ensure this.

A wobbulator is not present in the service department. There is little time to use one and most problems are overcome quite skillfully without. There is an oscilloscope which gets ever increasing use as the number of colour sets increases, together with a couple of colour-bar/crosshatch generators. Every technician has a meter.

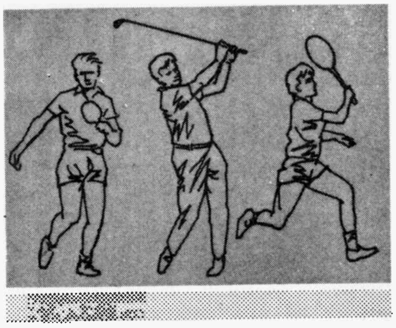
By ten each morning each technician has downed his cups of tea, got his moans off his chest and set off on his rounds. If all goes well he may not be back until the next day. He may ring in to pick up late calls however, though no promise is made in the customer agreements for anything except service "within twenty four hours". Every engineer likes if possible to finish early occasionally. Each technician will see his share of the same old moaning faces: "The girl in the shop promised me a new set" . . . . "How can it be the aerial, the set next door is OK?". . . . "I could have bought this set ten times over" . . . ."The other man promised to bring a new knob". . . . "It always goes when you've gone". . . .

Whilst some complaints are justified, the majority stem from the customer ignoring such necessities as a good aerial. There are lazy engineers too, but many of the failures to provide good service are due to lack of time. To avoid having twelve nasty decoder faults in a day it is necessary to trust to luck. Most fault finding ability comes through hard experience, but good technical knowledge is increasingly essential. Most companies today encourage high technical standards through training schemes and grading tests with financial renumeration. But it's a fast changing world. Too often engineers are expected to keep up with developments in their own time. They have to work unsocial hours—Saturdays and late Christmas Eve when everyone else is merry making. They have the bare minimum of days off at holiday times—Easter, Christmas, Whitsun—and in spite of the estate cars which are always mentioned when someone complains very few get more than £40 per week.

Before condemning them, try to think if you could reassure twelve unhappy people, replace four valves, clean four sets of tuner contacts, replace one line output transformer, adjust the convergence on a colour set you've never seen before and dig yourself out of a muddy drive—all in a day! — **Malcolm Burrell** (*Pwllhelli, Caernarvonshire*).



TV FOOTBALL & other GAMES ON THE TELEVISION SCREEN



P. BUSBY*B Sc

*IPC SERVICES LTD.

PART TWO

In this month's article modifications to a monochrome receiver are described, also the ramp generators and joysticks. When these have been completed the men and ball can be moved around on the TV screen. Modifications to a colour receiver are similar to those described here but will be dealt with in detail in a later article—the colour television chassis for which full interconnection and modification details will be given is the KB/ITT CVC5 chassis, which uses RGB tube drive.

Ramp Generators

Fig. 8 shows how the ramp generator circuits are driven from a monochrome receiver. The field ramp generator is triggered by the field flyback blanking pulse applied to the c.r.t. grid. The pulses are picked off via C30 and passed through filter R40, C31. This attenuates the line blanking pulses which are also generally present at this point. The field pulse is amplified by Tr10 and used to trigger the monostable IC10 which produces a 1mS output pulse. This 1mS pulse switches on Tr11 to discharge the ramp timing capacitor C35 which charges via the constant-current generator Tr12 to give a linearly rising voltage. A sawtooth signal is thus generated at the collectors of Tr11 and Tr12. R47 is connected in series with C35 so that the capacitor does not discharge fully during the 1mS blanking period: the net result is that the 2V ramp surmounts a 2V pedestal ensuring that the schmitt trigger circuits are properly turned off during the blanking periods.

A high input impedance emitter-follower (Tr13) picks off the sawtooth and drives another emitter-follower (Tr14) which has an output impedance low enough to drive the subsequent circuits.

The line ramp generator circuit is similar in operation but uses different component values to allow for the faster line signals. The line pulse signal is picked up by means of a metal plate placed in close proximity to the line output transformer. In the prototype receiver a 4×2in. piece of Veroboard with all tracks shorted together was tied inside the line output transformer screening can—well clear of any high-voltage points! Some experimentation may be necessary here to obtain a pulse from Tr15 emitter of about +5V amplitude. The monostable IC11 generates a 10μS pulse which drives Tr16 on to discharge the line timing capacitor C38. The charging, discharging, and emitter-follower pick-off circuits are similar to those used in the field ramp generator.

★ Components list

RAMP GENERATORS AND TV DRIVE

Resistors: (all ± 5%, ¼W)

R58	270 Ω	R55	22k Ω
R51	330 Ω	R42	27k Ω
R43	2.7k Ω	R56	33k Ω
R49, R57, R60	4.7k Ω	R41, R45, R48,	
R44	6.8k Ω	R53, R54	100k Ω
R59	10k Ω	R50	150k Ω
R40, R47, R52	18k Ω	R46	330k Ω

Capacitors:

C34, C37	470pF	C33, C40, C41	0.1μF Ceramic
C36, C38	1000pF	C32	0.22μF
C31	0.01μF	C44	0.33μF
C35, C42	0.1μF	C30	1μF, 400V
C43	0.1μF, 400V	C39	10μF, 15V

Semiconductors:

Tr10, Tr11, Tr13, Tr14, Tr15, Tr16, Tr18, Tr19 BC184
Tr12, Tr17 BC214 Tr20 BC182
D12 1N4148 (1N914) D13 BZY88 C10 400mW
IC10, IC11 74121

Miscellaneous:

Capacitive pick-up plate (see text)

JOYSTICKS (2 off)

Resistors:

R15, R19, R22, R29 1.8k Ω ± 10%, ¼W

Potentiometers:

VR4, VR5, VR6, VR7 10k Ω lin
VR9, VR10 5k Ω lin (long spindle)

Capacitors:

C10, C11, C12, C13 1000pF ceramic

Miscellaneous

S1, S2 DPST non-locking push buttons

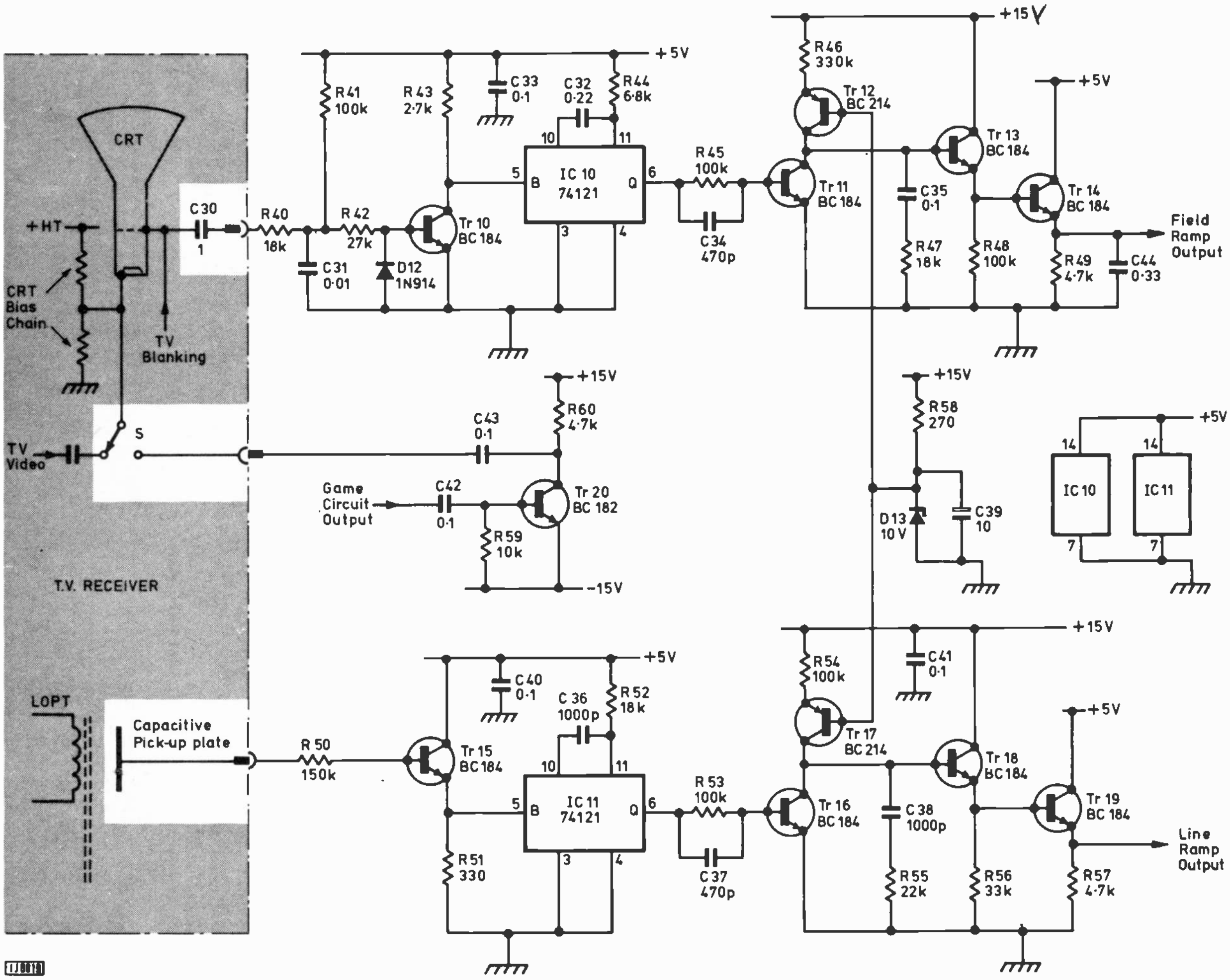


Fig. 8: Circuit diagram of the ramp generators and the TV drive circuit for use with a monochrome receiver. Existing receiver circuitry is shown within the shaded area on the left.

The field and line ramp outputs drive the men and ball circuits described in last month's issue.

Synchronisation

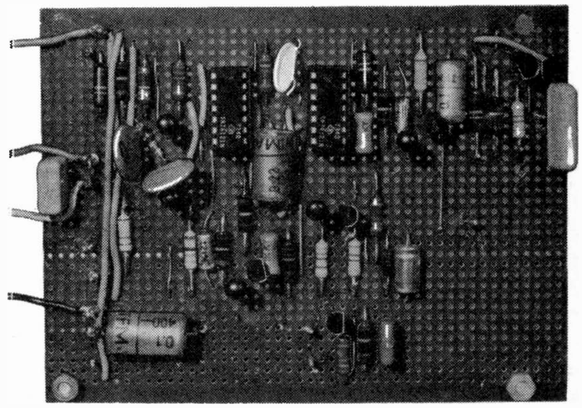
It should be noted at this point that the receiver must be tuned to a broadcast in order to synchronise the line and field pulses: this ensures jitter-free operation of the system.

Simple TV Drive Circuit

The final modification to the receiver is to provide the game modulation input connection. In the receiver used with the prototype equipment the video signal was a.c. coupled to the c.r.t. cathode. As an off-air signal is present in the receiver even when it is in use for games a switch (S) is incorporated to switch the input to the c.r.t. cathode from the off-air to the game video signal. It is vital to ensure that the tube bias circuits are not modified or affected in any way by the game circuits. In this connection note that some chassis use d.c. or partial d.c. coupling and cases of grid drive will also be found. The game circuits drive the c.r.t. cathode via the simple amplifier Tr20. The ramp generators and tube drive circuits are all wired on one card whose layout is shown in Fig. 10.

Joystick Controls

An attractive feature of the TV game outlined



The ramp generator and TV drive board.

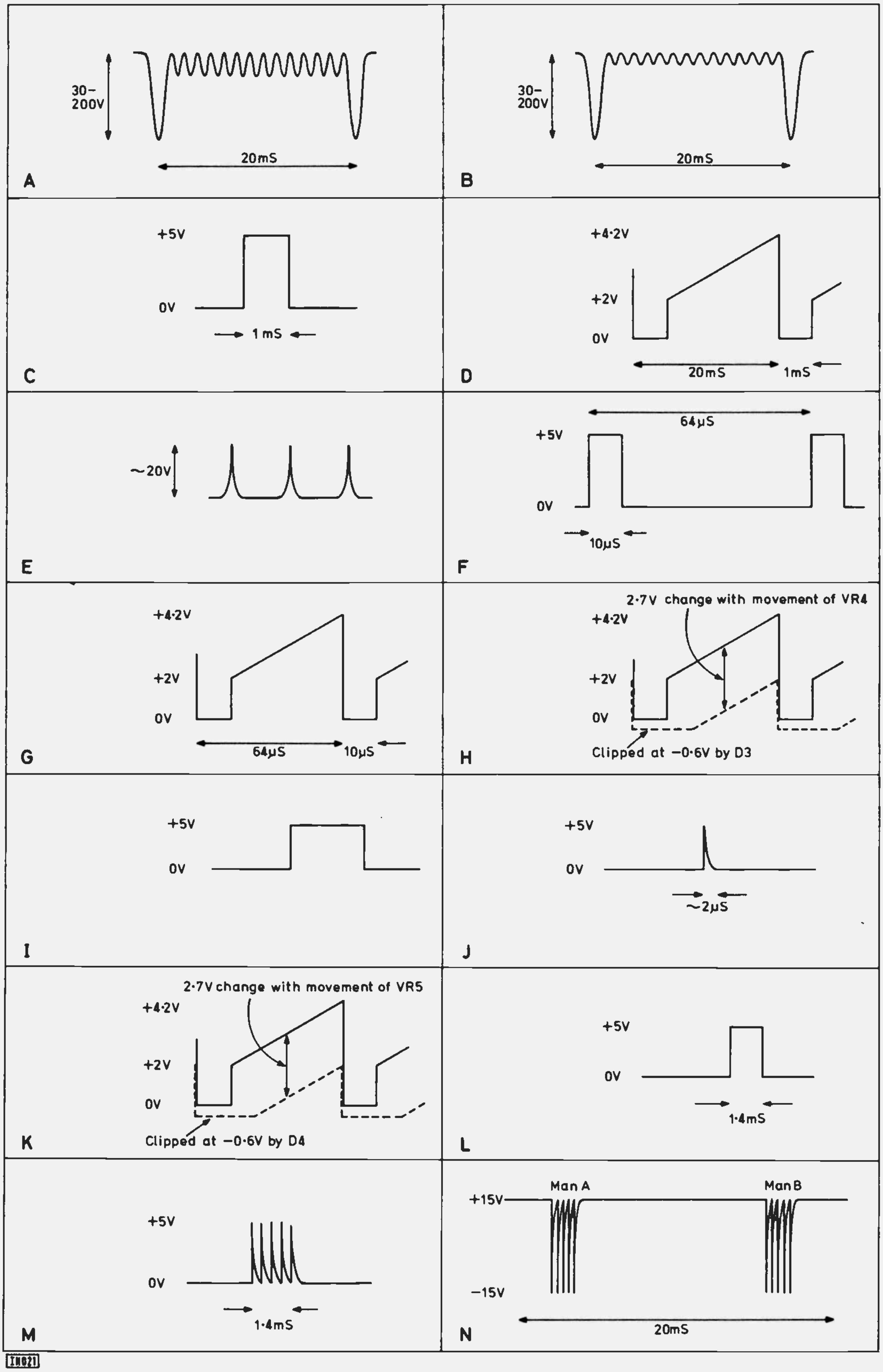


Fig. 9: Idealised ramp generator, men and ball board waveforms (see text).

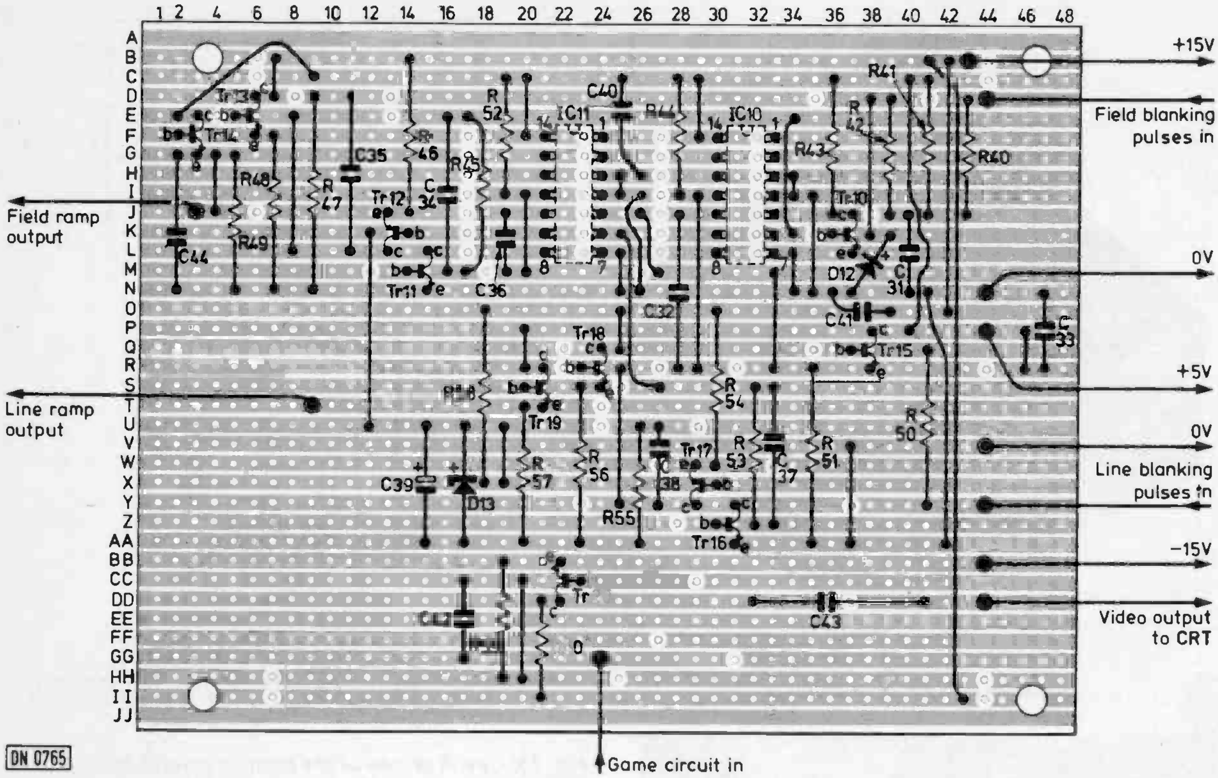
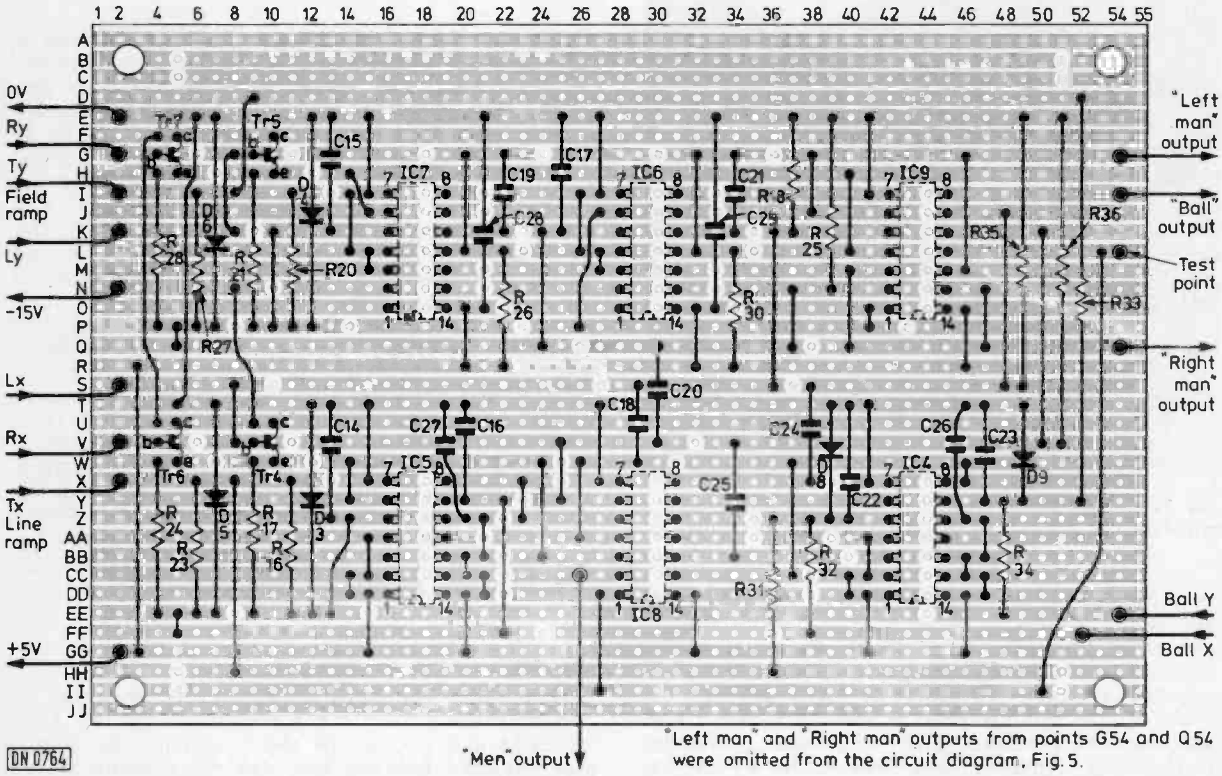
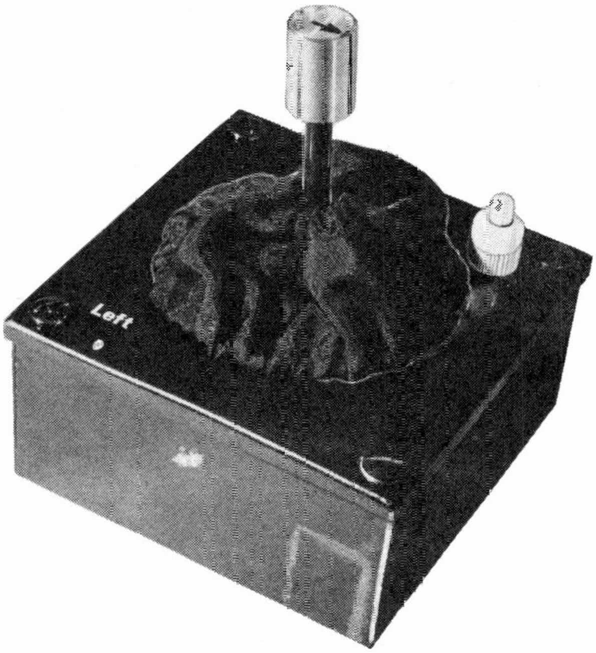


Fig. 10: Layout of the ramp generators and monochrome tube drive circuit, viewed from the copper side.



"Left man" and "Right man" outputs from points G54 and Q54 were omitted from the circuit diagram, Fig. 5.

Fig. 11: Physical layout of the men and ball circuits, viewed from the copper side of the board. For circuit diagram and description see Part 1 last month.



Finished joystick control box.

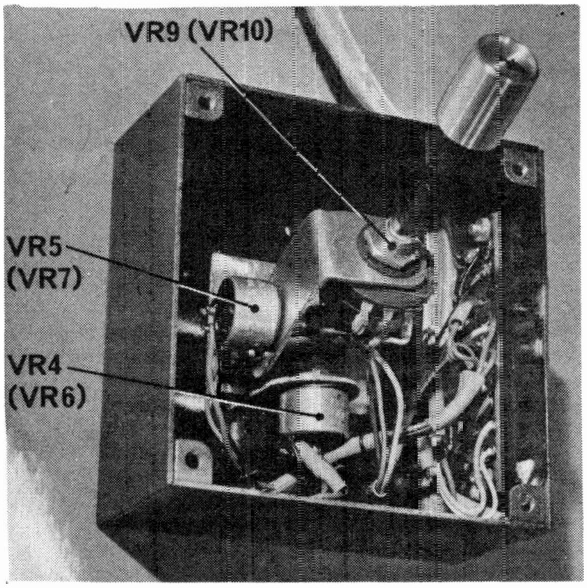


Fig. 12: Interior view of one of the joystick control boxes, showing the method of coupling together the potentiometers.

in this series is the joystick control, Fig. 13, which allows the players to move over the entire field of play. The joysticks are of simple construction and consist essentially of two potentiometers with the spindles anchored together at right angles. The body of one potentiometer is secured inside a suitable box with a bracket. The control stick is attached to the body of the second potentiometer by another bracket.

The control stick itself is a third potentiometer which in the simple game is used to determine the

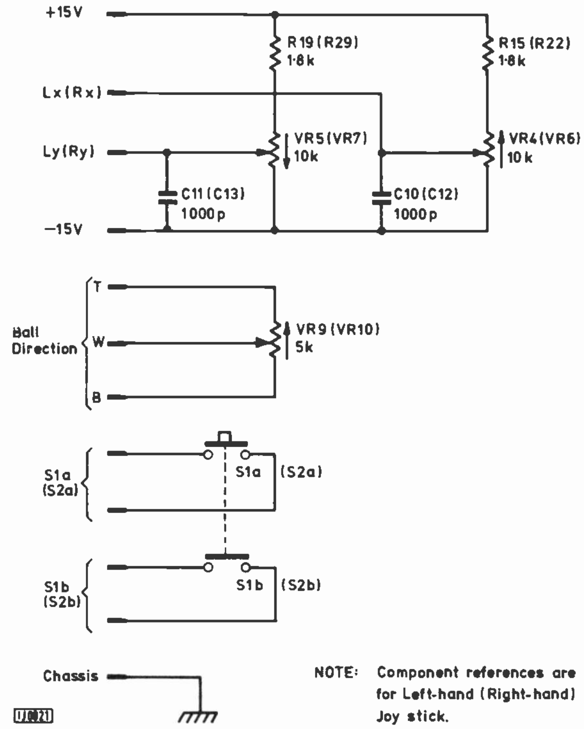


Fig. 13: Circuit of one of the joystick control boxes. Component reference numbers given apply to the left-hand box —those for the right-hand box are shown in brackets.

direction of travel of the ball. The construction of the hardware is shown in Fig. 12. The potentiometers themselves are ¼in. spindle types with a body diameter not greater than 1⅛in. Don't use potentiometers with plastic spindles as they tend to slip in the spindle clamp. The potentiometer used for the control stick should have a long spindle—not less than 2in.

The other two potentiometers should have 1in. long spindles and a screwdriver slot should be cut in the end to aid alignment. Assemble the joysticks with the wipers at the approximate centre of their travel when the control stick is vertical. The two joysticks are housed in individual metal cases of the type used for electrical junction boxes. For a professional finish the exposed parts of the joystick should be covered with a flexible skirt made from black cotton material. A double pole pushbutton is also fitted for recovering the ball after scoring. The joysticks are wired to plugs and sockets on the main unit with 12-way multicore cable of sufficient length to reach the TV set from your normal viewing chair. With this arrangement we can truly say that armchair football has arrived!

Wiring

The ramp generator board can be mounted in the main unit once the power supplies have been checked and set up. In the prototype the boards are mounted between ⅜in. steel bars, using plastic P clips. This has the advantage that the boards will pivot about one edge when testing. Care should be taken if for normal viewing the TV set is to be used without the isolation transformer. The plugs and sockets used for the wiring to the set must be of a type which will withstand mains voltage. Also, the pins should be well separated and the set-mounted socket well shrouded. The output from the isolating transformer is taken to a mains output socket on the back of the unit so that the TV set can be plugged directly into this. The men and ball board can then be mounted in the unit.

The power supplies should be wired to each board separately. After the interconnecting wiring between boards has been completed the unit is ready for testing.

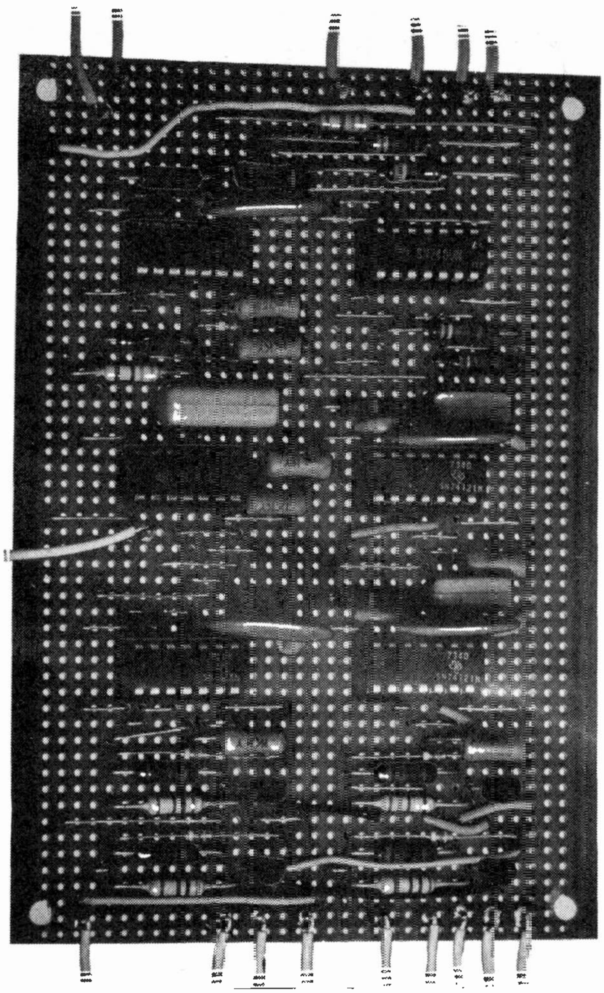
Testing

It is not possible to display the men and ball together at this stage as the mixer is on the game circuit board. To check the men circuits make a temporary link from the output of IC9d to C42 in the TV drive circuit. With the unit and set switched on, two men should appear on the screen—it may be necessary to move the joystick controls to get a display. When a display has been achieved each joystick can be set up. Check that the direction of movement of the control stick gives a corresponding movement on the screen: if not reverse the connections to the relevant potentiometers. With the control stick vertical the men should be central in the left and right halves of the screen respectively. To adjust the men, slacken off the clamp screws and rotate the potentiometers as required.

Waveform Checks

Whatever the outcome of switching the system on it is advisable to check the various waveforms with an oscilloscope. The main waveforms are shown in Fig. 9. A is the blanking pulses at the junction of C30 and R40. B is the filtered waveform at the junction of R40 and C31. C is the 1mS pulse at pin 6 of IC10. D appears at the emitter of Tr14—this is the field ramp used to drive the man and ball circuits. E is the line waveform picked up by the plate fitted adjacent to the line output transformer. F is the 10μS pulse at pin 6 of IC11. G is the line ramp generator output. Intermediate signals have not been given but obviously if the correct signal does not appear at the point stated it indicates that there is a fault to be located and rectified. The signals listed so far are all found on the ramp generator and driver card Fig. 10 (circuit diagram Fig. 8).

The man circuits are tested next. As both men are similar only one set of waveforms is shown. These should be checked out on each man. H shows the waveform at the junction of R16/R17 (or R23/R24). A smooth transition between the two levels shown must occur as VR4 is rotated. I shows the output of IC8b, the leading edge being movable from one end of a line to the other by rotating VR4. J is the waveform at the junction of C18, R18. K is the field ramp at the junction of R20/R21 and is moved between the limits shown by VR5. L is the output at pin 6 of the monostable IC7—it will be remembered that this determines the height of a man. In the prototype game a pulse of 1.4mS is used. M shows the mixed output from IC9d. The drive amplifier to the c.r.t. cathode (Tr20) inverts and amplifies the two men and the ball signal to give N. All these signals can be moved within the field period by adjusting the appropriate controls.



The men and ball board.

The ball circuits (Fig. 7) are very similar to the man circuits and no separate waveforms are necessary. To test the ball circuits the inputs to R32 and R34 should be temporarily connected to a variable source of +5 to −15V as described in the first article. As the output of IC9c is positive-going it will need to be inverted to drive the video output circuit. The spare inverter in IC8 can be used temporarily by linking IC9c (pin 8) to IC8e (pin 11) and connecting pin 12 to the video drive circuit (disconnect the player circuits first).

Game Circuits

This completes the basic circuits needed to play any game on a monochrome receiver. Nets and boundaries are generated in exactly the same way that men are produced, but their positions are of course fixed. The one essential feature not described so far is the circuitry for reflecting the ball from men and boundaries. In next month's article this vital topic will be described in connection with a simple ball game.

CONTINUED NEXT MONTH

YOUR PROBLEMS SOLVED

★ **Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 475 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone. We cannot provide modifications to circuits published nor comment on alternative ways of using them.**

FERGUSON 3618

The trouble with this set is that both the contrast and brightness controls have to be turned up fully to get a viewable picture and even so it is very sooty and like whitewash.—J. Turner (Egham).

The c.r.t. first anode supply could be incorrect: check C93 (0·1μF) which decouples this. Then if necessary check the PCL84 video amplifier and the resistors in this stage. (BRC 850 chassis.)

DECCA CS1910

There seems to be a fault in the blue channel in this set: there is not enough blue signal to give proper colour balance but at the same time there is blue streaking on the picture. The picture is also rather smeary.—G. Tyler (Woking).

You are quite right, there is a fault in the blue channel. These symptoms occur when the 5μF electrolytic capacitor C214 which couples the signal to the base of the first transistor TR207 in the blue channel is faulty. For best results make sure that your replacement is of the same type as the equivalent coupling capacitors in the G and R channels. Note that C214 is mounted close to R325 which feeds the clamping pulses from the line output transformer to the clamps in the RGB channels. This resistor gets hot so keep C214 as far from it as possible. (Decca series 10 chassis.)

BUSH TV125

Soon after the set warms up the width reduces by approximately one inch on each side of the screen and at this point the height increases by the same amount. Varying the width control 3RV6 makes no difference though the height can be adjusted. During the warm up period there is flashing and picture break up but this stops when the width decreases.—J. Bailey (Exeter).

The flashing noticed when the set is first switched on is almost certainly due to arcing inside the PY88 efficiency diode (a PY800 may be fitted). The height fault is related to the lack of width since it is due to a fall in the e.h.t. In short the line output stage is not providing enough power and replacing the PL36 output valve and efficiency diode should clear the troubles.

GEC 2000

We are having trouble clearing a field collapse fault on this set. A new PCL85 has been tried without improving matters but it seems that the fault is on the triode side as its anode voltage is very low at 10V. The field charging capacitor and all the components in the height circuit have been checked and found to be in order however.—T. Prior (Altrincham).

The fact that the triode anode voltage is so low suggests that the field timebase is not oscillating. The most likely cause of this fault is that the cross-coupling capacitor C93 (0·005μF, 1·2kV) from the pentode anode is defective but the other cross-coupling capacitor C92 (0·1μF, 350V) could also be the cause of the trouble.

HMV 2700

There are sync faults in this set. The test card appears like a cogwheel while if there is an area of white on the picture the field timebase trips and bounces and the line is pulled as well. The sync separator and field oscillator sections have been thoroughly checked.—R. Boyle (Cardiff).

The problem seems to be sync pulse distortion. The cause of the trouble is likely to be in the luminance amplifier stage VT1 or the pre-sync amplifier VT4 therefore. Check the voltages in these stages and note that there are several electrolytics that could be faulty in this area—C1 which provides coupling to VT1, C2 which decouples the supply to VT1 and C8 which forms part of VT4's input circuit. Diode W2 at the input to the sync separator VT5 could be faulty, and it would be worth taking a look at its anode bias resistor R25 (3·3MΩ). Make sure that the flywheel line sync discriminator diodes W1 and W2 are of equal, low forward resistance and high reverse resistance and that their load resistors R6 and R7 are both 10kΩ. Check that all the interconnecting plugs and sockets are making good contact—faults here can give odd symptoms. (BRC 2000 chassis.)

FERGUSON 3810

The problems with this set are weak line hold and intermittent loss of field sync, also a black band travelling down the screen. The main smoothing block, also C12 which decouples the HT7 rail and C38 which decouples the HT2 rail from which the sync separator is supplied have been replaced. The voltages in the sync separator stage seem to be correct and the flywheel sync discriminator diodes and associated components are all in order.—T. Elroyd (Barking).

The trouble is more likely to be in the 26V HT6 supply line. Check that this voltage is correct and that the reservoir and smoothing capacitors C58 and C56 respectively in this supply are in order. Common offenders are R44 (47kΩ) the upper resistor of the potential divider supplying the sync separator screen grid and C32 (50μF) which smooths the bias voltage on which the vision detector output is superimposed. If necessary check the coupling capacitor C42 to the control grid of the sync separator. (BRC 1500 chassis.)

BUSH TV300

The problem with this set is that after about an hour the contrast changes, with excessive whites and a pattern effect.—J. Lawrence (Tadcaster).

The fault could be in the brightness circuit: the supply for this is obtained via a rectifier from pin 4 of the line output transformer. Check for poor connections. On the other hand there could be a faulty transistor in the tuner, i.f. stages or video circuits, or a hairline crack or a component breaking down anywhere in these sections. If so there is unfortunately no simple answer: only patient inspection and careful voltage measurements will locate the fault. The patterning suggests a faulty tuner or faulty i.f. decoupling. Look for signs of overheating and leakage from capacitors: check earth connections and interconnecting leads.

PHILIPS G19T211A

The PY800 boost diode had an open-circuit heater and was replaced along with the PL504 line output valve and DY87 e.h.t. rectifier. Now on switching on the valves light up with a surge of brilliance before settling to a normal red glow, the e.h.t. comes up and a raster appears but after a minute or so disappears. This happens on both systems. If the set is switched off for a few seconds and then on again the sequence of events is repeated. If the e.h.t. cap is removed the e.h.t. remains however. Operating the tuner button a few times resulted in the PY800 arcing inside and its heater going open-circuit again. A PY81 has been fitted as a temporary replacement but runs hot and arcs inside during warm up, the e.h.t. then going as before. A faint whistle can still be heard after the loss of e.h.t. The components around the line output transformer all appear to be in order. At some time in the past a section of the mains dropper resistor has been replaced.—F. Sheldon (Wirral).

First check whether the dropper section replaced was the heater section which should be 125Ω: the correct value is important. Then ascertain whether the BY126 heater dropper diode is short-circuit—or shorts intermittently—thus over-running the valve heaters. The presence of the whistle indicates that the timebase is continuing to operate. So, if the e.h.t. is always present at full value (giving a really good spark) on the tube anode cap when this is removed from the c.r.t. either the DY87 has an internal short or the tube final anode an internal heavy leak to chassis. With the brilliance control set to minimum connecting the c.r.t. anode cap should have negligible effect on the spark obtained: if it arcs across as you bring the anode cap near either the e.h.t. rectifier or the c.r.t. is faulty. There is always a switch-on surge with these sets as there is no heater circuit thermistor: you can add one if you wish. (Philips 210 chassis.)

PYE CT200

We are troubled by sporadic mains fuse blowing in this receiver. No shorts can be traced, the mains filter capacitor has been renewed and there are no obvious signs of component failure.—J. Rawlings (Driffield).

You appear to have one of the early versions of this chassis. With these, spikes on the mains supply can trip the thyristor h.t. rectifier. The h.t. then rises and the overload cut-out 537 operates, shorting the h.t. line and blowing the mains fuse. In later production the problem was overcome by shunting the thyristor with a 2·2kΩ resistor and 0·2μF capacitor in series. We suggest you add these.

DYNATRON CTV4A

The fault on this set is present during the warming up period. On switching on a normal picture appears after about a minute and remains for about two minutes after which the brightness starts to increase, slowly reaching a peak of over brightness with diluted colours after a further seven minutes. The focus remains good. During the following three minutes the brightness returns to normal and remains so.—T. Bettison (Rugby).

The trouble is most likely to be in the luminance output stage. First check the valve, V6 (PL802), then the BC147 flyback blanking transistor connected in series with its cathode. The BC108/BC148 beam limiter transistor (line timebase chassis) could also cause this fault. Other possibilities are dry-joints on the colour-difference amplifier panel, the electrolytic capacitors associated with the anode and screen grid of the luminance output pentode (C352, C353 and C354) and the electrolytics associated with the colour-difference output pentodes/clamps (C367 and C371). (Pye 691 chassis.)

EKCO T434

This receiver came in minus one valve in the u.h.f. tuner. As the companion valve already in the tuner is a PC86 I assumed that the missing valve would be a PC88. On examination however the heater connections appear to be made to pins 7 and 8 of the valveholder whilst the PC88 heater pins are 4 and 5. —E. Downs (Newbury).

The correct valves for this tuner are indeed the PC86 and PC88. There is a valveholder type where the spare pin blanking washer can move around as you try to locate the valve, making it appear as if the keyway is incorrect. You appear to have one of these in the tuner unit. (Pye 11U series.)

McMICHAEL MT762DS

There is a rather baffling no e.h.t./no line whistle fault on this set. The line output valve is red hot and the h.t. voltage low. The boost diode top cap has been removed but this makes no difference. All line timebase valves, the flywheel sync discriminator diodes, the line oscillator anode load resistors, the line output valve screen grid resistor and the line output transformer have been replaced without success.—F. Mitchell (Gillingham).

The fact that the line output valve is red hot indicates loss of drive from the line oscillator which in this chassis is a cathode-coupled multivibrator. Check the cross-coupling capacitor C120 (330pF), the charging capacitor C125 (150pF), the output coupling capacitor C126 (0·01μF) and the oscillator cathode components R126 (820Ω) and C123 (800pF). (Sobell ST195 series.)

MARCONIPHONE 4808

There is a line hold fault on this set. As the line hold control is rocked the whole raster appears to move normally from side to side but on closer examination the top 20mm of the raster hooks to the left or right. Critical line hold adjustment gives good verticals on the test card but with a normal picture various amounts of hooking occur according to picture content. I have tried the stock hold faults in this chassis—the sync separator screen grid feed resistor and sync coupling capacitor—and have substituted just about every other component in the sync separator, flywheel sync, d.c. amplifier and line oscillator stages.—W. Grieg (Warley).

It strikes us that sync pulse distortion is occurring prior to the sync separator. We suggest you check the 64μF electrolytic coupling capacitor to the video amplifier for leakage and make sure that the preset contrast control R34 is set correctly. C39 which provides emitter compensation in the video output stage could be at fault but this is less likely. (BRC 1500 chassis.)

QUERIES COUPON

This coupon is available until August 19 1974 and must accompany all Queries sent in accordance with the notice on page 472. Don't forget the 11p (inc. VAT) postal order!

TELEVISION AUGUST 1974

TEST CASE

140

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.

? *An Ekco Model T530 fitted with the Pye 569 chassis was suffering from weak field lock. The tendency was for greater lock instability to occur on pictures at black level or very low brightness, the lock improving with increasing picture brightness. Critical adjustment of the field hold control was necessary under normal brightness conditions however. Line sync was good, as also was the display definition as shown by a Test Card.*

Since there appeared to be little or no fault with the line locking, tests were made of the components that integrate and feed the field sync pulses to the field timebase. All these appeared to be in order. Examination was then made of the video circuits, and as no fault could be found in this area the video signal and the sync separator output were examined on an oscilloscope. The video signal at the input to the sync separator was correctly proportioned, but the field pulses at the sync separator output were attenuated with respect to the line pulses.

What was the most likely cause of the trouble, and what steps would have to be taken by the service technician to prove this? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 139

Page 427 (last month)

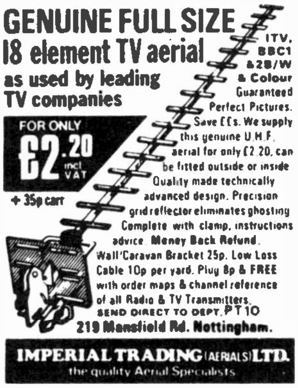
Since the chroma signal was getting into the chroma channel of the 8000 series chassis referred to last month lack of colour or intermittency would most likely be due to a fault in either the reference oscillator or burst gate circuit. One of the first tests however would be to check the operation of the colour-killer circuit since a fault here could mute the chroma channel. This department was found to be without fault and oscilloscope testing proved that the reference oscillator and its associated circuits were functioning correctly. When the 'scope was connected to display the gated bursts however it was found that the burst amplitude was very low during the fault condition.

The 'scope was then connected to display the pulse input to the gate (at test point 9) and it was then found that the gating pulses from the line output transformer (fed via the 33kΩ resistor R404 and 0.1μF capacitor C405) were of much lower amplitude than specified. The capacitor checked normally but the resistor had increased in value to about 2MΩ and varied with change in temperature. Replacing this resistor cleared the fault.

Published on approximately the 22nd of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London EC4A 4AD. Printed in England by Fleetway Printers, Crete Hall Road, Gravesend. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd. Publisher's subscription rate (including postage): for one year, £3.25 inland rate, £3.50 overseas rate. International Giro facilities Account No. 5122007. Please state reason for payment "message to payee". "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

TELEVISION CLASSIFIED ADVERTISEMENTS

AERIALS



J and A Tweedy Limited Incorporating Baines High Frequency Aerials
Full range of aerials by J BEAM
Parabeam PBM 12 £3.60. PBM18 £4.60. **Multi-beam** MBM 30 £4.70, MBM 46 £7.40, MBM 70 £12.95. **Log Periodic** Wideband £6.40. **Stereo-beams** SBM 2 £3.15, SBM 3 £4.70, SBM 4 £5.15, SBM 6 £7.95. Aerial Rotators AR 30 £27.50, AR 40 £33. Masthead Amplifiers £9.09. Setback £4.50. Full range of **Amtron** kits in stock.
Prices include VAT and carriage
Tuesdays to Saturdays — 0900 to 1730
79 Chatsworth Road, Chesterfield, S14 2AP
Telephone 34982—863755 (evenings)

WRIGHT'S AERIALS

Full range of J Beam and Antiference aerials and accessories: Antiference Trucolour: TC10 £4.00, TC18 £5.30; J Beam high gain: MBM46 £6.90, MBM70 £12.10, 2MBM46 £17.75, 2MBM70 £28.40; New Antiference Extra Gain: XG8 £7.75, XG14 £13.55. Also Aerialite SR10 with grid reflector £2.75. Please state channel group or transmitter if known. Coax: semi air-spaced low-loss 12p per yard.
Prices include VAT and UK mainland postage.
We specialise in high gain aerials, amplifiers, etc.: everything necessary for quality fringe area installations. Send SAE for full list. Comprehensive information sheets and individual advice supplied with order if requested.
Dept. 1, 3 Cheltenham Rise, Scawsby, Doncaster, Yorks.
Aerial erection service: Doncaster 69743/3080

FOR SALE

TELEVISION Colour Project. Following panels fitted with new components. R.G.B. Decoder, Timebase, magazine aligned IF and Tubebase. Offers. Box 116.

TELEVISION COLOUR receiver Time Base and R.G.B. complete, I.F. and Decoder almost finished. P.S.U., convergance and Tuner Boards unmade. Yoke Assy, Tube-Base L.O.P.T., Blue Lateral and Tuner First offer over £30.00 secures. Phone Luton (0582) 592269.

FOR SALE. Unused Colour TV. Tube 25" Mullard A63-11X (A63-120X). Price £55.00. Border Television Limited, Carlisle CA1 3NT.

LABGEAR. "Colourmatch". Rainbow Pattern Generator CM-6010 RG. Hardly used, as new £45.00. Telephone Harlow 24021. Before 9 a.m.

TELEVISION Colour Project. Panels for sale IF (Aligned by Magazine) Decoder, R.G.B., Tuner, uprated Transformer. All complete. Offers Phone Banwell 2435 (Evenings).

CCTV? Top Quality Vidicons Ex-Equipment. All Tested and usable. £1.25. Post paid, or S.A.E. Details. Baker, 12 Hampton Gardens, Blackfield, Southampton.

FOR SALE. Surplus to requirements Newnes Radio & Television Servicing Books Volumes 1-6 and years up to 1968 for further details please contact: A. L. Smith (Manager), The Society of Television, Radio & Electronic Engineers, 108 Holland Road, Harlesden, London, N.W.10.

BRAND NEW Mullard CRT AW43 88 and PRACTICAL TELEVISION 37 issues Nov '61 —Oct '70. Write Saunders, 26 Rowan Crescent, Streatham, London, SW16.

CCTV Camera parts:- Vidicon, yoke, case, P/U. Also part built P.C.B.S., with circuits–£16. High Gables, Abbey Drive, Staines, Middlesex.

SERVICE SHEETS

SERVICE SHEETS

(1925-1974) for Radios, Televisions, Transistors, Radiograms, Car Radios, Tape Recorders, Record Players, etc. with
FREE FAULT FINDING GUIDE

PRICES FROM 5p

Over 10,000 models available.
Catalogue 20p + SAE

Please send stamped addressed envelope with all orders and enquiries.

Hamilton Radio
47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

SERVICE SHEETS, Radio, TV etc. 8,000 models. Catalogue 20p. S.A.E. enquiries. Telray, 11 Maudland Bank, Preston.

LARGE SUPPLIER OF SERVICE SHEETS

All at 40p each
(T.V., RADIO. TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

"PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES & ORDERS"

Otherwise cannot be attended to

(Uncrossed P.O.'s please, original returned if service sheets not available.)

PLEASE NOTE
We operate a "by return of post" service. Any claims for non-delivery should be made within 7-days of posting your order.

C. CARANNA
71 BEAUFORT PARK
LONDON, NW11 6BX

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number alternative.

Free T.V. fault tracing chart or T.V. list on request with order.

Mail order or phone 01-458 4882

WANTED

NEW BVA valves of popular types, PCL805, PY800/1, PL504, etc. Cash waiting. Bearman, 6 Potters Road, New Barnet. 449/1934-5.

SERVICE SHEETS purchased. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

A.L.S. TECHNICAL INFORMATION SERVICE

10 DRYDEN CHAMBERS, 119 OXFORD STREET, LONDON W1R 1PA

MAIL ORDER ONLY

Books

We are pleased to be able to offer a very large and interesting choice of Books on all electronic subjects.

Radio & Television Servicing Books brought and sold.

Complete Lists of Service Sheets, Books & Printed Circuit Boards etc., Plus Free Fault-Finding Charts & Newsletter 25p + S.A.E.

As a Service to our customers we buy and sell good clean copies of back issues of the leading magazines—
Television
Practical Wireless
Practical Electronics
Wireless World etc.

Note: Do not send us any of the above until we write to you— Thank You.

Our stocks now exceed 20,000 items
Service Sheet Service only 40p plus S.A.E.

"Comprehensive Colour TV Manual"
by J. McCourt
Covers Faults & Causes on most British Sets.
Price £3 including Post & Packing

"Comprehensive Colour TV Circuit Pack"
Contains circuits on all the sets in the above manual. Price £2.50 post paid.

"Beginner's Guide to Colour Television"
by G. J. King
Highly recommended from our Book List
£2.20 post paid

"Questions and Answers on Colour Television" Reddihough
Simple, practical account on PAL system
£1.00 post paid

"TV Fault-Finding" J. R. Davie
Profusely illustrated including many photographs of actual faults. £1.00 post paid

"Getting the Best from Your Colour TV"
By R. Maude Price only 50p post paid

"A Guide to Television Alignment Using Only Transmitted Test Signals"
by B. R. Epton
Price 30p plus S.A.E.

Colour TV Manuals

All prices quoted are post paid.

BRC
2000 Series £3.50
3000 Series
3500 Series £2.50
8000 Series
8500 Series

DECCA
CTV19
CTV22
CTV25
CTV2200
CTV2203
CTV2207
CTV2225 £3.50
CTV2500
CTV2503
CTV2505
CTV2506
CTV2509
CTV2520
CS1730
CS1733
CS1830
CS1910
CS2030
CS2211
CS2213 £2.50
CS2230
CS2225
CS2227
CS2230
CS2500
CS2611/2
CS2630/1

GEC
2028/A/B
2029/A/B
2030
C2040/B
C2041/B
C2073 £2.50
C2100
C2103
C2107
C2110
C2115

ITT/KB
CVC1
CVC2
CVC5
CK403
CK405
CK500
CK550 £2.50
CK600
CK701
CK750
CK822
Studio 100
Col Scene

Philips
G6D/ST
G6S/ST
G8 Series
G25K500
All to 513
G22K500 £3
All to 537
G26K500
All to 526
Please state full Model no. required

Sony
KU1320 UB
KU1800 UB £2
etc.

All R.B.M. manuals in short supply but some still in stock
Prices from £2.50

Many more makes and models available offered subject stock position and/or availability.

All prices are subject to change by the publishers, but are correct at time of going to press

Please supply one Service Sheet, for which my cheque/P.O. for 40p & S.A.E. is enclosed.

PLEASE USE BLOCK CAPITALS

Name

Address

Model Number **MAKE** **TV, Radio etc**

TOP PRICES PAID for NEW VALVES and TRANSISTORS

popular T.V. and Radio types

KENSINGTON SUPPLIES (A)
367 Kensington Street, Bradford 8, Yorkshire.

WANTED. Radio and TV Servicing books from 1964 onwards. £2.00 per copy, paid by return of post. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire. Telephone 0423-55885.

EDUCATIONAL

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio & TV Servicing (Mono & Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on September 9th.

PROSPECTUS FROM:
London Electronics College, Dept.TT8
20 Penywern Road, London SW5 9SU.
Tel. 01-373 8721.

C. AND G. EXAM

Make sure you succeed with an ICS home study course for C and E Electrical Installation Work and Technicians, Radio/TV/Electronics Technicians. Telecommus Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computor Engineering and Programming. Also self-build radio kits.

Get the qualifications you need to succeed. Free details from:
INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 750S, Intertext House,
London SW8 4UJ. Or phone 01-622 9911

SETS & COMPONENTS

MAINS DROPPERS.
37-31-97-26-168 Ω 50p.
25-35-97-59-30 Ω 50p.
14-26-97-160 Ω 50p.
14-26-97-173 Ω 50p.
15-19-20-70-63-28-63 Ω 50p.
Post free. C.W.O.

Durham Supplies, 367 Kensington Street, Bradford, 8, Yorkshire.

250—New Resistors well assorted ⅛—2 watts. Carbon—Hi-Stab Oxide etc. £1.00 Post Free. Whitsam Electrical, 33 Drayton Green Road, London W.13.

TV's—Monochrome & Colour. TV Spares

TV's Tested Working	19" @ £8.50	£1.50 P & P
TV's Tested	23" @ £10.50	
TV's Untested	19" @ £4.00	
TV's Untested	23" @ £5.00	

TV Tubes any 19" @ £3.00; TV Tubes any 23" @ £4.50; £1.50 P & P
All tubes in good working order.
LOPT (Line Output Transformers) all at £2.00 plus 50p P & P
UHF Tuners Pushbutton @ £3.00 plus 50p P & P
UHF Tuners Rotary @ £2.00 plus 50p P & P
Integrated Tuners (6 button) @ £4.50 plus 50p P & P
Valves—any monochrome @ 12p plus 5p P & P
Postage & Packing free for orders of 6 valves and over
Speakers 5" Round, 6" x 4" Oval, 4" x 8" Ex. TV's from 20p plus 10p P & P
Other items available, i.e. Comp. I.F. & Line Time Base Panels for many makes of TV's, Scancoils, Frame or Sound Output Transformers, V. H. F. Tuners, etc. Colour Spares available for Philips, Decca, Bush, Baird, etc.

Colour TV's
19" Untested £70.00 plus £5.00 P & P
19" Tested £85.00 plus £5.00 P & P
25" Untested £75.00 plus £5.00 P & P
25" Tested £90.00 plus £5.00 P & P

TRADE ENQUIRIES WELCOME

Ring or Write to: **Mail Order Supplies,**
5 Commercial St., Harrogate (STD 0423) 3498

BARGAIN TV SPARES

Breaking large quantity of TV sets. Spares available for all makes and models. Enquiries for small items welcome.

EG LOPTS £1.65 FOPTS 77p.
S/Coils £1.10, Knobs 5p - 30p.
Tuners £1.10 Controls, IF coils, droppers, valve bases, electrolitics, all small items.

Valves 5p - 30p. All tested before despatch. Send SAE for enquiries, stating parts required and model number. All letters answered. New spares available if required.

Write or call.

J. C. WAKELY
200 High Street, Colliers Wood, SW19
Tel: 01-542 3861

COLOUR—COLOUR—COLOUR
19" DECCA £90.00
25" DECCA £100.00
25" RBM/PHILIPS £110.00
25" THORN £115.00
22" DECCA & PHILIPS single standard £130.00
Fully serviced, one month's guarantee. Delivery and Terms can be arranged. Non-workers available. S.A.E. Details please.
T.E.S.T.
P.O. Box 1. Kirkham, Preston, PR4 2RS
Telephone 077-48 2796 any time.

REBUILT T.V. TUBES FOR MEN OF VISION

Current types

17"	£4.00	21"	£5.00
19"	£4.00	23"	£5.00

Panorama & Rimguard types

19"	£6.00	23"	£8.00

Twin panel

19" £7.50

Cash or P.O. with order, no C.O.D. Carriage 75p in England, Scotland, Wales. Add £1.25 for carriage Northern Ireland. For all enquiries please send S.A.E. Each tube fitted with new electron gun assembly. Fully guaranteed for two years against any fault except breakage.

k.s.t. ltd.

Providence Mills, Viaduct St., Stanningly, Nr. Leeds, Yorks. Tel. Pudsey 78177

Top 20 Plus Tested TV Valves

PL504	18p	30FL1/2	15p
PCF801	15p	PCL84	10p
DY86/7	15p	PCL82	10p
PL36	15p	PFL200	10p
PC88	15p	ECC82	10p
PC97	15p	EH90	10p
PCL805/85	15p	EY86	15p

Colour Valves Fully Tested

PL509	40p	PY500/A	30p
PL508	30p		

Many others available including Mazda Types.
P. & P. 4p per valve, over 12 2½p per valve, orders over £4 post free.
Prompt service.
S.A.E. for free list
Mail order only.
L. & D. COMPONENTS LTD.,
71 Westbury Ave., London N22 6SA.
Tel. 01-888 2701.

EX RENTAL TV's BARGAIN

23" & 19" 3 Channel with U.H.F. Tuner £3.50
19" & 25" Colour from £50.00
19" & 23" tubes guaranteed from £2

All sets complete.

EDWARDS & SONS
103 Goldhawk Road, London W.12
Telephone 743-6996
CALLERS ONLY

Components Galore. Pack of 500 mixed components, manufacturers' surplus plus once used. Pack includes resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1 + 10p P. & P. C.W.O. To: Caledonian Components, Strathore Road, Thornton, Fife.

BBC2s £9. 850 and 900 Chassis. 950s £13. "Perfect" Trade Welcomed. H. Hawkes, 54 Waterloo Road, Preston Lancs. Tel. 0772-720666 and 725859.

LADDERS. 'Special Offer' 13' 4" closed–23' 10" extended. Unvarnished £17.25. Carriage £1.30. Home Sales Ladder Centre (PTT2) Haldane (North) Halesfield (1), Telford, Shropshire. Tel: 0952-586644.

AERIAL BOOSTERS £3.30
We make three types of Aerial Boosters: B45-UHF 625, B12-VHF 405, B11-VHF RADIO

VALVE BARGAINS
Any 5—50p, 10—75p, 50—£3.30:—
ECC82, ECL80, EB91, EBF89, EF80, EF85, EF183, EF184, EY86, PCC84, PCC89, PCC PCC189, PC97, PCF80, PCF86, PCF805, PCF808, PCL82, PCL83, PCL84, PCL85, PFL200, PL36, PL81, PL504, PY33, PY82, PY800, PY801, 30L15, EH90, PC86, PC88.

19" UHF/VHF (BBC2)—£6.00
Thorn 900 Series, with set of spare valves. Carriage £2.00 (Untested).

Press Button U.H.F. Tuners—£2.50.

Rotary U.H.F. Tuners—£2.00.

PLUGS—SOCKETS
Price per item, in brackets for ten
CO-AX PLUGS **6p (50p)** Socket surface **7p (60p)**, Connectors **4p (35p)**.

D.I.N. PLUGS
2 pin, 3 pin and 5 pin **20p (£1.65)**.

JACK PLUGS. Standard **18p (£1.50)**, 3.5 mm **10p (80p)**, 2.5 mm **10p (80p)**.
All prices include **V.A.T. p. & p. 10p** per order. Money back refund, S.A.E. for leaflets.

ELECTRONIC MAILORDER (BURY) LTD.
62 Bridge St., Ramsbottom, Bury, Lancs. Tel. Rams 3036.

130 Above

WITWORTH TRANSFORMERS

MONOCHROME TV Line out-put transformers

(Discounts to Trade)

ALL ONE PRICE £5.72 EACH V.A.T. & CARRIAGE PAID

(£5.45 PERSONAL SHOPPERS)

BUSH

TUG versions	TV125
TV75 or C	TV125U
TV76 or C	TV128
TV77	TV134
TV78	TV135
TV79	TV135R
TV83	TV138
TV84	TV138R
TV85	TV139
TV86	TV141
	TV145
TV91	TV148
TV92	TV161
TV93	TV165
TV94	TV166
TV95 or C	•TV171
TV96 or C	TV175
TV97	TV176
TV98C	TV178
TV99 or C	181S
TV100C	183
TV101C	183D
TV102C	183S
TV103 or D	183SS
TV105 or D or R	185S
TV106	186
TV107	186D
TV108	186S
TV109	186SS
TV112C	191S
TV113	191D
TV115 or C or R	193S
TV118	193D
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.

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
TPS173	ST286 or ds	1013	1039
TPS180	ST287 or ds	1014	1047
ST195 or ds	ST288 ds	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

MURPHY

V310	V430	V520	V879 or C•	V789	V2015SS
V310A	V430C	V530	V923•	V153	V2016S
V310AD	V430D	V530C	V929 or L•	V159	V2017S
V310AL	V430K	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	V2415SS
V410C	V490	V843•	V735	V20145	V2416D
V410K	V500	V849•	V783	V2015D	V2316S
V420	V510	V873•	V787	V2015S	V2417S
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.

PHILIPS

23TG111a	G19T210	G23T210
23TG113a	G19T211	G23T211
23TG121a	G19T212	G23T212
23TG122a	G19T213	G24T230
23TG131a	G19T214	G24T232
23TG142a	G19T215	G24T236
23TG152a	G20T230	G24T238
23TG153a	G20T232	G24T300
23TG156a	G20T236	G24T301
23TG164a	G20T238	G24T302
23TG170a	G20T300	G24T306
23TG171a	G20T301	G24T307
23TG173a	G20T302	G24T308
23TG175a	G20T306	G24T324
23TG176a	G20T307	
23FG632	G20T308	

GEC

2000	2015	2022	2043	2064
2001	2017	2023	2044	2065
2010	2018	2032	2047	2066
2012	2019	2033	2048	2082
2013	2020	2038	2063	2083
2014	2021	2039		

PYE

11u Series
12u
13u — State Pt. No.
14u — required
15u — AL21003 or
20u — 772494

V700 or A or D
V710 or A or D — State Pt. No.
V720 — required—
V830A or D or — 772444 or
LBA — 771935

FERGUSON, ULTRA, MARCONI, H.M.V. (BRC, Jellypots).
ALL MODELS IN STOCK.

ALBA, COSSOR, EKCO, FERRANTI, K.B., PYE. ALL MODELS IN STOCK.

E.H.T. RECTIFIER TRAYS (MONOCHROME)

THORN B.R.C. MONOCHROME	ORDER Ref.	
980, 981, 982	RT1	£3.30
911, 950/1, 960	RT2	£3.60
950/2, 1400 -5 stick	RT3	£3.90
1400 Portable-3 stick	RT3A	£3.60
1500 20" 3 stick	RT4	£3.60
1500 24" 5 stick	RT5	£3.90
1580 Portable-2 stick	RT16	£3.50
1590, 1591	RT17	£1.30

E.H.T. RECTIFIER TRAYS (COLOUR)

MAKE	CHASSIS COLOUR	
DECCA	CTV19, CTV25	£8.00
DECCA	CS1910, CS2213	£8.00
DECCA	CS1730	£5.80
GEC	Dual & Single std. Valve Type	£6.70
ITT-KB	CVC-1, 2, 3	£7.20
PHILIPS	G8 510-550 Series	£7.20
PYE	691, 692, 693, 697	£6.70
PYE	713 CT200	£6.40
BUSH MURPHY	Single std plug-in	£8.00
BUSH MURPHY	Dual standard	£9.80
THORN BRC	2000	£8.00
THORN BRC	3000	£7.10
THORN BRC	8000	£4.10
THORN BRC	8500	£7.00
GEC	Solid State 90°	£7.80
PYE	CT262 & 266 731 Chassis	£7.40

COLOUR TV Line out-put transformers

THORN (BRC)
2000 Chassis
Scan O/P Tx.
EHT O/P Tx.
3000 Chassis
Scan O/P Tx.
EHT O/P Tx.
8000 Chassis
8500 Chassis
All £6.80 ea.

GEC
Dual Standard
Single Standard
£7.90 ea.

ITT-KB
CVC1 Chassis
CVC2 „
£7.10 ea.
CVC5 Chassis
£8.10 ea.

PHILIPS
G6 Chassis D/S
G6 „ S/S
£8.70 ea.
G8 Chassis
£7.90 ea.

BUSH
CTV25 Mk. 1 & 2
£11.50 ea.
CTV25 Mk.3
CTV162
£7.90 ea.
CTV167 Mk.1 & 2
£11.50 ea.
CTV167 Mk.3
CTV174D
CTV182S
CTV184S
CTV187CS
CTV194S
CTV197C
CTV199S
£7.10 ea.

DECCA
CTV19 Valve Rec.
CTV25 „ „
Primary Coil
£3.70 ea.
CTV19 D/S Tripler
CTV25 „ „
CTV25 S/S Tripler
CS1730
£7.80 ea.
CS1910
CS2213
£7.10 ea.

EKCO
CT102
CT104 £12.00 ea.
CT103
CT105
CT106
CT107
CT108
CT109
CT111
CT120
CT121 &/T
CT122 £8.90 ea.

PYE
CT70
CT71 £12.00 ea.
CT72
CT73
CT78
CT79
CT152
CT153
CT154 £8.90 ea.

MURPHY

CV1912	CV2510 Mk.3
CV1916S	CV2511 Mk.3
CV2210	CV2516S
CV2212	CV2610
CV2213	CV2611
CV2214	CV2614

£7.90 ea.
CV2510 Mk. 1 & 2
CV2511 Mk. 1 & 2
£12.00 ea.

Most items listed stocked. Most newer and older models in stock. S.A.E. for quotation

For by-return service contact your nearest depot. Callers welcome.

Tidman Mail Order Ltd., Dept. NA.
236 Sandycombe Road,
Richmond, Surrey.
London: 01-948 3702
MON - FRI 9 am to 12.30 pm 1.30 pm to 4.30 pm
SAT 10 am to 12 noon

Hamond Components (Midland) Ltd., Dept. NA.
89 Meriden Street,
Birmingham 5.
Birmingham: 021-643 2148

NO HIDDEN EXTRAS - PRICES INCLUDE V.A.T. and CARRIAGE