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All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Kings Reach Tower, Stamford Street, London SE1 9LS. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

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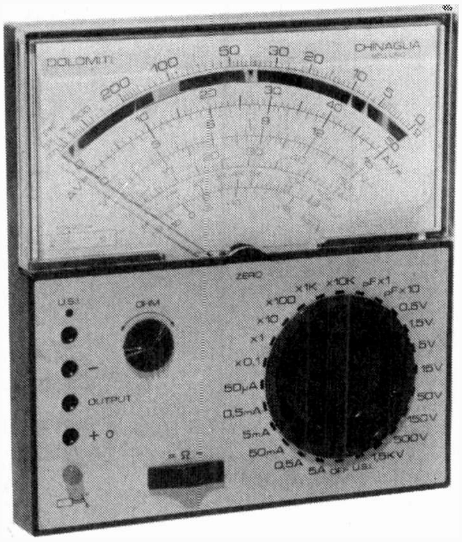

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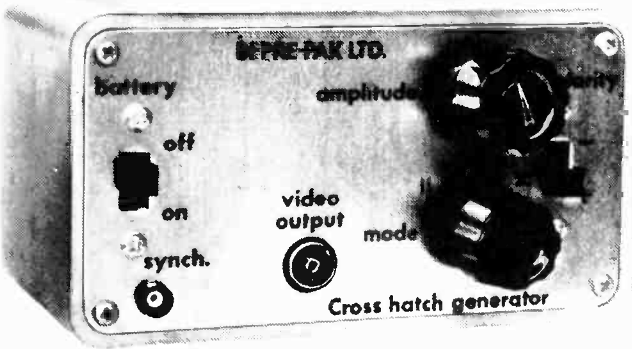

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EXAMINATIONS

It seems that whenever we raise the subject of training we get a tremendous post bag. There is no doubt about the lively interest in the matter amongst those involved in training, those receiving the training, and those who subsequently employ the trained. A variety of well-argued views have been put forward in a number of letters we have received recently. Probably the greatest divide is between those who feel that technicians should be given an all-round training so that they can understand and deal with most types of electronic equipment, and those who feel that the most important point is that technicians should end up reasonably familiar with the equipment the trade is mainly concerned with – domestic radio and TV sets. With the limited amount of time available, it's not practicable to do both.

We respect the former view. An engineer with a detailed knowledge of the basic fundamentals of electronic circuit design obviously has the greater scope. Nevertheless we incline towards the latter view, that if we want capable TV technicians, say, then we've got to ensure that their training makes them familiar with the techniques found in practice in commercial equipment and the types of fault that arise in day to day servicing – defective semiconductor junctions, burnt resistors, leaky capacitors and so on. Anyone aspiring to wider knowledge can always take further courses after he's proved himself capable in a particular field, and we don't think that's putting the cart before the horse.

Be that as it may however, this month we want to have a beef about those who set the examination papers. A correspondent recently sent us a paper for part III (fourth year) of the City and Guilds 222 Mechanics' course. That's the final part, concerned exclusively with TV. Checking through the questions, we came to the conclusion we'd have done quite well. The circuitry chosen was mostly well known, and the questions asked about it were straightforward. We first raised an eyebrow however when we came across a piece of circuitry that we are certain doesn't in practice exist: a neat idea for providing colour c.r.t. protection against a horizontal white line in the event of field timebase failure. It looked to us as if it had been dreamt up by an examiner, and somehow lacked conviction as to its practicality. It was easy enough to see what it was supposed to do: but is it fair to ask examinees about a circuit that's but a gleam in the examiner's eye? – they were also asked about what the effect of a fault in one of the components would be!

Not too serious that perhaps, but next we came across a question on the well known three PCL84 colour-difference output stage/clamp circuit used in so many hybrid colour receivers. To test examinees' understanding of it, they were asked some questions about faults. But let's first imagine that you weren't familiar with the particular circuit. One clue would be the presence of a clamp pulse input. So it would not exactly help if, as here, the pulse input coupling capacitor was shown simply connected to the h.t. rail! (Because the original manufacturer's circuit used the "harness line" technique in which you follow a common line around the circuit, watching for where "b" goes in and comes out etc.) The mysterious fourth grid shown on one of the PCL84s can be forgiven perhaps.

But part of the question was what visible symptom would indicate whether a fault was in the output stage or clamp part of the circuit. And to anyone familiar with the circuit that's unanswerable. There are quite a number of faults that can and do occur. Presumably you were supposed to trot out a pat bit of theory along the lines that a clamp fault would affect all the c.r.t. guns and thus the monochrome display, whilst an output stage fault would affect only the colour reproduction. But you wouldn't have been right by any means. One of the most common clamp faults is change of value of the resistors in each clamp triode anode circuit – anyone with a bit of practical knowhow would spot those high-value resistors straight away. And this clamp fault alters the colours of course! Conversely, no clamp is perfect, and the clamp action occurs only during the line flyback. Output stage faults can still disturb the c.r.t. grid conditions, the "monochrome" display then taking on a colour cast.

It's difficult to set a fair and varied selection of questions that is going to provide a reasonable assessment of a candidate's ability. But it's a damn sight more difficult attempting to answer an unanswerable question or to try to divine what an examiner could possibly be getting at. It's also a waste of everyone's time, since technical competence is not being assessed.

Candidates may have to contend not only with incorrect information and dubious questions but also with confusing presentation. A few years ago we edited a book (not on TV this time) which had at the end a collection of examination papers on the course the book covered. On going through them we decided to draw to the author's attention the fact that many of the questions were vague or didn't make much sense. His understandable comment was "all I can do is to prepare readers for the sort of questions they're likely to be asked!"

We're undoubtedly complaining about a small minority of examination questions. But it does strike us as unforgiveable when the examiners make a botch of the examining. Meanwhile, candidates have been warned!

teletopics

RESULTS FOR 1975

1975 was noteworthy for the UK electronics industry as a whole, being the first year since 1971 that an overall trade surplus was shown – exports were 35% up while imports rose only 7·5%, giving a small overall surplus of £4·21 million. Imports of domestic electronics products – which played such a large part in the deficits recorded during the previous three years – fell by 7·6%, while exports rose by 25%. There was still a substantial deficit in this sector though. Particularly heartening however was the result for the colour TV set industry: imports fell by nearly 40% to £38·44 million while exports rose by more than 136% to £38·41 million, putting the industry almost into import/export equilibrium after the substantial deficits of recent years. We've always maintained that the UK TV setmaking industry is competitive, and it does now seem that if the necessary export sales effort is made it could become a lasting positive contributor to the balance of payments.

Meanwhile, looking at the UK domestic market during 1975, total colour set deliveries were down 28% compared with 1974, the final total being 1,590,000 sets of which imports accounted for 264,000. There seemed to be signs of a slight upturn in December. Total monochrome set deliveries for the year rose by 15% to 938,000. The number of imported sets here was much greater however – 433,000.

We commented recently (March) on the losses made by the servicing side of the TV trade. A recent inter-firm comparison report produced by the RTRA (which we must now learn to call the RETRA – Radio, Electrical and Television Retailers Association) shows that the average loss is even higher than we last reported – 27·8% in respect of service income and rental maintenance compared to costs, though before making allowance for stocks held and work carried out under guarantee.

SET NEWS

In *Teletopics* last November we mentioned the luxury colour TV set introduced by **Grundig** at the Berlin Radio Show. This has now been released on the UK market – at a recommended retail price of £629 including the "Telepilot 12" 20-function ultrasonic remote control unit. A noteworthy technical point is that it is one of the first sets on the UK market to use the Mullard 20AX in-line gun colour c.r.t. – type A66-500X. Just to recap some of the features of this unique set: at the touch of a button on the remote control unit the time is displayed superimposed on the picture, a quartz controlled digital clock being built in; the new channel number appears for approximately eight seconds in the lower right-hand corner of the screen whenever the channel is changed; and to help with setting up, a full-screen tuning meter showing all channels from 21-68 can be displayed on the screen. Servicing is assisted by using 17 plug-in modules and by provision of a socket into which the Grundig "diagnostic adaptor" can be plugged to enable many of the circuits to be checked in one operation. There is also a new Grundig 12in. monochrome portable, Model P1216, with a recommended price of £104.80 including VAT.

An 18 in. colour receiver with 110° in-line gun c.r.t. has been added to the **Skantic** range. This is Model 47512 which has a recommended price of £263.96 plus VAT and is another set featuring a service adaptor socket for rapid diagnosis of basic faults. The c.r.t. fitted is one of the Toshiba RIS types.

An interesting optional extra has been introduced by **Nordmende** for use with their top two luxury colour models (which sell at over £700). This is the ASC-infra system, which enables the TV sets' sound signal to be transmitted by modulating an infra-red source (luminescent diodes) and picked up via an infra-red detector on lightweight, cordless headphones. The headphones have their own independent volume control, which can still be used with the set's volume control turned right down. The advantages of using infra-red transmission are that it saturates the room – i.e. there are no directional problems – while it doesn't penetrate the walls to cause interference outside. F.M. is used for the infra-red transmissions. The system adds £72 to the price of these sets – which also feature the Mullard 20AX tube. It is understood that other W. German setmakers are planning to introduce this cordless remote TV sound system, which was originally devised by Siemens.

COLOUR TUBES

The aftermath of the closure of the Thorn/RCA Skelmersdale colour c.r.t. plant continues to haunt the industry. It has been reckoned that the import bill for essential colour tubes will be about £30 million a year, and obviously more once production by UK setmakers increases again. Mullard, the remaining UK colour tube manufacturer, is now talking about making further investments though still loosing money on tubes. Obviously getting the 20AX tube into full production is going to call for considerable expenditure.

But here's an interesting item of news that seems to show it's possible for governments to work together with the industry. It is reported that the Finnish government is to take a 60% stake in a new TV tube manufacturing plant, with leading Finnish setmaker Salora taking a 20% stake and the remaining 20% stake being taken by Hitachi who will provide the technical know-how. The initial production target is 300,000 colour tubes a year, of which most will be taken by Salora while Hitachi will market the rest in W. Europe. If the Finns can be happily organising the establishment of a colour tube industry one wonders why the UK industry seems to get the worst of both worlds – capacity when its not needed and lack of capacity when it is.

TELETEXT DECODER SERVES 15,000

Teletext as a free extra is being provided by Rediffusion to their 15,000 cable subscribers in Brighton and Hove. A cable TV network is certainly the simplest way to make Ceefax/Oracle available – in this example a single decoder installed at the main aerial site serves the 15,000 receiving installations.

NEW VIDEO OUTPUT CIRCUIT

An interesting new video output circuit, making use of the complementary-symmetry principle (an npn/pnp pair of transistors operating in push-pull), is described by D. J. Beakhirst and M.C. Gander in the October 1975 issue of *Mullard Technical Communications*. The basic circuit is shown in Fig. 1, but it must be emphasised that some elaboration is required for practical implementation. Advantages are its low quiescent current and thus power consumption compared to the usual single transistor or cascode class A video output circuit, and also its much better transient response since the load capacitance is both charged and discharged by transistors – in a class A circuit the positive-going edges of the video waveform are slower than the negative-going edges because the load capacitance is being charged via the stages' load resistor, giving rise to an asymmetrical h.f. response. This improved transient response means that the circuit is particularly suited to data display, which from the domestic point of view means that it is capable of good, clean teletext characters. The lower transistor Tr2 receives base bias via R3. For this reason Tr1 must be provided with some forward bias, hence the potential divider R1, R2 in its base circuit. R3 also stabilises the d.c. conditions by feedback action. The stage operates under somewhat different conditions at l.f. and h.f. At l.f., transistor Tr2 acts as a class A amplifier with its load formed by Tr1 and R5. The voltage developed across R4 drives Tr1, keeping the current in the combination Tr1/R5 substantially constant. At h.f. Tr1 is also driven, via C1, and there is then roughly equal current swing in the two output transistors, Tr1 conducting more as Tr2 conducts less and vice versa. R6 and C2 stabilise the d.c. conditions in Tr1, and enable a high a.c. gain to be achieved. Philips are developing an i.c. specially to drive complementary-symmetry RGB output circuits, so this is a configuration one can expect to meet in due course. It's also pointed out that the power saving makes the circuit attractive for use in mains/battery monochrome sets. In this application the stage would be driven by the usual emitter-follower driver used in such receivers. Suitable Mullard transistors for use in the circuit are the BF422 (npn) and BF423 (pnp).

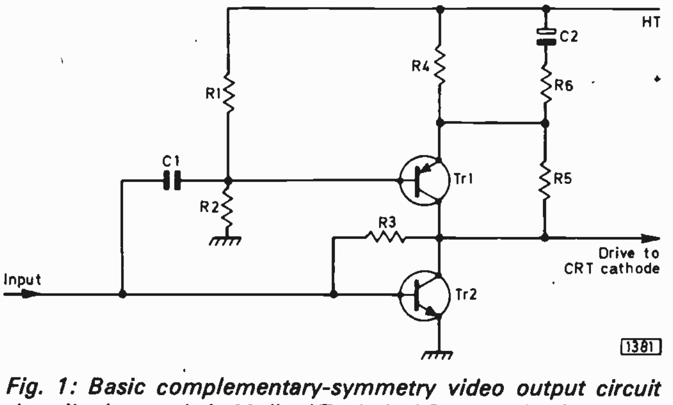


Fig. 1: Basic complementary-symmetry video output circuit described recently in Mullard Technical Communications.

WIDEBAND IC TUNER

What looks to be a major development, though in the UK of potential interest at present mainly to DXers, has been announced by Philips' Eindhoven Research and Development Laboratories. It's a new TV tuner unit concept, using i.c.s and providing very wide bandwidth without switching. The prototypes cover the complete TV band from v.h.f. through u.h.f. up to 950MHz. A range of i.c.s has been specially developed for this application. It includes a wideband amplifier using four u.h.f. transistors and a number of resistors, an attenuator – for a.g.c. application – consisting of seven pin diodes and seven resistors, and a frequency changer i.c. with double balanced mixer stages using Schottky diodes plus a tuning circuit. Diffusion techniques are used to produce the diodes and transistors, but to achieve the required high-frequency performance an air insulation technique has been adopted. This reduces parasitic coupling between components, while parasitic wiring capacitances are reduced by using a multi-level arrangement.

CORRECTION FROM THORN

Thorn have issued a manual correction relating to the 8000/8000A/8500 chassis recently covered in *Television*. The correct diode for use in the base circuit when a BDX32 line output transistor is used is type 1N4001.

TRANSMITTER NEWS

The BBC's high-power transmitter at **Keelylang Hill**, providing a service for most of the Orkney Islands, is now in operation. BBC Scotland is on channel 40 and BBC-2 on channel 46. Horizontally mounted group B aerials should be used.

The following relay stations are now in operation:

Auchmore Wood (Scotland) BBC-1 (Scotland) channel 22, ITV (Grampian) channel 25, BBC-2 channel 28. Receiving aerial group A.

Bassenthwaite (Lake District) BBC-2 channel 45, ITV (Border TV) channel 49, BBC-1 channel 52. Aerial group B.

Bodmin (Cornwall) BBC-1 channel 39, BBC-2 channel 45, ITV (Westward) channel 49. Aerial group B.

Garth Hill (Powys, near Wales/Salop border) BBC-1 channel 57, ITV (ATV) channel 60, BBC-2 channel 63. Aerial group C/D.

Winterborne Strickland (Dorset) ITV (Southern TV) channel 43. Aerial group B.

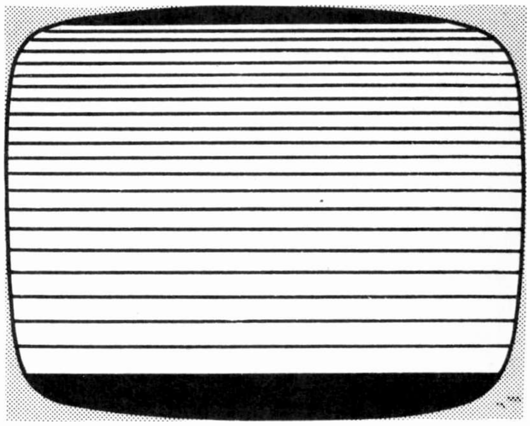
The above relay transmissions are vertically polarised.

NOTE FOR OVERSEAS READERS

Many overseas readers of *Television* have been affected by the closure, due to economic conditions, of the IPC magazine subscription department. Those experiencing difficulty in finding a local supplier should write to the Editor who will send the name of the local agent.

Small Picture and other Field FAULTS

John LAW



ONE of the most common faults on older television receivers is that of a "small picture". This usually means a picture with a gap at the top and the bottom. It is interesting to see how this and related fault symptoms develop.

Representative Circuit

A representative valve field timebase circuit is shown in Fig. 1 – as used in the popular Thorn 850 chassis. It consists of two cross-coupled triodes in a multivibrator circuit and a pentode output stage. The arrangement is almost standard, though in most chassis a single triode is used with cross-coupling between this and the output pentode.

Looking at the circuit in more detail, the cathodes of the two triodes are strapped to chassis while their anodes and grids are cross-coupled, via C112 in one case and C113/C114 in the other. V7B conducts during the forward scan period, while V13A conducts briefly to provide the flyback action. Negative-going field sync pulses are applied via C111 to the grid of V7B to ensure that it cuts off at the right time, driving V13A into saturation.

The field sawtooth waveform is generated across C116 which charges from the boost rail via R104, the height control and R146. Its earthy side is returned to the cathode of the output pentode: the parabolic waveform here helps linearise the end of the scan (bottom of the picture). C116 discharges when V13A conducts, providing the flyback action.

The sawtooth drive is coupled to the control grid of the output pentode by C115. This stage is biased by R150/C117. Overall and top linearity correction is provided by the feedback loop between the anode and control grid of the output valve. The scan coils are driven from the secondary winding on the field output transformer T4. The voltage-dependent resistor Z3 stabilises C116's charging voltage and thus the height.

Small Picture

The small picture symptom may develop slowly over a period of several months. It can be corrected initially by making periodic adjustments to the height and the linearity controls. In due course however further correction will be impossible and the shrinkage will continue, leading to a service call. Less often the fault develops overnight, due to the sudden development of a fault in a valve or other component in the circuit.

The complaint "small picture" requires clarification before it is possible to diagnose accurately what is responsible. Let us assume that the available picture is clear and linear, with a gap at the top and bottom. A common cause of this symptom is low voltage at the anode of the triode section of the PCL805. As we have seen, this voltage is obtained from the boost rail. In time the passage of current through the series feed resistor R146 may result in its chemical composition changing. As a result its resistance increases and there is insufficient charging voltage. In consequence there is lack of drive at the grid of the output pentode, reduced output and a small picture.

Charging Circuit Checks

Check the value of R146 by connecting an Avo Model 8 switched to the ohms times 100 range across it. If the value is found to be well above 680kΩ the resistor should be replaced.

Suppose however that R146 reads 680kΩ and that when the height control R145 is checked in the same way the Avo reads from 2·5MΩ down to zero. The next step is to check the voltage at pin 1 of the PCL805. If low, check for around 600V boost voltage at the top of the height control. If this voltage is normal the trouble is likely to be due to an aged PCL805. If the voltage at the top of the height control is low check further along the feed: there is generally an *RC* filter between the boost capacitor in the line output stage and the height control. The components are R104 and C88 in Fig. 1. The resistor can go high-resistance just as R146 can. In some chassis it is the first one to check – it depends on which resistor has the higher value. Also the capacitor can leak or go short-circuit. In many chassis, as here, it is connected between the boost feed and the h.t. rail. When it goes short-circuit therefore the charging voltage source is the h.t. line instead of the boost rail: the height is reduced and the associated resistor will overheat. If all these components are in order but the boost voltage is low the trouble is in the line timebase – though in this case symptoms in addition to a small picture should be evident.

Faulty Valve

Assuming that a replacement PCL805 restores a full, linear raster, it is interesting to consider what can happen to the valve to cause the small picture symptom. After a period of time the flow of current through the valve will produce a chemical change in the material coating the heater and cathode. These changes will result in reduced current flow, i.e. low emission. The power handling capability of the valve is thus reduced and this shows up as a small picture.

Bottom Cramping

A fault which is even more common is a small picture with the bottom inch or two cramped. Replacing the output pentode may well fill the top part of the picture – assuming

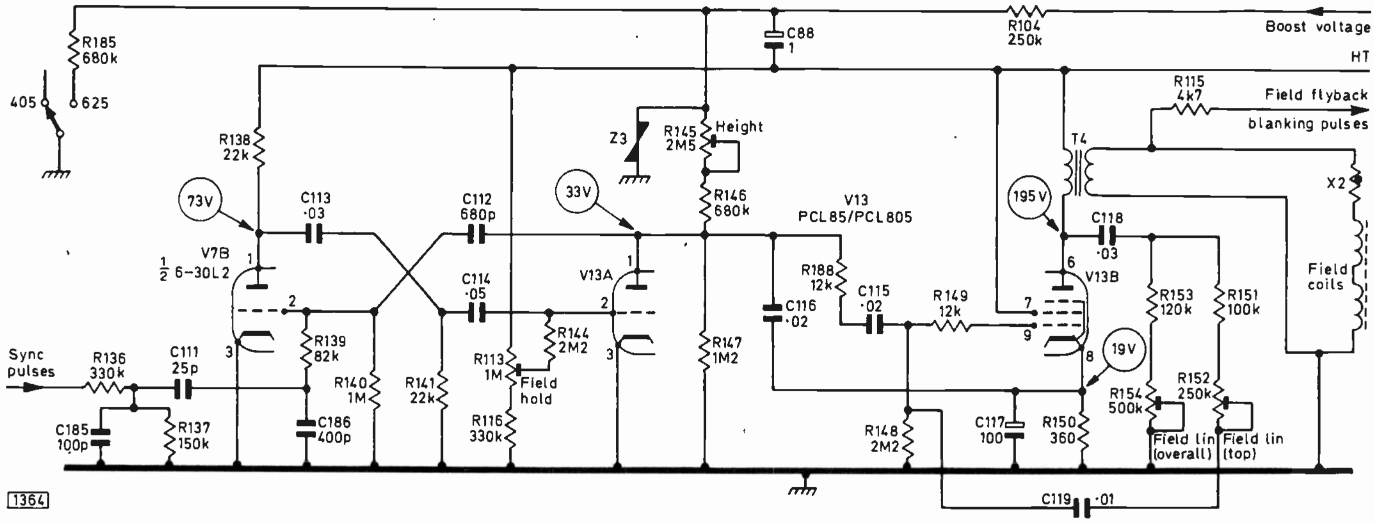


Fig. 1: Representative valve field timebase circuit – as used in the Thorn 850 dual-standard chassis. Though many valve and hybrid chassis use two triodes in the field oscillator circuit, as here, it is more usual to use a single triode, with cross-coupling from the pentode which thus forms half the multivibrator circuit as well as the output stage. R185 provides height equalisation on 625 lines.

that the valve's emission was low – but the bottom cramping will still be present, and there may still be a gap here.

There are several possible causes of this trouble but the most likely one is in the valve's cathode bias network. The bias resistor R150 is decoupled by the 100μF electrolytic capacitor C117 which can deteriorate over the years. The leads within the can may corrode where they are joined to the plates of the capacitor. As this corrosion develops, so the internal resistance of the capacitor gradually increases, effectively reducing its capacitance. Eventually the corrosion will eat through the lead(s) and the capacitor will be disconnected from the circuit, i.e. it will be open-circuit. Another electrolytic capacitor fault is leakage of the electrolyte from the can. This again reduces its capacitance. Excessive heat from the chassis and possibly from adjacent valves or dropper resistors can dry out an electrolytic capacitor, again lowering its efficiency. All these faults result in the associated resistor no longer being effectively decoupled. This produces negative feedback action, reducing the pentode's gain and thus its ability to fill the screen, particularly at the end of the scan, i.e. the bottom of the screen.

A quick method of checking the cathode decoupling capacitor is to connect a known good one in parallel and note the effect. If the raster opens out to give a normal, linear picture the capacitor is in need of replacement. Cut it out and solder in a new one.

A defective bias resistor can also contribute to this symptom – small picture with bottom cramping. How does this happen? Suppose there is a heater-cathode leak in the PCL805. The severity of this will depend on the position of the PCL805 in the heater chain. If, which is likely, it is at the upper end of the chain, the voltage between the heater and chassis will be much higher than the voltage between the cathode and chassis. The resultant voltage produced across the bias resistor will be determined by the severity of the leak.

Linear Valve Operation

The field output valve's bias voltage is chosen so that the valve operates on the linear portion of its grid voltage/anode current characteristic curve. This ensures that the valve provides a full, linear scan. An increase in the bias voltage produced by a heater-cathode leak will move the valve's operating point along its characteristic curve, limiting the valve's power handling capacity. The visible result is reduced scan with cramping, the degree of which will be determined by the amount of leakage.

Bias Circuit Checks

Replacing the valve may well completely cure the fault. If not, check the appearance of the bias resistor. It may be discoloured or even burnt. If so, check its value with the Avometer switched to read ohms. It will probably be found that the value has changed. As we have seen the fault starts with heater-cathode leakage in the valve, as a result of which the voltage across the resistor is increased. As we know from Ohm's Law, this will increase the current through the resistor and the heat it dissipates. Eventually the dissipation will exceed the resistor's wattage rating, with the result that it overheats and its resistance value changes. Whether the resistor increases or decreases in value (it generally decreases) the result will be that the valve's bias voltage moves away from the correct point along its characteristic curve, reducing its power handling capacity and causing bottom cramping. The effect of a slight increase in value will be more noticeable at the top of the raster however.

Even if a new valve completely cures the fault it is worth checking the resistor. If it has changed value due to a slight leak in the previous valve the life of the new one will be shorter than it should be.

Leaky Capacitors

We have not yet exhausted the possible causes of this symptom however. Consider the PCL805's control grid circuit. The voltage here is normally negative with respect to its cathode and the value is chosen to ensure a full, linear scan. If there is a leak in the coupling capacitor C115 however some of the positive voltage at the triode anode will appear at the pentode's control grid, reducing the negative grid voltage and once again moving the valve's operating point along the characteristic curve. The symptoms in this case may not be confined to bottom cramping but may extend to a complete foldover of the scan over the bottom inch or two of the raster.

The field charging capacitor C116 is connected between the triode anode and the pentode cathode. This can also develop a leak, changing the valve's bias voltage with similar results.

The paper capacitors used in such circuits can be checked for leakage using an Avometer in the same way as when checking resistors. Switch the meter to the ohms times 100 range, disconnect from the circuit one end of the suspect capacitor, and connect the meter leads across it. If the meter records a brief pulse – as the capacitor charges – and then settles at around infinity the capacitor is in order. If the meter shows a steady resistance reading however, the capacitor is leaky – the greater the leak the lower the resistance reading. Even a very slight leak can upset the operation of the field output stage: if there is the slightest doubt, replace the capacitor.

Don't overlook the capacitors in the linearity circuit – C118 and C119 in this case – as these can also cause cramping. C118 is more likely to cause top cramping – see later. Look for burn spots and check them for value and leakage. If in any doubt replace them – they are not expensive.

Top Cramping

There are other field faults of course. Field roll for example can be due to a faulty valve, resistor or capacitor. Cramping at the top of the screen is generally caused by a mismatch in the output pentode's anode circuit. Many field output stages have a capacitor and resistor connected in series across the primary winding of the output transformer. Top cramping will be produced if this capacitor is leaky. If there is a resistor on its own this can fall in value to give the same effect. Other sets have a voltage-dependent resistor across the primary winding to limit the amplitude of the flyback pulse. A fault in this component will give similar symptoms. C118 which taps off the linearity feedback is another suspect, and a high-resistance cathode bias resistor can also be responsible as mentioned earlier.

Where a two-valve multivibrator circuit is used, as in our example, a change in the value of the first triode's anode load resistor R138 – i.e. the triode which is conductive during the scan – can also cause top cramping. Check the value with an Avometer as described earlier.

Output Transformer Faults

The field output transformer can break down completely, leaving no field scan (bright horizontal white line across the screen). Or adjacent turns inside the transformer can short, reducing the height of the scan with top cramping. Transformers cannot usually be tested except by replacement.

No Field Scan

No field scan can also be caused by a defective output pentode, or by a fault in the oscillator circuit as a result of which there is no drive to the output stage. If the oscillator is not working the anode voltages will be high: check the valve(s) and cross-coupling components. Resistors and capacitors can both go open-circuit and sometimes do so intermittently.

Field Slip

Where field slip is experienced the field sync pulse coupling circuit should not be overlooked. Another possibility is a changed value resistor in the field hold control circuit, e.g. R116 and R144 in Fig. 1. Weak field hold can also be caused by a fault in the sync separator circuit – or the video amplifier circuit – however, even if the line sync is satisfactory. Check valves, decoupling capacitors, and voltages in order to reveal changed value resistors.

Hum

Hum which takes the form of an expanded section of the raster sandwiched between compressed areas may not originate in the field timebase circuit. It can be due to failure of the power supply smoothing electrolytic capacitors. Heater-cathode leakage in one of the field timebase valves can contribute to this fault however.

Bright Line on Raster

A single bright line drifting up or down, superimposed on the raster, can be caused by a defective valve. A stationary bright line will result from spurious pulse pickup at the control grid of the output valve.

Excessive or Varying Height

Excessive height or intermittent height variations can be caused by the height stabilising voltage-dependent resistor Z3. Defective linearity controls can also be responsible for these faults. Excessive height will also be the symptom if the linearity feedback loop goes open-circuit.

Faulty Thermistor

The thermistor (X2) connected in series with the scan coils to compensate for height variation as the set warms up can also be defective. The usual symptoms are lack of height, slight bottom cramping and field jitter with critical field hold. The thermistor is to be found on the deflection yoke.

Centre Compression

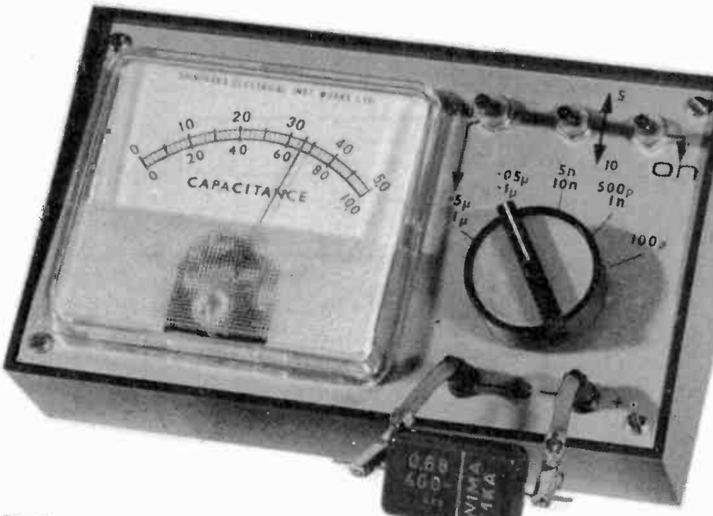
Compression towards the centre of the raster is a rare though occasionally encountered fault. A new output valve will generally cure it but check whether there is a screen grid feed resistor. If one is fitted and it is found to be high-resistance it could be responsible for the symptom. If it is high-resistance it is quite likely to be so as a result of passing excessive current due to a fault in the valve. So check both, also if necessary any decoupling capacitor present.

Conclusion

In conclusion, the diagnosis of field faults involves study of the visible symptoms on the screen to decide on which part of the circuit is likely to be involved, followed by valve, voltage, resistance and capacitor checks as necessary to locate the defective component.

Before replacing a capacitor, check the rated working voltage printed on it – this is especially important with capacitors in the output pentode anode and linearity circuits since these are subject to high-voltage pulses. They may be rated at 1kV or sometimes 1·25kV. Make sure that the replacement is of at least the same rated value, or a further breakdown will occur. ■

DIRECT-READING CAPACITANCE METER



A. WILLCOX

MANY people may perhaps place a capacitance meter last on their list of workshop requirements, but once such an instrument is available it is surprising how rapidly it becomes indispensable. I wonder how many engineers, searching for an elusive timebase fault have, like myself, ended up with half a dozen new capacitors fitted in, just in case those which 'read OK' on an ohmeter were perhaps low capacity. And what about those polystyrene capacitors – increasingly popular in line oscillator and reference oscillator circuits – which have a nasty habit of going open circuit. Add to this the capacitors one encounters with obscure or rubbed off markings, and the case for a capacitance meter grows.

Aerial installers may also find a use for such a meter, for, once the capacity per unit length of cable is known (typically 56pF per metre), then the amount of cable left on the reel can be found without unwinding, by measuring its capacity. Also if a break has occurred internally in a length of cable, the distance of the break from the end can be found.

The direct reading capacitance meter described here uses a particularly simple circuit based on the 555 timer i.c. which is widely available at low cost. Capacitance from 1 or 2pF to 10μF can be measured, and to give a good indication at all intermediate values a five-position range switch is used, plus a $\times 10$ switch to extend the highest range to read up to 10μF. The five positions give full scale deflections corresponding to 1μF, 0·1μF, 10nF, 1nF and 100pF. A divide-by-two switch is provided to convert these to 0·5μF, 0·05μF, 5nF and 500pF f.s.d. The $\div 2$ switch does not apply accurately to the 100pF range, but it can be used without much error to ease reading very small capacitances of the order of a few picofarads.

The voltage applied to the capacitor under test is unidirectional and of 4·5V maximum value. This means that polarised capacitors such as tantalums and electrolytics can be measured, and also reverse-biased semiconductor junction capacitance. A particularly useful measurement is the collector to base capacitance of a transistor, which gives an indication of the frequency range over which the transistor could be used as an amplifier. For example, an AC187 with an f_T of 5MHz has a collector-base capacitance of about 150pF, whilst a BC108 with an f_T of 300MHz has a capacitance of 3pF. The meter reads the discharge current only, and so short-circuit capacitors and forward biased semiconductor junctions give zero deflection. In this way the meter movement is protected from overloads due to shorts.

The total current consumption is less than 3mA, ensuring a long battery life – always assuming one remembers to switch off the unit when it isn't in use. A 'push to read' switch was considered in place of a

★ Components List

Capacitors:
C1 10nF polystyrene or silvered mica
C2 470μF 16V electrolytic

Resistors:

R1a	8·2MΩ 5%Hystab	R2a	1MΩ 5%
R1b	820kΩ 2% Oxide	R2b	100kΩ 5%
R1c	82kΩ 2% Oxide	R2c	10kΩ 5%
R1d	8·2kΩ 2% Oxide	R2d	820Ω 5%
R1e	820Ω 2% Oxide		
R3	47Ω 5%	R4	5·6kΩ 5%

Variable Resistors: (all min. presets)
VR1 47kΩ VR2 10kΩ VR3 470Ω

Semiconductors:
D1, D2 OA47 gold-bonded germanium
D3 BZY88 C6V2 400mW 6·2V zener
Tr1 BC107 or similar silicon npn
IC1 555 timer (NE555V, MC1455P, LM555CN, etc.)

Miscellaneous:
S1 2p 6w midget wafer (5 positions used);
S2, S3, S4 s.p.d.t. midget toggles (RS Components);
M1 50μA 86x78mm (SEW MR65P, Laskys); 2mm plugs and sockets, 2 off; Instrument case (RS Components Type 21); Stripboard, 87 x 35mm (3·45 x 1·4 in), 2·54mm (0·1 in) pitch; PP3 battery; Knob for S1.

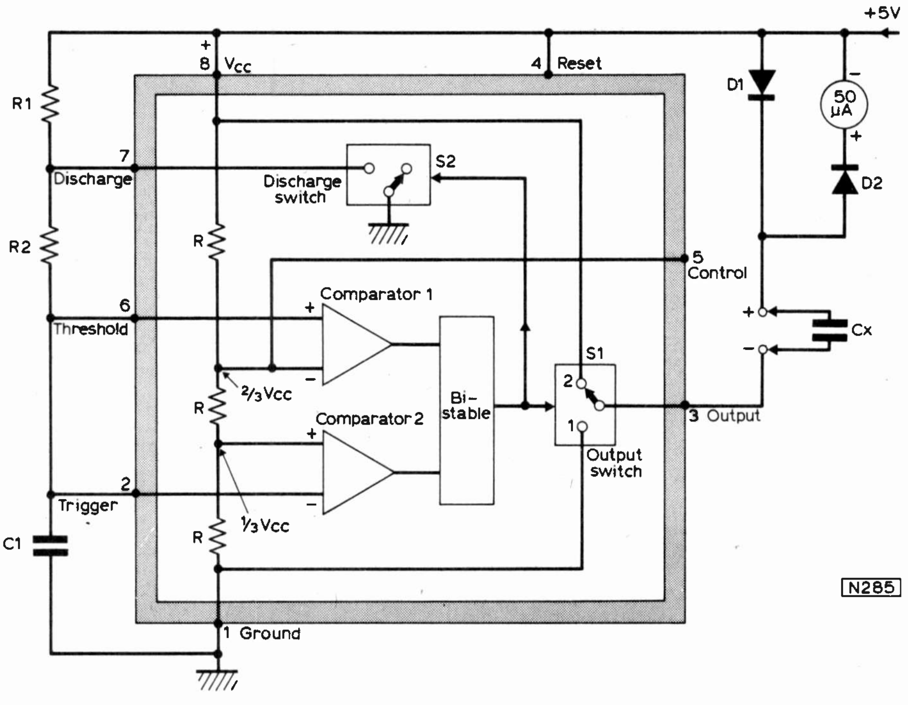


Fig. 1: Basic circuit of the capacitance meter, showing the 555 timer i.c. connected for astable operation. For simplicity, the transistor switches S1 and S2 are shown as mechanical switches.

conventional on/off switch, but this was rejected in case there was an occasion for a reading to be observed over a period, perhaps while the effect of temperature changes on the capacitor were noted.

The Circuit

The basic circuit is shown in Fig. 1, in which parts of the i.c. are shown as simple switches in order to clarify the circuit operation. When power is first applied C1 charges through R1 + R2 until 2/3 of the supply voltage is reached. At this point comparator 1 provides an output which changes the state of the bistable, and hence that of the transistor switches S1, S2 also. With S2 now closed the charge current to C1 is bypassed, and a discharge path is provided through R2. When C1 has discharged to 1/3 V_{CC} comparator 2 gives an output to the bistable, which returns switches S1 and S2 to their original state and so the cycle continues.

The point which concerns us here is that the output switch S1 connects one end of the capacitor under test Cx alternately to either supply rail, at a rate determined by the values of R1, R2 and C1. When the switch is in position 1 the capacitor Cx charges rapidly through D1 to the supply voltage, and when the switch returns to position 2, Cx discharges relatively slowly via D2 and the internal resistance of the meter movement Rm (typically 2kΩ). The meter responds to the average value of this discharge current, which is shown shaded in Fig. 2(d). It can be shown (see appendix) that as long as the period between discharges (T) is long compared to the time constant Cx.Rm, then

$$\text{I average} = \frac{\text{V.Cx}}{0{\cdot}7(\text{R1} + 2\text{R2})\text{C1}} \quad \text{.....................(1)}$$

where V is the voltage to which Cx charges. If this equation is examined it will be seen that the average current is directly proportional to the value of Cx (giving us a linear meter scale), and inversely proportional to R1 + R2. In other words if we *reduce* the value of R1 + R2 by a factor of 10, the value of Cx required to give the same meter deflection also reduces by a factor of 10.

This is the basis of the range switch employed in the complete circuit shown in Fig. 3. To take an actual example: when the range switch is set to read 0 – 0·1µF, R1 = 820kΩ and R2 = 100kΩ. C1 is fixed at 0·01µF. The effective voltage to which Cx becomes charged is less than V_{CC} because of the voltage drops across the diodes and the output switch of the i.c., and is of the order of 4·5V. Now inserting these values into equation (1) gives us

$$I_{AVE} = \frac{4{\cdot}5 \times \text{Cx}}{0{\cdot}7 \times 10^6 \times 0{\cdot}01 \times 10^{-6}} = 642 \times \text{Cx}$$

(note: 820k + (2 × 100k) = 10^6 ohms approx.)

Now when Cx is given in microfarads the answer is in microamps, and so if Cx = 0·1µF, the meter current is 642 × 0·1 = 64·2µA. This current turns out to be just over the 50µA required by the meter movement, and so all that is needed to effect calibration is some means of reducing this current slightly. It so happens that the figure of 0·7 appears in equation (1) because C1 charges and discharges between 1/3V_{CC} and 2/3V_{CC} (see appendix), and if either or both of these voltages were altered then the factor of 0·7 would no longer apply. If these charge and discharge limits are increased, this factor also increases, reducing the total value of the equation thereby. The means is available to do this because pin 5 of the i.c. is connected to the internal potential divider from which the 1/3 and 2/3V_{CC} points are obtained. By connecting pin 5 to V_{CC} via a preset, therefore, the meter current can be lowered, and the instrument calibrated.

If the resistors on the range switch differ in value from each other by a fixed ratio at each step, then calibration need only be carried out on one range. This is important because it means that only one close tolerance capacitor is required to calibrate the completed instrument. Reference to Fig. 3 will show that R2 is omitted at the high frequency end of the range switch, and R2d is less than would be expected. The reason for this is that the effective resistance of the switching transistor at pin 7 is comparable to the value required of R2 at these switch positions.

When the divide-by-two preset VR2 is in circuit the voltage on the internal potential divider is lowered to the point where the frequency of oscillation is doubled. Under these conditions the capacitor under test discharges into the meter circuit twice as often, and so it follows that half the capacitance is required to give the same deflection.

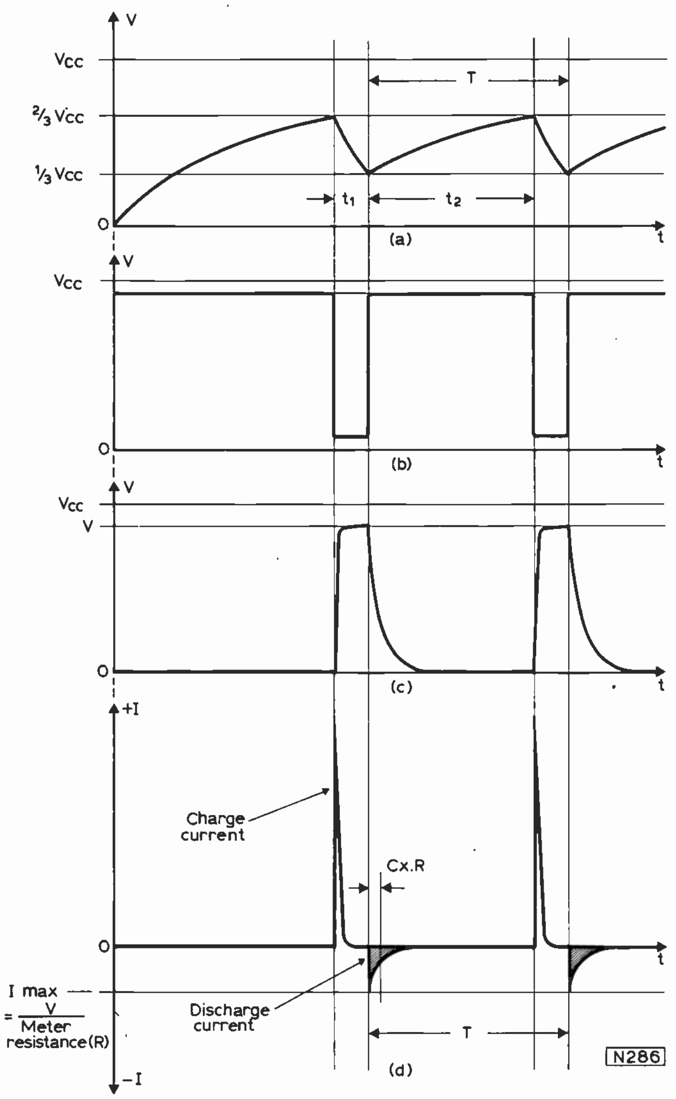


Fig. 2: (a) Voltage across C1 from switch-on. (b) Output voltage of i.c. at pin 3. (c) Voltage across the test capacitor Cx. (d) Current through Cx. The shaded area is the current measured by the meter.

The ×10 circuit functions by shunting 9/10 of Cx's discharge current around the meter, so raising by a factor of 10 the value of Cx required to give the same deflection. Due to the low frequency of the oscillator on the $1\mu F$ range some fluctuation of the meter pointer is evident, and so advantage of the ×10 switch is taken to introduce a smoothing capacitor across the meter movement.

APPENDIX

The time between successive discharges of Cx (Fig. 2(d)) is equal to $t_1 + t_2$ (Fig. 2(a)).

To find t_1

Now t_1 is the time taken for C1 to discharge from $\frac{2}{3}$ Vcc to $\frac{1}{3}$Vcc. That is, to lose one half of its voltage. The fall in voltage is given by $Vt=Vo.e^{-t/C1R2}$ where Vt is the voltage across C1 after an interval t, & Vo is the initial voltage. This may be written

$$Vo/Vt=e^{t/C1R2}$$

$$\text{or } \log_e\frac{Vo}{Vt}=t/C1R2$$

$$\text{from whence } t=C1R1\log_e Vo/Vt$$

Now Vo/Vt in this case is $\frac{2}{3}Vcc/\frac{1}{3}Vcc=2$

and so $t_1=C1R2\log_e 2=0{\cdot}6931\ C1R2$

$=0{\cdot}7C1R2$ approximately

To find t_2

Just as the time taken for a capacitor to lose one half of its charge was found to be 0·7× the time constant, so the time taken for a capacitor to charge to halfway between its initial and final values is also 0·7CR. Reference to Fig. 2(a) will show that this is the case with the interval t_2. As C1 charges from its initial value of $\frac{1}{3}$ Vcc to the final value of Vcc, the charge is halted at the halfway point $\frac{2}{3}$ Vcc. In this case, however, C1 charges via R1 and R2 in series and so $t_2=0{\cdot}7\ (R1+R2)C1$.

The total cycle time $T=t_1+t_2=0{\cdot}7\ C1R2+0{\cdot}7(R1+R2)C1$
$=0{\cdot}7(R1+2R2)C1$

Turning now to Cx, the average discharge current is the area under the curve (shaded in Fig. 2(d)) divided by the base line T.

If R=the discharge resistance provided by the meter movement and nCxR=T then

$$I\ ave=\frac{1}{nCxR}\int_0^{nCxR} Imax.e^{-t/CxR}\,dt$$

$$\text{or } I\ ave.=\frac{k.Imax}{n}\int_0^{n/k} e^{-kt}\,dt \qquad \text{where } k=\frac{1}{CxR}$$

$$=\frac{k.Imax}{n}\left[-\frac{e^{-kt}}{k}\right]_0^{n/k}$$

$$=\frac{k.Imax}{n}\left(\frac{-e^{-n}+e^{0}}{k}\right)$$

$$=\frac{Imax}{n}\left(1-\frac{1}{e^{n}}\right)$$

If however T is large compared to CxR, $\frac{1}{e^n}$ becomes so small that it can be ignored giving $Iave=\frac{Imax}{n}$

Now $Imax=\frac{V}{R}$ where V is the voltage to which Cx charges so

$$Iave=\frac{V}{Rn}\ldots\ldots\ldots\ldots\ldots\ldots\ldots eq(1)$$

As $T=nCxR=0{\cdot}7(R1+2R2)C1$ so $n=\frac{0{\cdot}7(R1+2R2)\ C1}{Cx.\ R}$

substituting this value of n in eq(1) gives

$$Iave=\frac{V.\ Cx}{0{\cdot}7(R1+2R2)\ C1}$$

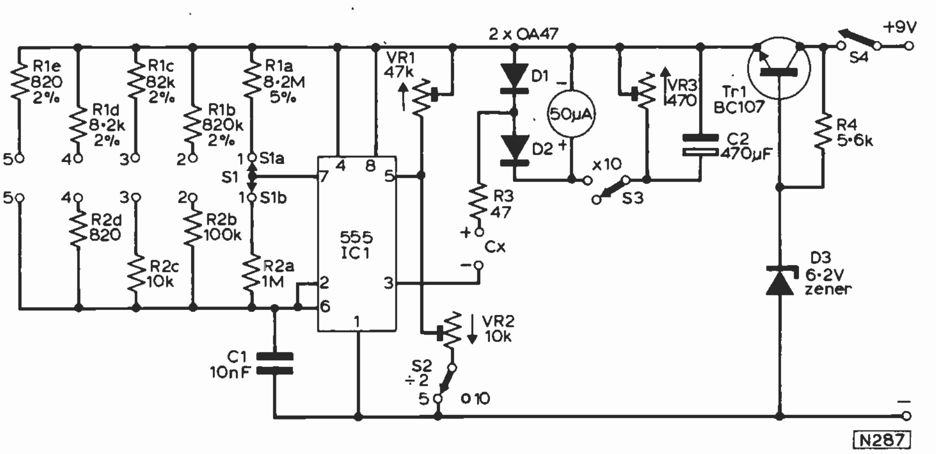


Fig. 3: Complete circuit of the capacitance meter. The arrows against the preset potentiometers indicate direction of movement with clockwise rotation.

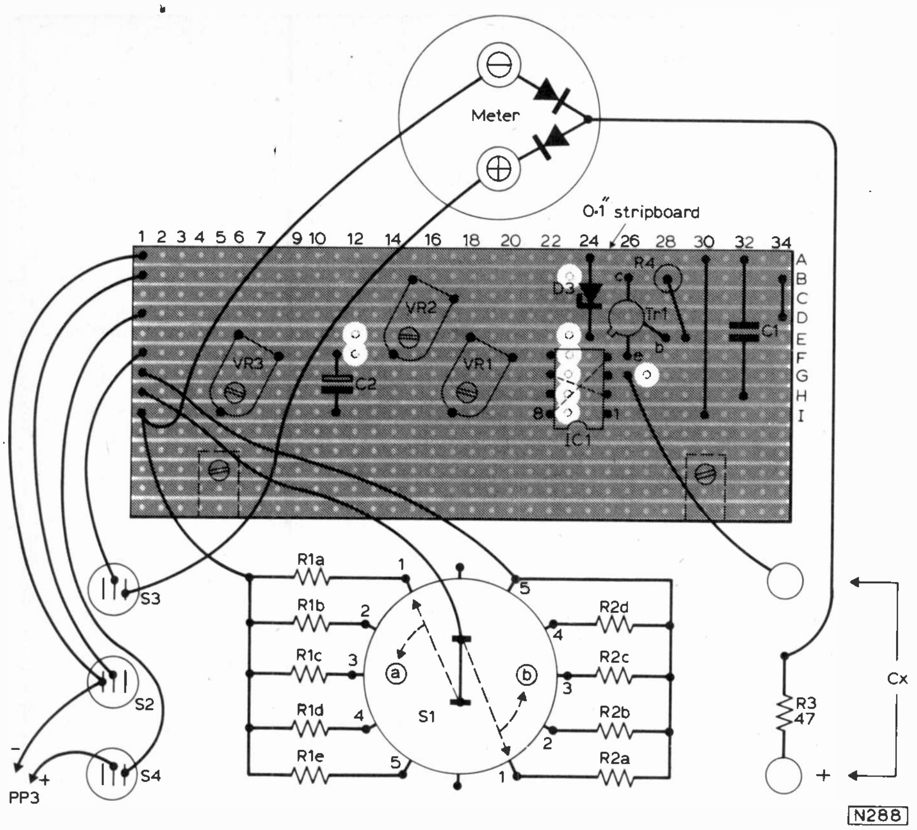
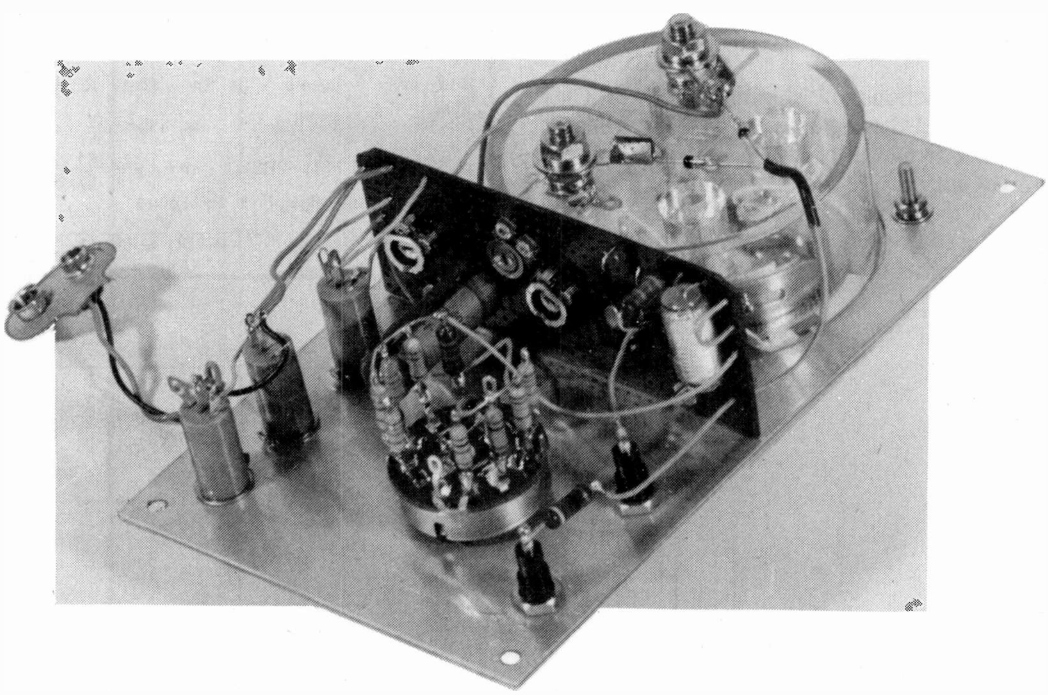


Fig. 4: Practical wiring diagram of the complete instrument. The stripboard is viewed from the component side. The tracks should be broken at the following points: B23, E12, E23, F12, F23, G23, G27, H23, I23.

To ensure continued accuracy as the battery ages a simple stabilised power supply is used; as reference to equation (1) will show, the current through the meter is proportional to the voltage to which Cx charges.

Components

For the meter any movement of $50\mu A$ sensitivity can be used, but a check should first be made that the dimensions are not too great to be accommodated by the case specified. Close tolerance resistors should be used for R1a – R1e because their relative value dictates the overall accuracy from range to range. The tolerance of R2a – R2d is not so important because their value contributes to only 25% of the cycle time of the oscillator. Because initial calibration is set by VR1 the tolerance of C1 is not important, but it should nevertheless be a good quality silvered mica or polystyrene component. The gold bonded diodes OA47 specified for the meter rectifiers must be used if optimum results are to be obtained.



Interior view of the prototype. The range resistors (R1/R2) are mounted directly on the range switch. The angle-brackets supporting the circuit board are secured under the meter fixing nuts.

Calibration

If the meter movement used has a single scale marking, it will be necessary to remove the front panel and add another set of scale markings to avoid a mental multiplication or division by two when the ÷2 switch is operated. With the movement specified in the components list it is a simple matter to prise off the front cover, and to remove the two screws holding the scale in position. The scale can then be carefully removed and an additional range added as shown in the illustrations. When replacing the cover, care must be taken to engage the set zero mechanism correctly. When interpreting the meter reading, the top scale of the meter and range switch applies with the ÷2 switch up, and the lower scale with the switch down.

Before switch-on the presets should be set to near minimum position (anticlockwise). The instrument can be calibrated on any range, but close tolerance capacitors are more readily available in the lower values. Assuming a 1000pF 1% capacitor is used, this should be connected to the test terminals, and the range switch set to the 1n/500pF position. The ÷2 switch should be down (out of circuit) and the instrument then switched on. VR1 is now advanced until the meter reads full scale deflection.

In order to set the ÷2 circuit the range switch should first be turned to the 10n/5n position, then the ÷2 switch operated (up position). VR2 should be advanced until the meter reads 10 on the 0–50 scale. Alternatively, if a 500pF capacitor is also available, the ÷2 preset can be adjusted to give f.s.d. on the 1n/500pF range. As explained below the ×10 switch is used only on the 1/0·5μF and 0·1/0·05μF positions of the range switch, and due to frequency restrictions the ×10 preset must be set up on these ranges. A close tolerance component is not required, however, and a capacitor of around 0·47μF is ideal. With the range and ÷2 switches set to read 0–0·5μF, the value of the capacitor should be read and noted. The ×10 switch is now operated, and the range switch set to read 0–0·05μF. VR3 is now advanced until the same deflection as before is obtained. Calibration is now complete, and the instrument ready for use.

Using the Instrument

As explained before, the meter pointer will be subject to some vibration on the 1/0·5μF ranges. To overcome this the 0·1/0·05 range can be used in conjunction with the ×10 switch to fulfil the function normally provided by the 1/0·5 range. And so the highest range would only be used with the ×10 switch operated, in order to read 5 or 10μF f.s.d. In this way maximum use is made of the extra smoothing added when the ×10 switch is on. Short circuit capacitors will give a zero reading, while a leaky component will read low capacity.

Semiconductor junctions will read their capacity at 4·5V when reverse biased, and zero when forward biased. For example, the BA102 varicap diode, used in reference oscillator circuits, can be tested and should read around 40pF.

Safety

The only way in which the meter movement can be overloaded is if a large capacity is connected while the range switch is in a low capacity position. For this reason the switch is arranged so that one would logically start at the highest range and rotate the switch clockwise until a reasonable deflection is obtained. ■

FIELD TIMEBASE FOR THE PIL TUBE

by S. George

THE self-converging Mazda/RCA PIL colour tube with its in-line guns and permanently fixed toroidal scan coils is used in two chassis at present on the UK market, the Thorn 9000 and the Korting 55636 chassis. Apart from the use of the PIL tube however these chassis have little in common. The scanning sections of the Thorn 9000 chassis were described in some detail in the August 1975 issue. The transistor line output circuit also provides power supply regulation – Thorn's "Syclops" circuit. In contrast the Korting 55636 20in. set uses a thyristor line output stage. The field deflection circuits are also completely different, and the purpose of this article is to see how Korting have gone about the field scanning of the PIL tube. Thyristor line output circuits will be dealt with in a later article.

Modern solid-state field timebase circuits tend to be much more complicated than the old valve circuits with which we are so familiar, employing many more stages. Once such circuits are broken down into appropriate subsections however it's simple enough to follow the basic action. The Korting circuit under consideration uses a total of nine transistors, though the first two are simply there to provide sync pulse amplification and inversion. The complete field timebase circuit is shown in Fig. 1.

Field Sync Circuit

The field sync pulses are obtained from pin 7 of a TBA920 sync separator/line oscillator i.c. After integration they are fed via C301 to the base of the sync pulse amplifier transistor T301, at an amplitude of 0.9V peak-to-peak. This transistor is without forward bias, the positive-going input pulses driving it into conduction. The resultant negative-going pulses developed across its load resistor R303 drive the inverter transistor T302, and in consequence positive-going pulses, of 12·5V peak-to-peak amplitude, appear across R306. These drive transistor T303 in the multivibrator circuit to saturation at the end of the forward scan, starting the flyback action.

Oscillator

T303 and T304 form a conventional astable multivibrator. The output is taken from T303 which conducts during the flyback period to discharge the field scan charging capacitors; T304 conducts during the forward scan. The duration of the forward scan is mainly determined by C307/R307 in conjunction with the coarse and fine field hold controls. C305/R316 determine the duration of the flyback. The emitter voltage of the two transistors is set by D301. Field flyback blanking pulses are also taken from the collector of T303, and the same path is used to apply 12V to the collector of T303 when the service switch is in the "line" position – to collapse the raster by stopping the field oscillator.

Since T303 is cut off during the forward scan and saturated during the flyback its collector waveform consists of a series of 10·9V peak-to-peak negative-going spikes. What we require from the field generator of course is a sawtooth waveform, and this is provided by the following *RC* charging circuit.

Charging Circuit

The charging capacitors are C309 and C311 which during the forward scan charge via R336 and the height control R335: a 'scope connected across them would show the usual sawtooth voltage curve. T303 is cut off during this period, its high collector voltage reverse biasing D302. At the end of the scan – the timing being determined by the circuit time-constant in the absence of an input from the aerial, but made slightly earlier when the circuit is synchronised by the presence of a signal – T303 switches on and its low collector voltage forward biases D302. As a result, the capacitors are rapidly discharged via D302 and T303.

Field Linearity Correction

Only one capacitor is required in order to develop a sawtooth waveform of course, but the use of two connected in series makes it possible to inject a feedback linearising waveform – a technique generally used in solid-state field timebases. R329 provides overall linearity adjustment. Since the height control R335 is decoupled by C308 its adjustment does not affect the linearity. Top linearity control is effected in the emitter circuit of the preamplifier stage T305: the feedback waveform is integrated by the top linearity control R344 and C317, and coupled to this point by C315.

Driver and Output Stages

The preamplifier stage is followed by the driver T306, which develops at its collector a 23V peak-to-peak waveform. This directly drives the "upper" output transistor T351. Since the output stage requires a push-pull drive however the input to the "lower" output transistor T352 must be inverted. For this purpose the inverter stage T307 is incorporated. D304 maintains the correct bias conditions while D305 protects the base-emitter junction of T352 by removing excessive negative peaks from the drive waveform. The output is capacitively coupled to the scan coils by C355, the large value of this capacitor being necessary because of the low impedance of the toroidal scan coils.

Pincushion Distortion Correction

Now although the PIL tube is self-converging, i.e. it requires no dynamic convergence circuitry, there is

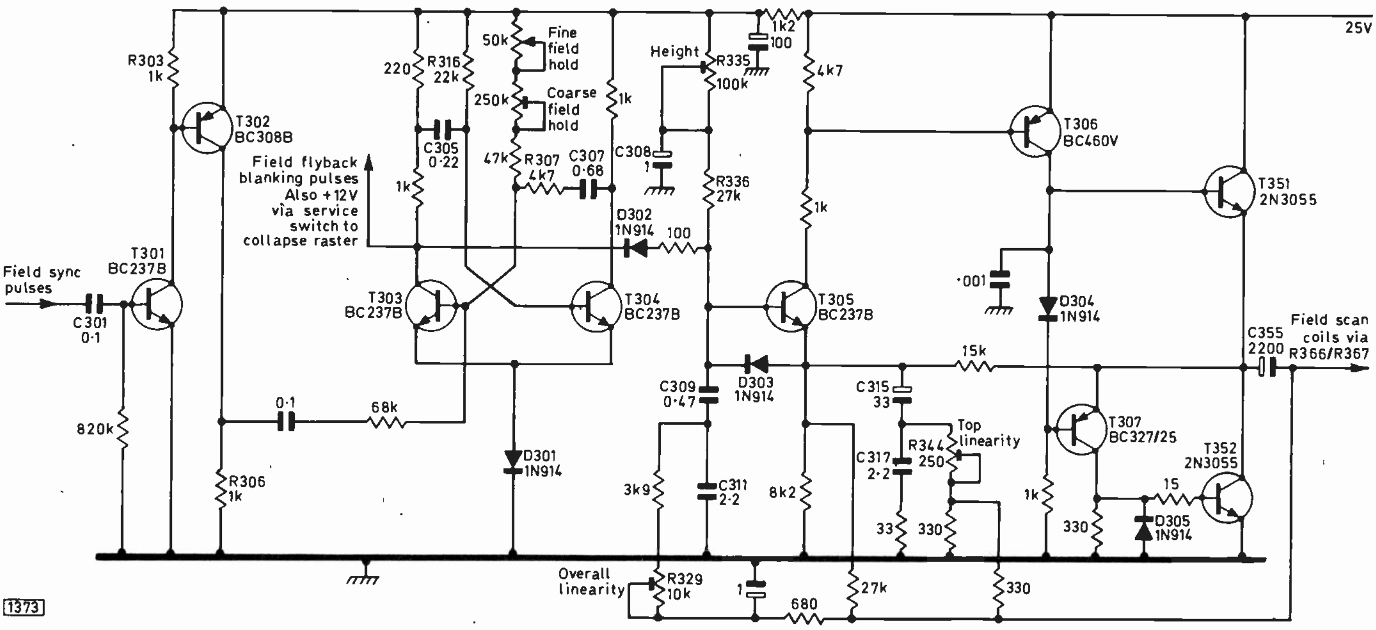


Fig. 1: The field timebase circuit used in the Korting 55636 chassis which is fitted with a 20 in. 90° deflection angle self-converging PIL colour tube. A single transductor provides EW and NS pincushion distortion correction (see Fig. 2).

nevertheless a degree of pincushion distortion in both directions – top to bottom (NS) and side to side (EW). This requires compensation, and a single transductor circuit is used for this purpose (again in contrast to the Thorn 9000 chassis, which employs separate EW and NS pincushion distortion correction circuits). The circuitry involved is shown in Fig. 2.

The field scan waveform from C355 passes via the temperature compensating network R366/R367 to the series connected scan coils and then to chassis via winding 6-5 on the transductor and then the NS phase coil L352. A line frequency pulse waveform is fed to the other transductor windings (8-7, 1-2). C358, R372/R374, R375 and C361 all contribute to producing a damped tuned circuit which converts the line pulses to a parabolic line frequency signal giving NS pincushion distortion correction. What we are doing here is to use this line frequency signal to modulate the field scan at line frequency. Conversely, the field frequency signal in winding 6-5 modulates the line scan since the other windings on the transductor load the line output stage. Let's look at this in greater detail.

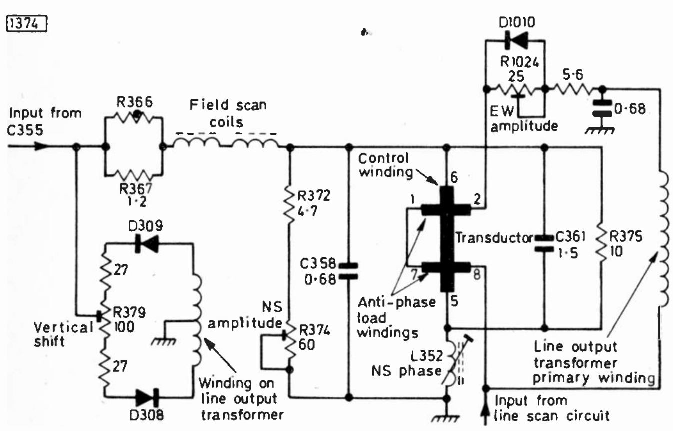


Fig. 2: The pincushion distortion correction circuit.

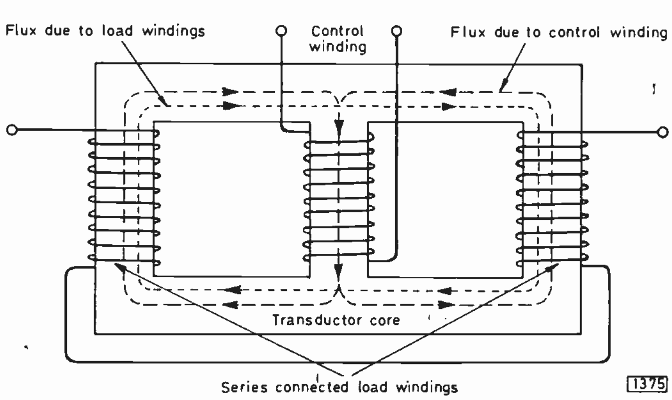


Fig. 3: Transductor windings and action.

Transductor Action

The transductor consists basically of three windings wound on a three-leg iron core which is easily saturated (see Fig. 3). The "load" windings are wound on the outer legs and are connected in series opposition. Thus an a.c. signal applied to the central "control" winding will produce equal but opposite phase voltages across the two outer load windings, their combined e.m.f. being zero. A heavy current in the control winding however will, by taking the core towards saturation and thus preventing it from responding normally to further magnetising changes, affect the inductance, and thus the impedance, of the two load windings. In consequence if another a.c. signal is flowing through the load windings it will increase in amplitude as the control current increases – since the impedance offered by the circuit will be less. In a nutshell, the current in the control winding varies the impedance offered by the load windings to any a.c. flowing through them.

It might at first seem that an a.c. signal flowing through the series-connected anti-phase load windings would have no effect on the magnetisation of the core – and hence on the current flowing in the control winding. This would indeed be the case with a conventional transformer. A transductor differs however in having an easily saturated core while two different currents flow through the control and load windings. What happens is that while the current

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UHF AERIAL PERFORMANCE

Roger BUNNEY & Ian BECKETT

THE many different u.h.f. aerials on the market make it difficult to know which type to select for a specific purpose, while very little information has been published comparing the results obtained with aerials from different manufacturers' ranges. In an effort to do something about this lack of information we tested a number of the aerials currently available from UK manufacturers. We could not test all aerials of course, but what we have attempted is to take a representative selection so that the performance to be expected from a particular type of aerial can be assessed.

The aerials were tested under similar conditions by Ian Beckett at his country location near Buckingham. Several transmitters can be received there, so that comparisons can be made over a wide bandwidth. Each array was mounted on a ten foot mast, two meters of known accuracy being used to measure the signal strength. The meters were from Labgear and CED.

DEVELOPMENTS

Before going into the results, some notes on u.h.f. aerial developments over the last ten years may be appropriate. The arrays now available are either grouped (A, B, C/D or E) or wideband. Details of the performance of individual aerials are generally given by manufacturers in their sales literature – either average gain over the bandwidth covered, peak gain and front-back ratio at one particular point in the band, or a typical gain/bandwidth graph. With the rapid growth of the u.h.f. TV network in the UK during the late 60s and early 70s many small firms entered the market. Some of these produced aerials with inferior performance – inconsistent gain, poor matching into the feeder, and dubious polar response over the claimed bandwidth. To improve standards, two organisations were set up, the British Aerial Standards Council to which the larger aerial manufacturers belong, and the Aerial Manufacturers Association. The Council has laid down specific design guidelines – see later – and manufacturers who are members conform to or better these standards.

With the advent of the multidirector assembly the performance of u.h.f. aerials improved markedly. This design was introduced here from West Germany, where Fuba and Hirschmann had been using it for a number of years. Prior to its arrival in the UK, u.h.f. aerial design had been limited mainly to the basic in-line Yagi array with anything up to 23 elements (e.g. the original Aerialite "Golden Gain" aerial had 18 elements in its standard form, but a five element add-on section was also available). Other variations included the J-Beam (now Jaybeam) skeleton slot system – available in versions up to twelve over twelve.

In the late 60s there was considerable controversy over the pros and cons of using a balun to match the aerial to the feeder. Jaybeam and Antiference used baluns (Antiference had a printed circuit version), whereas Wolsey, Belling and Aerialite preferred to use specially shaped dipole assemblies to maintain the matching over the bandwidth. Jaybeam still use wound baluns in their u.h.f. and Band III arrays, while Antiference use a balun in their XG range: other manufacturers use alternative matching methods.

With their Parabeam range Jaybeam were the first to depart from the use of a dipole: instead they adopted a variation on the skeleton slot, married to an in-line director chain. This gave a +3dB power gain over that of the usual dipole arrangement. The Parabeam assembly also had a reflector based on the skeleton slot principle.

Subsequently Wolsey introduced a variation on this theme, with the use of parallel dipoles but with different dipole-to-feeder connections.

Amongst UK aerial manufacturers, Jaybeam was the first to introduce an aerial featuring multidirector assemblies. In comparison to an in-line director array the multidirector technique increases the gain to something approaching that of a quad stacked array, but without the complex mechanical construction and the interconnecting harness. What the multiple director assembly attempts to do is to simulate four directors: hence the performance akin to that of a quad stack but with only the single aerial boom.

Of this type of aerial now available, the Jaybeam Multibeam range utilises the skeleton slot assemblies of their earlier Parabeam range, the Antiference XG range uses a "shallow X" dipole which is very similar in appearance to their full-wave multidirector chain, while Aerialite use a half-wave director unit resembling a "Squared S".

WIDEBAND ARRAYS

As yet Wolsey have made no use of the multidirector approach. They were the first however to introduce a wideband u.h.f. array with a relatively level response and good gain/bandwidth product. The Antiference and Jaybeam ranges both include log-periodic arrays which have a similarly wide bandwidth but have relatively low gain. With the channel grouping system used in the UK there might seem to be little need for wideband u.h.f. aerials. The system assumes that a maximum of four u.h.f. channels is available in any area, with the transmitters co-sited. The groups are channels 21-34 (A); 39-53 (B); 48-68 (C/D); and 39-68 (E). Thus most u.h.f. aerials are designed for operation in any of the four groups, giving maximum

Table 1: Measured Aerial Performance.

Aerial	Channel 23	24	26	27	31	33	39	42	45	57	60
Antiference TC18 group A in-line Yagi	55μV	750μV	38μV		660μV		30μV				
Maxview Hi-Gain group A in-line Yagi	55μV	775μV	35μV		590μV		33μV				
Aerialite SP50 group A multidirector Yagi	60μV	925μV	45μV		610μV		<30μV				
Jaybeam MBM70 group A multidirector Yagi	65μV	860μV	45μV		910μV		52μV				
Jaybeam MBM88 group A multidirector Yagi with launch elements	75μV	1·2mV	50μV	920μV	1mV	27μV	60μV				
Antiference XG21/A group A multidirector Yagi	55μV	3mV	30μV	890μV	2·1mV	35μV					
Antiference XG21/K wideband (chs. 21-48) multidirector Yagi	50μV	3mV	30μV		2mV		85μV	75μV		210μV	90μV
Jaybeam LBM2 log – periodic		760μV	27μV		120μV		28μV	34μV		3mV	3mV
Maxview stacked bowtie wideband array	30μV		28μV		205μV		50μV	50μV		1·8mV	1·3mV
Wolsey Colour King stacked bowtie wideband array	32μV		30μV		290μV		70μV	70μV		1·9mV	1·2mV
Jaybeam PBM12 group C/D in-line Yagi		170μV		110μV	83μV		43μV	33μV	28μV	1·1mV	1·4mV
Jaybeam PBM12 group C/D with group A reflector		390μV		195μV	130μV		45μV	45μV	35μV	1mV	1·4mV
Antiference TC18 group C/D in-line Yagi		32μV		45μV	90μV		62μV	63μV	50μV	1·2mV	2·2mV
Antiference TC18 group C/D with group A reflector		63μV		90μV	190μV		65μV	62μV	42μV	1·3mV	1·1mV

Notes: The PMB 12C/D and TC18C/D with group A reflector retained their directional properties in Group A.
The MBM88 and XG21/A were tested on alternate days to the other aerials. All readings averaged over a period.

performance over that bandwidth only. With the proliferation of high-power u.h.f. transmitters however it is often possible to receive alternative programmes to those provided by the local transmitters. And since the alternative programmes will be on channels outside the local group there has arisen a demand for wideband u.h.f. aerials. Equipped with an aerial rotator and a suitable wideband preamplifier it is quite possible to receive upwards of two ITV programmes in addition to the local one – assuming a favourable geographical location of course.

Jaybeam and Antiference have maintained production of wideband log-periodic aerials which because of their good front/back ratio and clean polar response are excellent for use in high signal strength areas where ghosting is a problem. For use in fringe areas however their gain leaves something to be desired. Until recently Wolsey held the wideband market with their Colour King, a stacked bowtie unit with a flat response over the whole channel 21-68 spectrum. Maxview aerials have since introduced a stacked bowtie with a similar performance.

The problem of gain/bandwidth has obviously been under consideration by several manufacturers since whilst this article was in preparation two firms have introduced new wideband u.h.f. arrays. The aerials in the Antiference XG range are now available in wideband form – the XG21/W reaches a peak gain of 19dB with a low of 13·2dB over its bandwidth (channels 21-68). Telerection have introduced a completely new system, their unique short backfire aerial. The basic gain of the Telerection backfire aerial is 13dB, but this is increased to 15dB with the addition of a seven-element front director array. The response is said to be flat over the bandwidth (450-900MHz).

TESTS

In testing the arrays we were particularly interested to see how the gain was maintained over the designed for bandwidth, and into the lower reaches of the next channel group. For the tests, group A aerials (or wideband ones) were selected since there is an abundance of transmitters which give good field strength in this channel group at Buckingham.

The front/back ratio of all the aerials tried was good with the channels selected and was within the specifications given by the manufacturers. The gains achieved by the aerials are listed in Table 1. The first six aerials are group A types, the Antiference TC18 and Maxview Hi-Gain being in-line Yagis. These had a similar gain performance over the channel group. Four group A multidirector aerials (Aerialite SP50, Jaybeam MBM70 and MBM88 and Antiference XG21/A) were tested and we can comment as follows on these. The SP50 had good low and mid-band gain but tended to fall off at the top end of the spectrum (generally a higher gain is sought at the high frequency end of the spectrum to counteract rising cable losses). The MBM88 gave improved performance compared to its predecessor the MBM70 over the whole band. The

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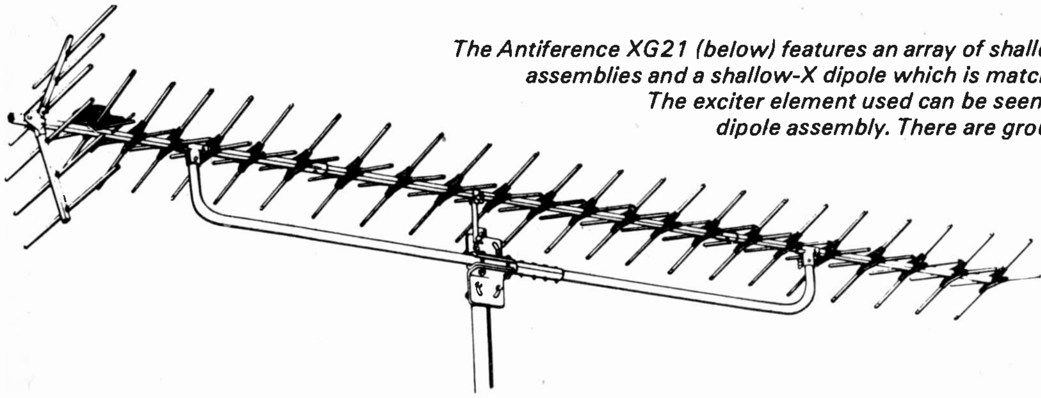


The Antiference XG21 (below) features an array of shallow-X multi-element director assemblies and a shallow-X dipole which is matched to the feeder by a balun. The exciter element used can be seen mounted just in front of the dipole assembly. There are grouped and wideband versions of this aerial.

Video Effects Generator

A TV PROJECT

PART 2

E.A.PARR, B.Sc C.Eng MIEE

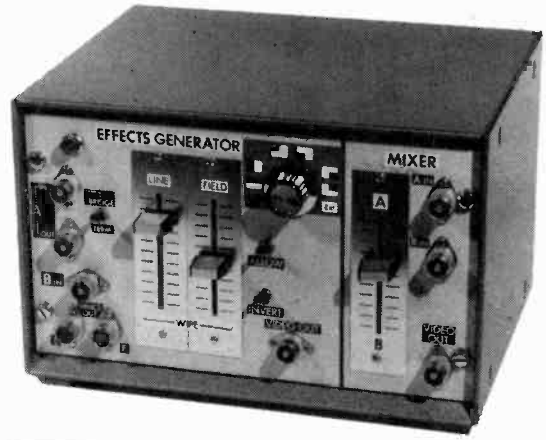


Fig. 8: Effects generator printed circuit board, showing (left) track layout and (right) component location and external connections. Both drawings are full size. Track patterns for Tr3, Tr4 and Tr11 allow the use of either metal or plastic case devices. On VR3 and VR4, the wiper pin should be cut off, and the connection made instead by means of a link soldered across at the base of the potentiometer.

Printed boards, ready drilled, are available from WKF Electronics, Welbeck Street, Whitwel, Worksop, Notts. Prices are £4.00 for DN0799A and £1.25 for DN0780A, plus 15p p&p for either or both boards. All prices include VAT.

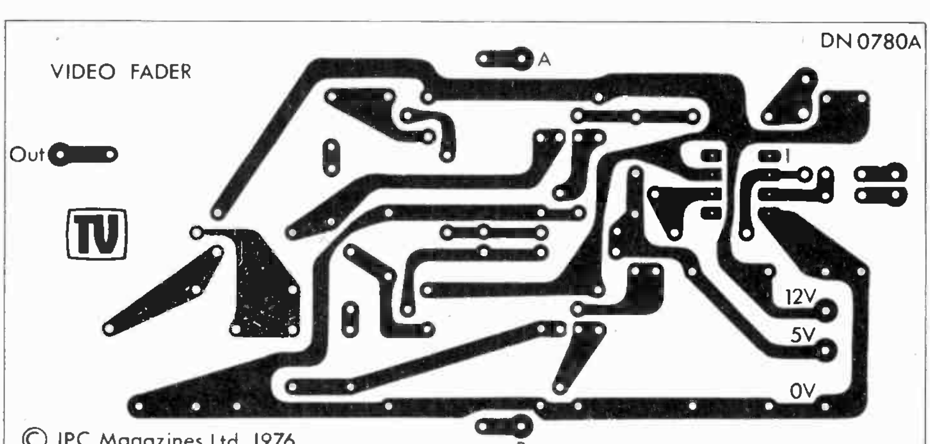


Fig. 9: Video fader printed circuit board, full-size track layout and component location. Capacitors C54/C56 and C55/C57 each effectively form a reversible (unpolarised) electrolytic of 5μF capacity.

Between the stripboard prototype and the final printed circuit board version of the unit some problems of instability crept in. These were eventually traced to the input emitter followers Tr1 and Tr2, and were cured by adding the base stoppers R34/R35 and decoupling capacitors C15/C19. No problems arose in the Fader section, but should they do so similar steps should prove effective.

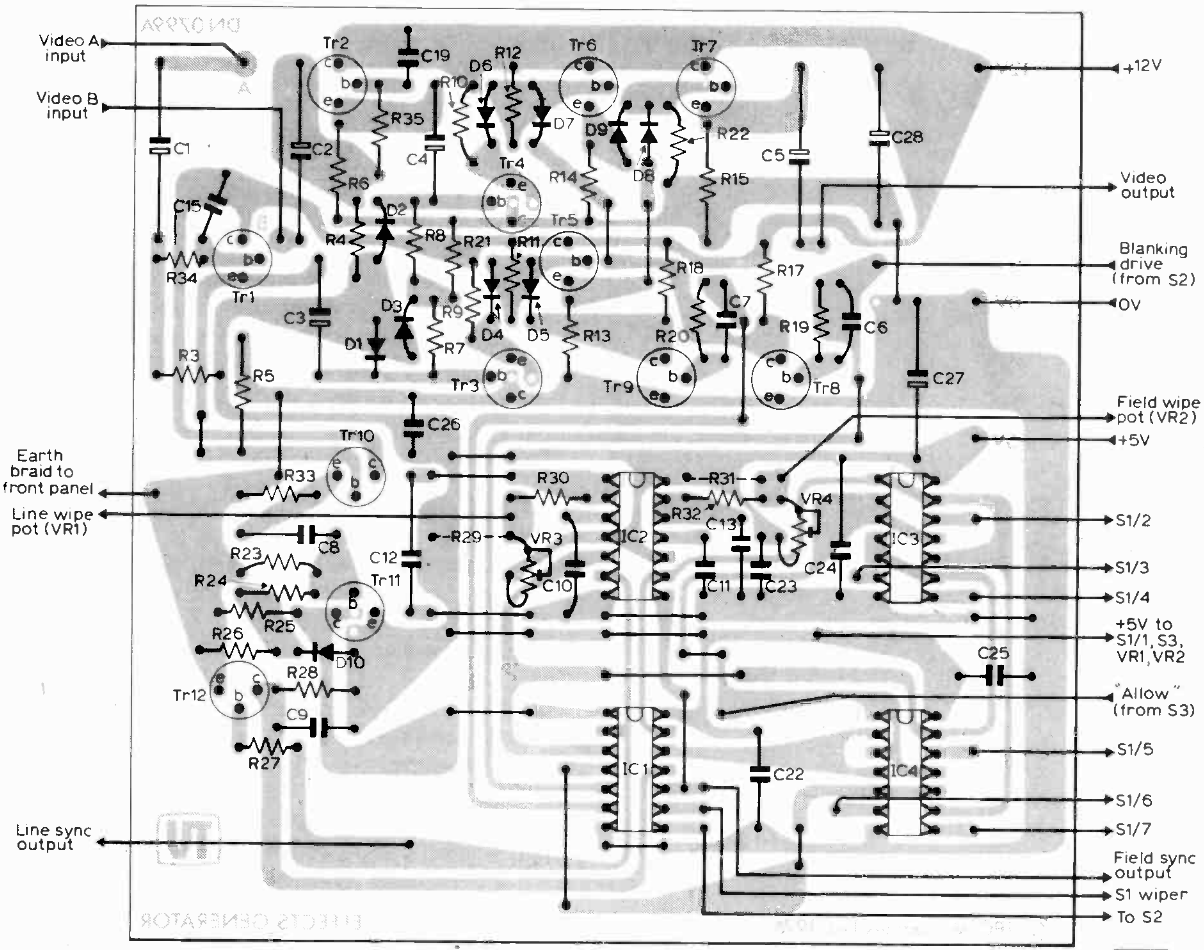
As Part 1 of this article was going to press the instability was still under investigation, and some decoupling capacitors which were added to the circuit diagrams given there have subsequently proved to be unnecessary. These capacitors, C14, C16-C18, C20, C21 and C58-C62 are therefore omitted from the board layouts and components list.

Additional supply rail decoupling in the form of 4·7μF tantalum bead capacitors has been added to the +5V and +12V rails on each board (C27, C28, C63 and C64). Also a 0·01μF disc ceramic C26 on the +5V line near sync separator Tr11.

On Fig. 2 last month the supply connections to IC4 were omitted. These are Pin 7 to 0V, Pin 14 to +5V with C25, a 0·01μF disc ceramic, connected across them.

Construction and setting up

For the most part the construction is quite straightforward, but there are a few places where a certain amount of care is necessary. Where pnp transistors are used, the track pattern on the printed board layout allows the use of either TO18 devices (corresponding to the BC148) or TO92, plastic case devices (corresponding to the 2N3703). Make sure that you use the correct holes. Printed board layouts are shown in Figs. 8 and 9.



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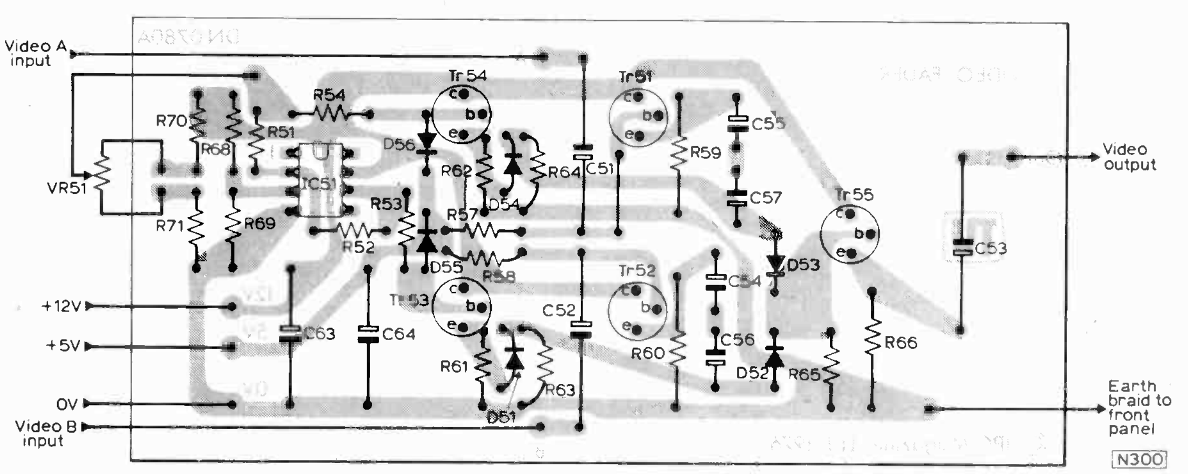


N300

★ Components list

EFFECTS GENERATOR

Resistors: († ½W, remainder ¼W)

R34, R35	47Ω		
R1, R2	82Ω †	R3, R4, R7, R8, R16	10kΩ
R15	390Ω †	R24	22kΩ
R5, R6	470Ω †	R19*, R20*, R27	33kΩ
R9-R14, R17, R18, R21		R23	1MΩ
R22, R25, R26, R28, R33	1kΩ		

Variable Resistors:
VR1, VR2 10kΩ linear sliders
VR3, VR4 100kΩ horizontal min. presets

Capacitors:
C15, C19 22pF silver mica
C6*, C7* 470pF polystyrene or silver mica
C12 6800pF polystyrene or silver mica
C25, C26 0·01μF ceramic disc
C8 – C11 0·1 μF polyester
C13 2·2μF tantalum or min. electrolytic
C27, C28 4·7μF tantalum
C1 – C5 100μF 25V electrolytic
C14, C16-C18, C20, C21 not used

Semiconductors:
D1 – D9 1N914, 1N4148 or similar
D10 0A91 or similar (germanium)
Tr1, Tr2, Tr5, Tr6, Tr8-Tr10, Tr12 BC107, BC108 or similar
Tr3, Tr4, Tr11 BC178, BC478, 2N3703 or similar
Tr7 2N3053
IC1 7414 IC2 556 IC3, IC4 7410

Miscellaneous:
S1 12W s.p. rotary; S2, S3 s.p.d.t.; S4 s.p.s.t.; Coaxial sockets, 7 off; p.c.b.; Pointer knob for S1.

*Values of R19, R20, R29 – R32, C6 and C7 are discussed in the text.

FADER

Resistors: († ½W, remainder ¼W)

R55, R56	100Ω†	R70, R71	2·2kΩ
R59, R60, R66	390Ω†	R51-R54, R57, R58	
R61, R62, R68, R69	1kΩ	R63-R65, R67	10kΩ

Variable Resistor:
VR51 10kΩ linear slider

Capacitors:
C63, C64 4·7μF tantalum bead
C54 – C57 10μF tantalum bead
C51 – C53 100μF 25V electrolytic
C58 – C62 not used

Semiconductors:
D51-D56 1N914, 1N4148 or similar
Tr51-Tr54 BC107, BC108 or similar
Tr55 2N3053 IC51 741

Miscellaneous:
Coaxial sockets, 3 off; p.c.b.

POWER SUPPLY

C101 2200μF 25V electrolytic; C102, C103 0·47μF polyester; D101 Diode bridge, 50V 1A; IC101 MVR12V; IC102 MVR5V; T101 Transformer 240V: 15V 1A; FS101 0·5A; FS102 1A; LP101 240V neon indicator; S101 d.p.s.t.; Mounting case; Fuseholders, 2 off.

Resistors R29 to R32 in the timing logic (Fig. 2) are selected to give the correct limits for the wipes, compensating for initial variations in the values of the timing components. A value of 1kΩ will probably suffice in all cases for R30 and R32, which are not particularly critical. These set the minima corresponding to the top and left-hand edges of the screen. The maxima for the wipes are set by R29 and R31, and here some experiment will probably be required. Start at 47kΩ and adjust up or down as required, so that the limit of the wipes just reaches the bottom and right-hand edges of the screen. Alternatively, space is provided on the printed board for miniature presets VR3 and VR4 to replace R29 and R31. This makes the setting up easier for the cost of two potentiometers.

Components R19/C6 and R20/C7 in the mixer circuit (Fig. 4) determine the characteristics of the switching at the changeover from one video signal to the other. The changeover should be a clean, crisp edge. To give this the values 33kΩ and 470pF were found to be optimum for BC107s. If some other general purpose silicon npn transistor is used, and the changeover is a bit peculiar, producing for example an overlap or a black line between the two halves of the picture, the resistor capacitor network will probably need changing. Note that the resistors R1, R2 and R16 on the effects unit and R55, R56 and R67 on the fader are mounted directly on the associated coaxial sockets on the front panel.

The power supply is constructed on the back panel of the case. The two i.c. regulators have their cases connected to the zero volt line, so they can be mounted directly on the casework without the need for insulating washers, etc.

Connection to cameras and use

The simplest connection for two cameras and the effects generator is shown in Fig. 10. It is again emphasised that the two cameras must be locked, either by using the sync outputs from the effects generator as shown or by using an external sync pulse generator.

Wipes from top to bottom of the screen, or vice versa, (position 2 of S1) are controlled by the "Field wipe" control, VR2, while wipes from side to side (position 3 of S1) are controlled by the "Line wipe" control, VR1. Corner to corner wipes (positions 4 to 7 of S1) are achieved by simultaneous movement of the two wipe controls. Inserts in any of the four corners are produced by selecting the appropriate position of S1, presetting the wipe controls to give the required area, and then operating the "Allow" switch, S3, when the insert is to appear.

The "External" socket (position 8 of S1) can be used with external circuitry to provide effects other than those available with the basic unit, see Fig. 11. The input signal required is a standard TTL level +5V/0V. Typical extensions here are diagonal wipes, centre inserts and possibly even some form of keying.

Fader connections are shown in Fig. 12. Here the output from Camera A is fed via the Video A In and Out sockets on the effects generator so that the sync pulses necessary to lock Camera B can be derived. If an external sync pulse generator is used instead, both camera outputs may be connected directly to the fader inputs. Interesting effects can be obtained by using the fader with the mixer as shown in Fig. 13. Here the fader, instead of providing a gradual transition between video A and video B, provides a gradual transition from the complete video A to a picture consisting of video A with an insert from video B. In other words the insert is faded in rather than switched.

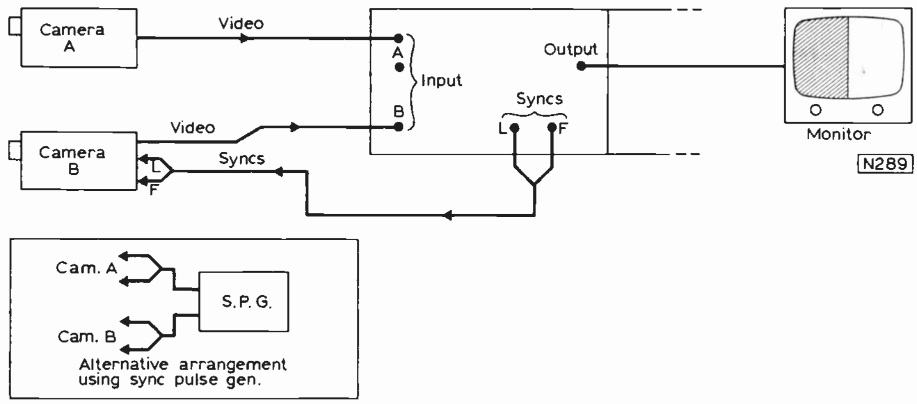


Fig. 10: Simple effects connections, deriving syncs for Camera B from Camera A, or (inset) using an external sync pulse generator to provide syncs for both cameras.

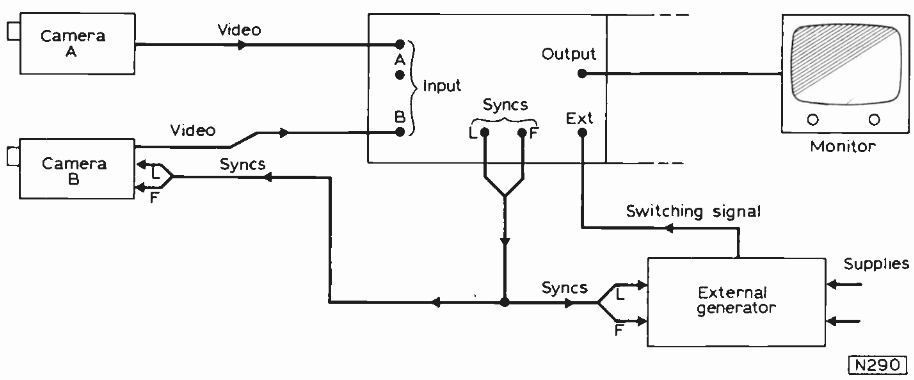


Fig. 11: Using an external generator to produce other effects. Again, an external s.p.g. may be used to provide all the required syncs.

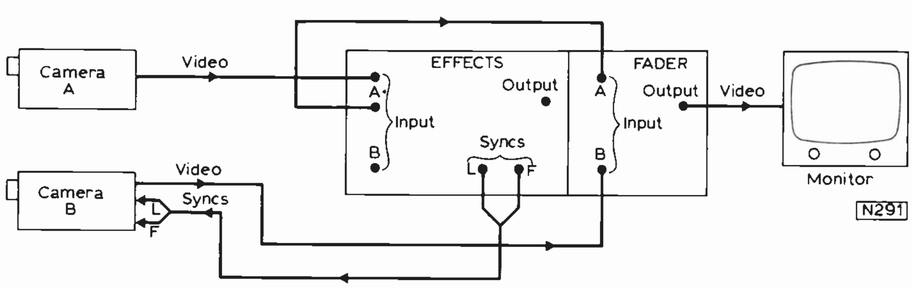


Fig. 12: Fader connections using the Effects generator sync separator to derive sync pulses for Camera B. If an external s.p.g. is used, the video outputs of both cameras are connected directly to the Fader inputs.

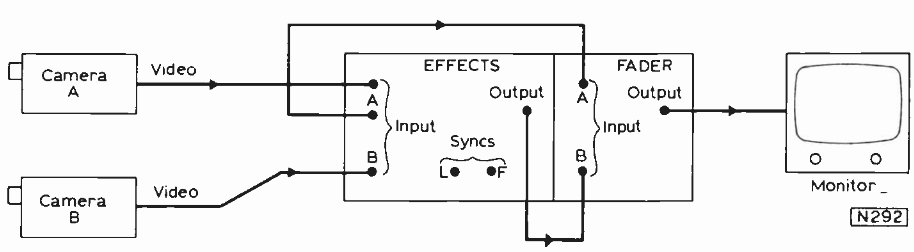


Fig. 13: Combining the Effects and Fader sections. Sync connections are the same as for Fig. 10.

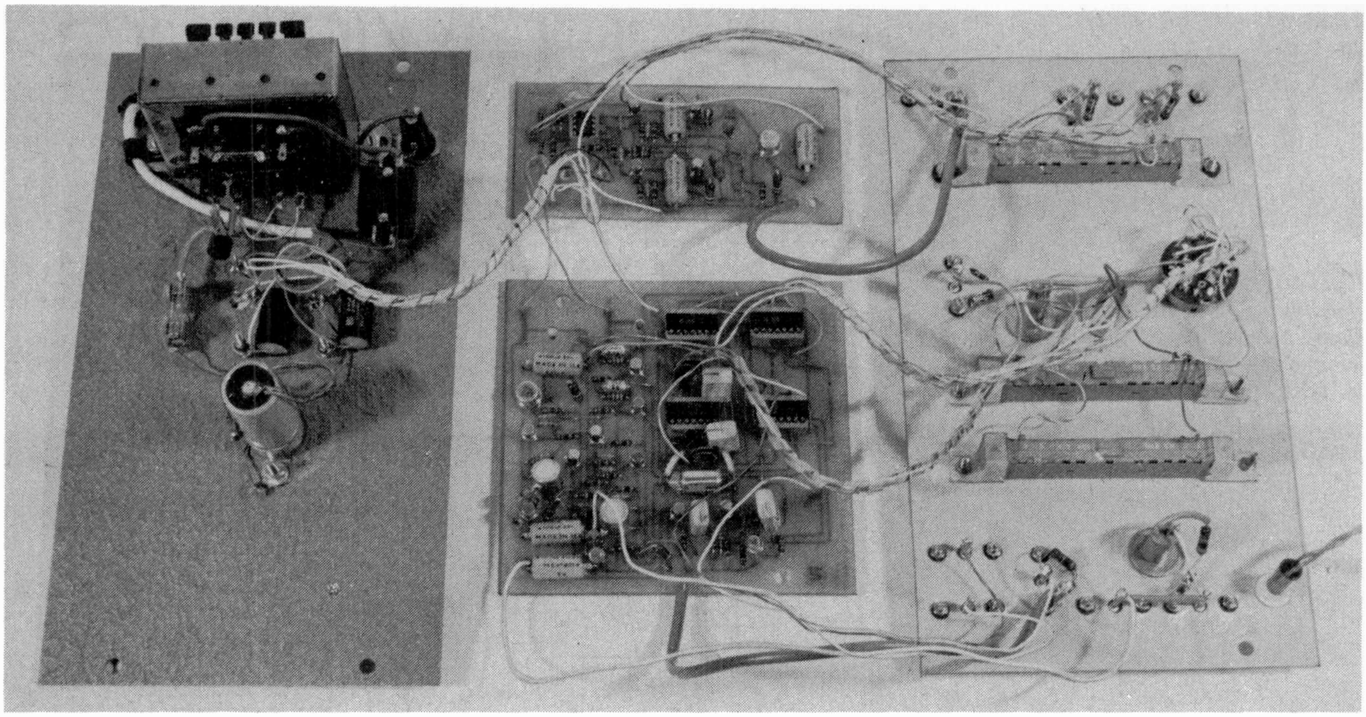
Both the effects generator and fader will operate with either 1V peak-to-peak or 1·5V peak-to-peak signals, provided that both video A and video B are the same. If it is required to use a 1V and a 1·5V camera together, the 1·5V signal should be reduced by means of a simple resistive attenuator network.

Improvements

The unit does not pretend to be of professional quality; as its cost is only about one tenth of that of a cheap commercial unit this is hardly surprising. None the less the quality is adequate for most amateur work and also for the hard-up educational establishment wanting to add to a CCTV system.

The shortcomings of the unit can be overcome at the expense of more complexity. For anyone who is interested in improving the design, the more obvious areas for attention are as follows.

The d.c. restoration could be improved. The main shortcoming of the d.c. restoration is that it is done with a signal of relatively small amplitude. If the video signal was amplified, then restored, then mixed and finally reduced to its original amplitude a better result would be obtained. Alternatively a transistor clamp circuit could be used, switched by a signal derived from the sync pulses.



The prototype instrument removed from its case, showing (from left to right) the rear panel carrying the complete power supply, the fader (top) and effects generator (bottom) printed boards, and the front panel carrying the controls, input and output sockets and pilot lamp. The External Input socket, not fitted when this photograph was taken, can be mounted on the rear panel.

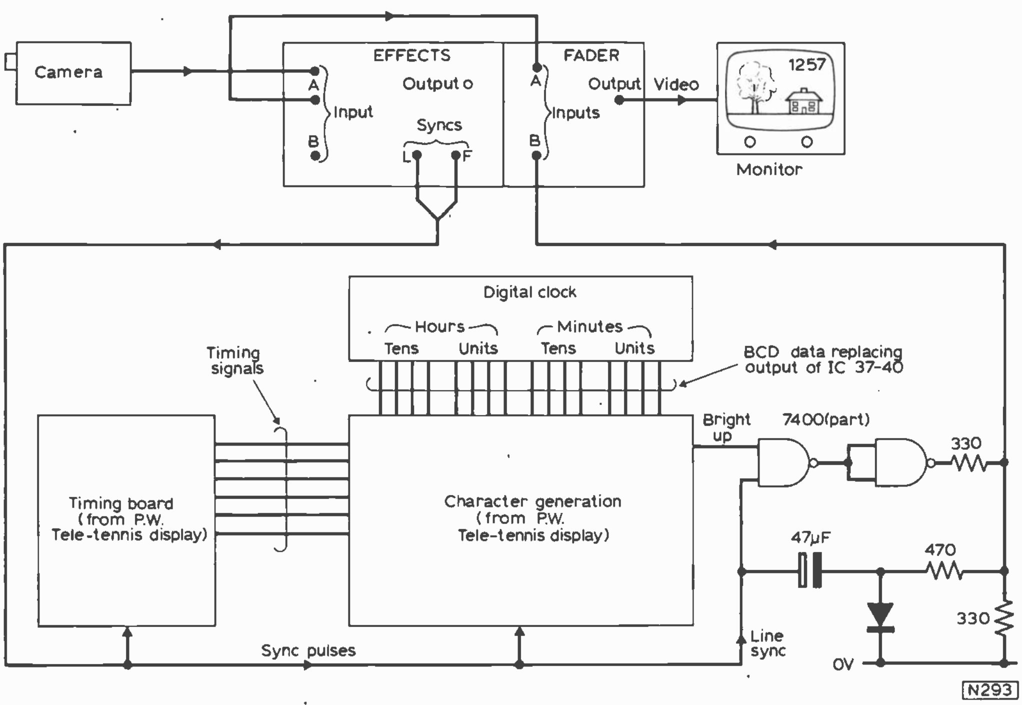


Fig. 14: Using the P.W. "Tele-Tennis" display boards to superimpose a digital clock display on a CCTV picture.

The output is a.c. coupled, it would be better if the d.c. level was kept throughout. This requires either careful design of a suitable output stage, or keeping the a.c. coupled output and adding another d.c. restorer. Both of these alternatives would probably require a negative supply rail to be added to the power supply.

Clock display

It is possible to use the fader in conjunction with a digital clock and the two printed boards from the *Practical Wireless* Tele-Tennis scoring unit (September 1975) to superimpose the time onto a CCTV picture. The digital clock must be a type constructed with discrete i.c. packages (e.g. 7490s), not one of the single-chip clocks which use a multiplexed output. The connections are summarised in Fig. 14. The two NAND gates add the sync pulses to the video bright-up signal to give a composite video signal which is then mixed with the CCTV picture. The fader control is adjusted to give the required brightness of the time on the screen. Any other data that can be provided in BCD (binary coded decimal) form can be displayed in a similar manner. ■

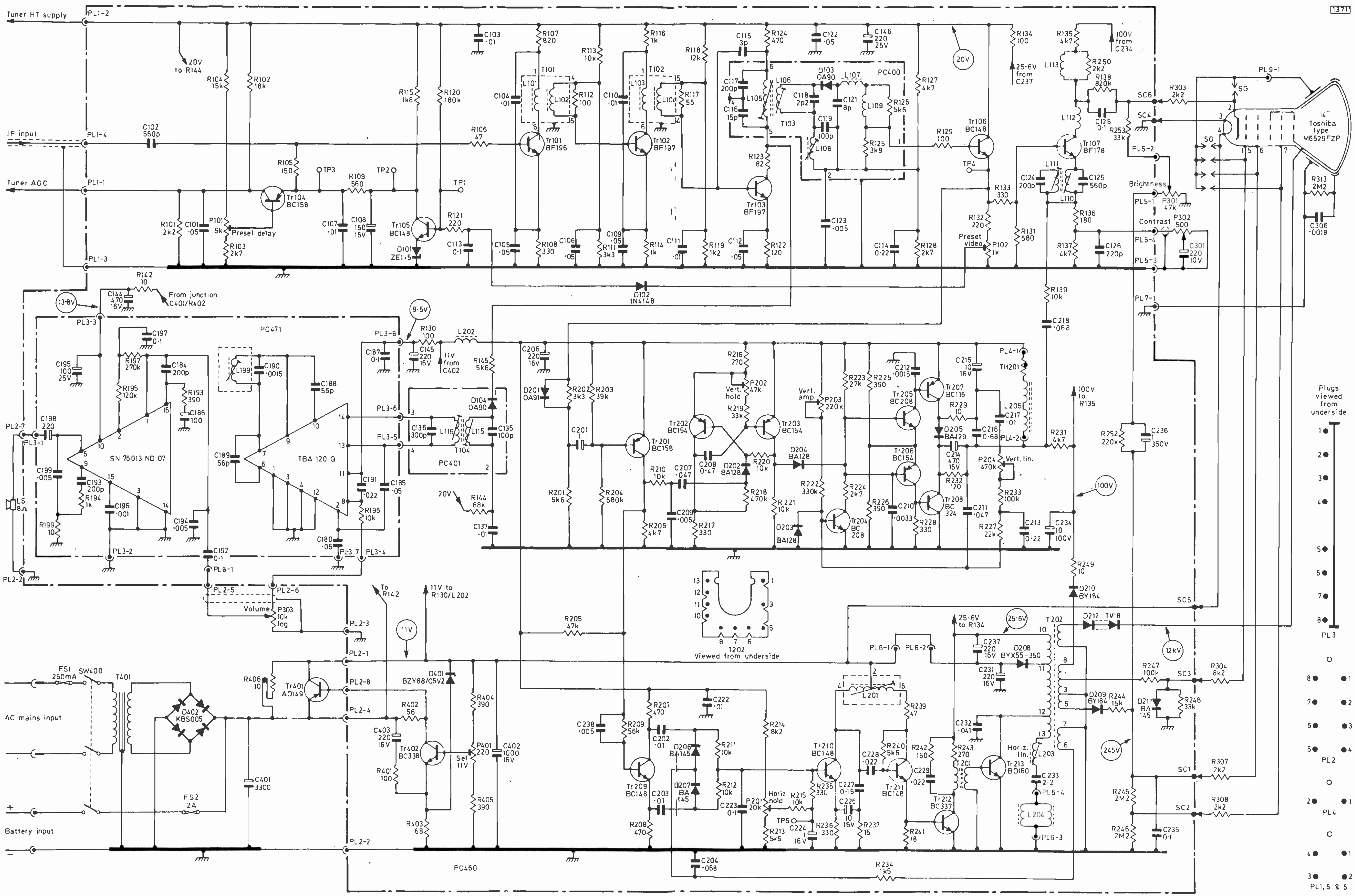


Fig. 4: Circuit diagram, GEC Junior Fineline Model 2114. Modifications are listed overpage.

from the boost circuit – diode D208 and capacitor C237.

If there is no line timebase operation and no voltage at the collectors of TR212 and TR213 the boost diode(s) will probably be found open-circuit. They don't both go at once but once one goes the other doesn't survive very long (some sets have one diode and others two in parallel). It should be appreciated that these diodes must be special fast-acting ones of the BYX70 type or equivalent (a single in

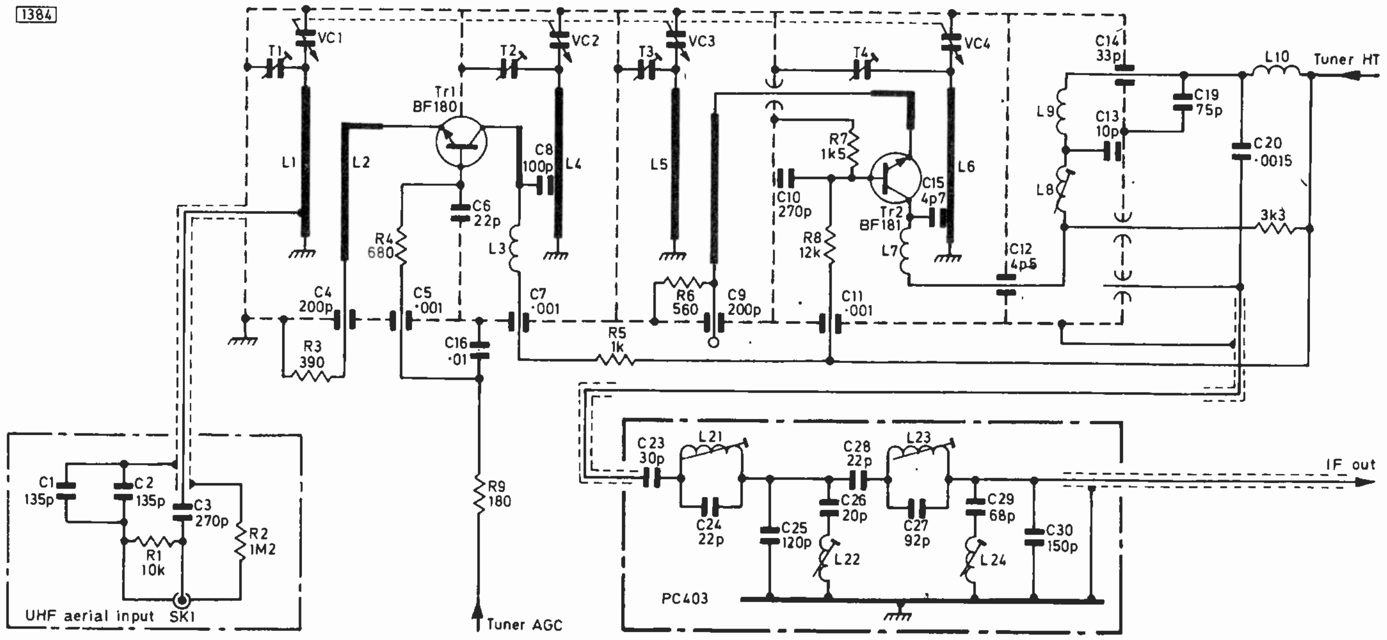


Fig. 5: Circuit of the tuner unit and i.f. bandpass shaping filter (unit PC403).

some cases, e.g. Thorn D31). It is no use trying ordinary power diodes.

The output transistor itself is often responsible for non-operation of the timebase, sometimes blowing the 2A fuse (FS2) or opening the thermal cut-out (R406) when it develops a collector-to-emitter short.

There are several supply lines from the line output transformer, feeding those sections of the set requiring a higher voltage than the 11V provided by the power supply circuit. There are two BY184 diodes (D210 and D209) providing the 100V and 245V lines, and of course the e.h.t. rectifier D212 which is fed from the overwind.

Either of the BY184s can short and cause trouble. If D210 is found to be a dead short the 10μF electrolytic C234 should also be viewed with suspicion.

The e.h.t. rectifier (type TV18) can produce some funny symptoms but not all of these are due to a fault in the rectifier itself. More often the end clips do not make proper contact. This produces a sizzling effect, pulling the picture horizontally in lines. Access is easy once the screening can over the timebase has been removed. It's held by three screws, two obvious ones at the rear and a not so obvious one under the front. When removing the screen take care to free off the e.h.t. lead, and avoid entangling the tube earthing lead. With the screen off, the e.h.t. rectifier plastic housing will be seen at the top. This can be removed and divided into its two sections to expose the rectifier and its end clips.

The e.h.t. rectifier stick can deteriorate, affecting the line output transistor. Thus when the line output transistor has to be replaced (probably short-circuit between emitter and collector, with FS2 or R406 open) it is advisable to disconnect the e.h.t. rectifier. If on reconnecting it the line timebase does not operate it should be replaced.

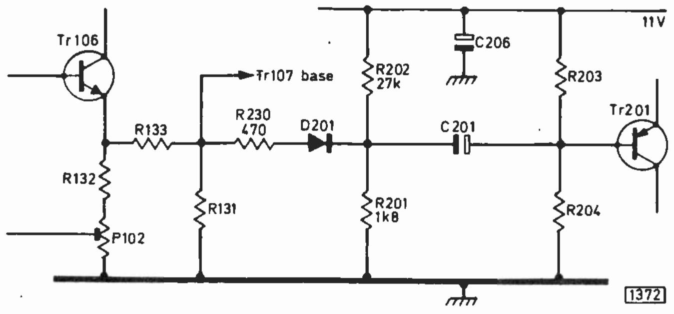


Fig. 6: Modifications to the sync separator circuit.

Tuner Unit

We have left the tuner until the end because we haven't much to say about it. It is quite conventional and simple in operation, following the pattern of other u.h.f. tuners which we have discussed time after time. A.G.C. (delayed) is applied to the base of the BF180 r.f. amplifier via R9 outside and R4 inside the tuner. This BF180 is liable to develop an open-circuit base-emitter junction, resulting in a very grainy picture if any at all – depending upon the reception area. If the transistor reads right on a cold test, check the a.g.c. line which should apply some 2V to the transistor's base.

Check clearance of vanes and other mechanical parts including the spindles of the pushbuttons. Clockwise rotation of the buttons tunes the unit to the upper end of the u.h.f. band (up to channel 68), some 18 turns anticlockwise being required to bring the tuning down to channel 21.

AGC Delay Control

The a.g.c. delay control P101 is factory preset and should not require resetting. If it has been disturbed however it should be reset so that with no signal input 3·8V appears at the base of TR104.

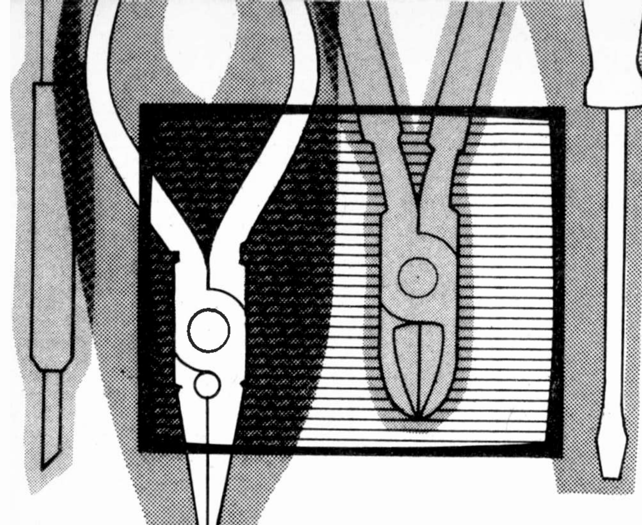
Modifications

To improve the sync performance under fringe area conditions the sync separator input circuit was modified to that shown in Fig. 6 in later production. Also, the flywheel line sync diodes' load resistors R211 and R212 were changed to 22kΩ. Further to improve the field sync performance, C201 was changed to 0·1μF.

The video output transistor's collector load resistor R135 was changed to 6·8kΩ. R222 and the height control P203 were transposed, with P203 changed to 470kΩ.

The later Model 2114/1 has a slightly different cabinet with black c.r.t. surround.

NEXT MONTH: PYE 173 CHASSIS



SERVICING TELEVISION RECEIVERS

GEC MODEL 2114

– continued –

L. LAWRY-JOHNS

Video Stages

The detected signal from PC400 is applied to the base of TR106 which is an emitter-follower buffer stage driving the video amplifier. TR106 can be responsible for a number of queer fault symptoms which when they appear on the screen are difficult to describe. They can vary from a picture lacking in detail and with weak sync to a picture which looks for all the world as though the tube has gone soft (not exactly, but that's as near as we can get without trying too hard). This is in addition to the more expected weak picture (or no picture).

So TR106 is not a BC148 to trifle with. Check it cold, check it hot and if in doubt replace it.

This brings us to the video amplifier TR107 (BF178). The usual fault here is for the transistor to go open-circuit, leaving the screen illuminated but with little or no picture, the sound being quite normal. If this is so its collector voltage will be high (up to the supply line – 100V – instead of about 80V). Its base voltage will be about right (varying with the signal content, but around 3V) whilst its emitter voltage will be sadly lacking.

So there's not much mystery here unless the collector voltage is found to be low. This could be due to a fault in the previous stage, for example TR106 going short-circuit or leaky so as to increase the voltage applied to TR107s base. If both TR106 and TR107 are o.k. the most likely culprit will be the electrolytic C301, and this can be easily confirmed since the fault will be present only when the contrast is well advanced. A glance at the circuit will show why. With the contrast at minimum the capacitor has no effect as it is at chassis potential at both sides. As the contrast is advanced the capacitor has more effect and if it is short-circuit it will pull down the emitter voltage and increase the TR107 current, thus pulling down the collector voltage as well.

What is the purpose of the capacitor? Without it the current feedback across the emitter resistive element formed by the contrast control cancels the video signal: as the contrast control is advanced the capacitor bypasses the signals and steadies the emitter so reducing the feedback. This means that the capacitor should also be suspected if the contrast is low and the control has little effect, the fault then being the opposite of a short, i.e. an open-circuit, in which case a test capacitor of near value shunted across it will restore normal contrast.

Before passing on we must mention that the brightness control works on the tube cathode, not on the grid which is left free for the application of line flyback blanking pulses. Field flyback blanking is carried out in TR107's emitter circuit, the pulses being applied via C218 and R139.

Field Timebase

At first sight the field timebase circuitry from TR202 to TR208 looks fairly complex. When broken down however (not broken down really) the purpose of each part becomes obvious and this understanding can be a great help when faults occur.

TR202 and TR203 form a type of multivibrator where the latter can be regarded virtually as a switch (on and off) for the former. The exact timing is determined by the diode D202 which cuts off TR202 when the sync pulses tip the diode into conduction. This initiates the flyback which is timed by R217 and C208. This part of the circuit is fairly reliable except for the occasional failure of one of the BC154 transistors, so we won't elaborate on the exact function of each component.

When TR203 is turned on (flyback) D204 conducts turning on TR205 and TR207 and turning off TR206 and TR208. When TR202 conducts (forward scan) the base voltage of TR204 rises due to C211 discharging. Thus TR204's collector voltage falls, turning on TR206 and TR208 and turning off TR205 and TR207. The key component is thus C211 which charges and discharges via R222 and the height control P203.

The voltages throughout the circuit are interdependent so there is no easy way of pointing a finger when things go wrong. We cold test each transistor as far as the circuit values will allow, removing transistors from the circuit for a more positive check where necessary. This is the easiest course of action where there is complete field collapse – one or the other of the transistors will usually be found at fault.

We have been fooled by lack of height however, checking around only to find that the height control itself was the culprit. We went to the bottom of the class for that one. In short, check transistors, electrolytics and presets first and you won't go far wrong.

Line Timebase

The line sync pulses are fed to a phase splitter (TR209) which feeds the discriminator diodes. As usual, these are also fed with a reference pulse from the line output stage (via R234).

The discriminator output voltage is applied to the base of a reactance transistor (TR210) which determines the frequency of the sinewave oscillator (TR211). The output of this transistor is coupled to the line driver TR212 which switches the output transistor TR213 on and off. The voltage supplies for the driver and output stage are obtained

MILLER'S miscellany

CHAS. E. MILLER

Easter Greetings . . .

. . . to all you happy servicepersons out there! I use the term advisedly in this era of equality, since there may be lady engineers about. I've never met one yet, but here's hoping! It has been said that the presence of women in the workshop could cause embarrassment due to the bad language and coarse jokes. But I'm sure that given time they would tone down their behaviour and become as decorous as we men.

Time, Gentlemen, Please

I suppose that most self-employed people in the service industries share one occupational hazard – that the general public imagines their services to be on tap every hour of the day and night, seven days a week. Those who would never dream of trying to contact a solicitor say at home after office hours will ring up a TV engineer at 10 p.m. on Sunday. A case in point: I've just had to leave the typewriter to talk on the 'phone to an erstwhile customer who having purchased a colour set from another firm wants my free advice on whether he should take out a maintenance contract with them! Some weeks ago a customer who knocked me up at 10.30 p.m. to ask for his set seemed quite taken aback when I asked him to return next day. But the winner so far must be the character who rang up just as I returned to the house one Sunday after taking a week's holiday: when I told him I could do nothing about his set, which had been brought to the workshop, until next day he told me in no uncertain manner that I'd no right to take a holiday without letting him know first.

Internal Lightning

Had another strange fault the other week on a set fitted with the Thorn 1500 chassis. The complaint was no picture or sound but very loud banging from inside the set, and this was no more than the truth. When the back was removed, flashes could be seen across large areas of the print – like a miniature thunder storm. It was so violent in fact that the set couldn't be left running for more than a minute or so at a time. For this reason it took me some time to discover that the 30FL2 sync separator/line oscillator valve had gone short-circuit from heater to cathode in such a way that the line timebase was still running but the c.r.t. heater and the transistor supply line were effectively shorted out. Having nothing better to do, the e.h.t. was making its way to earth as best it could, causing the flashing. Fortunately, and rather surprisingly, the print seemed to have suffered no permanent damage from this treatment, and after I'd cleaned off the burn marks and fitted a new 30FL2 the set was as right as rain.

A Change of Luck

Apart from that I've had no odd faults to contend with during the last few weeks. A few half forgotten old favourites have turned up again however. Such as the internally shorted PCL83 a.f. valve which sets the volume control on fire in the Philips 19TG158A series . . . The d.c. restorer diode, in the control grid circuit of the video amplifier section of the PFL200, failing and causing the contrast level to drop sharply in the Philips 300 series . . . The open-circuit linearity feedback winding on the field output transformer in the Philips 210 chassis, producing unlimited height – enough to scan a 99in. tube . . . Field slip in certain Bush/Murphy sets (TV161U series) due to a short-circuit heater chain dropper diode . . . The line sync discriminator diodes which cause line slip in the Thorn 1400 chassis . . . The self-destroying mains cut-out in the Thorn 3500 chassis . . . The cracked print on the aerial socket panel of any GEC/Sobell set . . . And last but not least low brightness due to the control itself going low-resistance on the Ferguson Model 306T. And if you're thinking that the 306T must be twenty years old, you're quite correct: some people will do anything for money, and I just happen to be one of them . . .

And now for something entirely different . . .

Well, we don't repair TVs all the time, do we? That's my excuse for digressing on to the subject of radiograms. One of the aforementioned Sunday callers pressed a paper bag full of valves into my hand and asked me to test them. (Have you noticed how, complaining of low volume or distortion, they always bring the tuning indicator along for test?). Anyway, the complaint this time was that although the set worked it wouldn't play records in stereo. I made a note of the address and in due course made a call. It turned out to be a conventional early 60s furniture store special low-boy radiogram constructed of sumptuously veneered hardboard and old fish boxes. Both speakers produced sound on gram, but it certainly wasn't stereo. As soon as I removed the back I saw that someone had taken the left-hand speaker wires from their socket and crammed them in with the right-hand ones. On putting this right and confidently switching on I discovered that there was now no sound at all from the left-hand speaker. I then found the balance control physically jammed fully to the right – to such an extent that I had to use pipe grips to turn it back to a central position. Still nothing from the left. Next, due to the lack of a load when the speaker had been disconnected the peak voltages across the primary of the left-hand output transformer had caused the small parallel tone correction capacitor to go short-circuit. Even with this replaced however the left channel remained mute. The final cure was effected by replacing the cartridge, which had been damaged by mishandling. Lord help us when everyone has quadraphonics!

Vintage Spot: Murphy VU150

In the early 1950s UK television set manufacturers were beginning to turn away from the massive console receiver, with expensive transformer driven power packs, to lighter table models making use of a.c./d.c. techniques. Murphy was no exception to the trend, and the fruits of their labour was one of the most bizarre designs in television history – Model VU150, introduced in 1950. I would emphasise that this was long before the company came to be part of the Rank empire, since when of course Bush and Murphy sets have become identical except for the badges and styling.

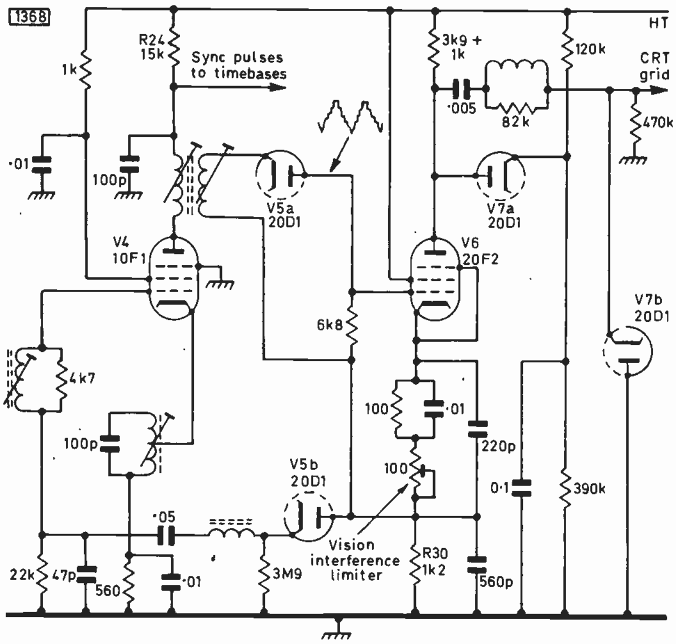


Fig. 1: Vision circuits of the Murphy Model VU150. The sync separator is V5b, while V4 acts as reflex sync pulse amplifier as well as being the single vision i.f. stage.

The original Murphy company was founded by Frank Murphy in the 1930s. Older readers may remember photographs of him, pipe in mouth, in the Murphy advertisements. After some kind of internal dispute he left the company and emigrated to Canada, where he was reported years later to be working as a lift operator.

During and after his reign Murphy radio sets gained a reputation for being "different", and this tradition was certainly upheld by the VU150 – from the aerial socket inwards. For a start there were two r.f. amplifier stages before the triode-heptode frequency changer. The sound and vision channels had just one i.f. stage each, and the vision one did double duty as a reflex sync pulse amplifier. This and the following video stage are shown in Fig. 1.

Since the c.r.t. was grid driven, the detector output consisted of positive-going sync pulses and negative-going video. The sync separator diode V5b – operating on similar principles to the pre-war EMI circuit described in an earlier *Miscellany* – conducted when the signal across R30 in the video amplifier's cathode circuit reached the sync level – V6 then being saturated. The pulses were passed back to the grid circuit of the vision i.f. amplifier V4, appearing amplified across R24. The video signal was a.c. coupled to the c.r.t. grid, with d.c. restoration by V7b. V7a acted as a vision interference limiter, providing a clamp action to prevent the anode voltage of V6 exceeding the voltage at V7a cathode. The vision interference control was in the video amplifier's cathode circuit, setting the mean anode voltage and thus the signal level at which V7a conducted (this arrangement was subsequently modified).

Jumping ahead to the power supply section, there was a complicated three-chain heater circuit, dictated by the choice of the Mazda valves used. The h.t. was supplied by one of the "new" metal rectifiers – they'd just been rediscovered after a brief popularity in early mains radio receivers. The field timebase consisted of two 20F2 r.f. pentodes, one as blocking oscillator and the other as output stage. But strangest of all was the line timebase, shown in Fig. 2.

Apart from the e.h.t. rectifier, this employed just a single 20P1 beam tetrode valve in a self-oscillating circuit – feedback was between the anode and screen grid of the valve, via the line output transformer. There was no efficiency diode, and the e.h.t. rectifier was directly coupled to the anode of the 20P1, with no e.h.t. overwinding. Some boost was given to the e.h.t., which was a mere 6kV, by returning the e.h.t. reservoir capacitor C30 (500 or 680pF and presumably a lot of volts working!) to winding c on the line output transformer. Windings a and c/d were wound in opposite phase, thus providing this boost. But the most remarkable feature was the 20P1's screen grid circuit. The d.c. supply was obtained from the cathode of the sound output valve – where the line hold control was to be found! The idea was to provide a stable supply by making use of the

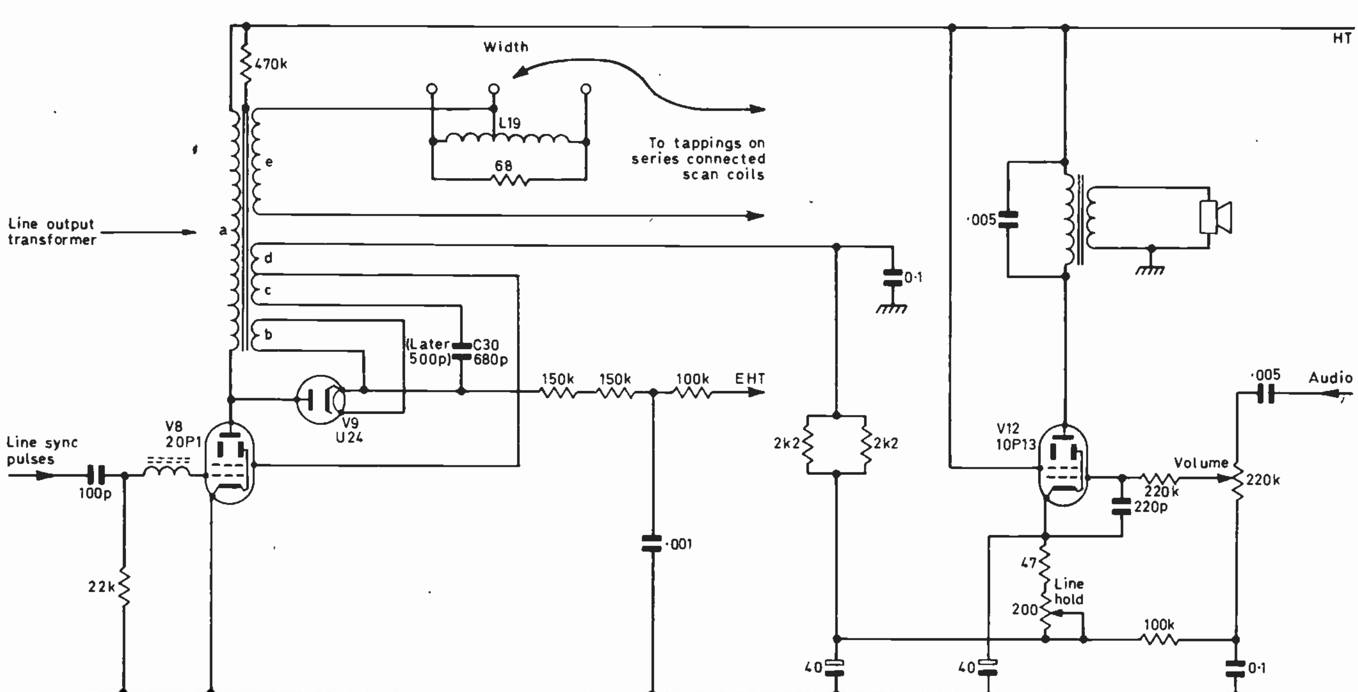


Fig. 2: The line timebase of the Murphy Model VU150. The screen grid of the output pentode received its d.c. supply from the cathode of the audio output valve – where the line hold control was to be found!

constant current characteristic of the beam tetrode sound output valve. The line hold control altered the bias on this valve, thus varying the line output valve's screen grid voltage. The sound output valve's anode current flowed via the 20P1, winding d on the line output transformer, the two 2·2kΩ parallel resistors, then the sound output valve's cathode components. V12's cathode voltage was nominally 37V, but the screen grid of the 20P1 appeared to carry nearly 1kV at line frequency! Adding inductance (taps on L19) varied the width, and compensating tap adjustments had to be made on the series-connected line scan coils to keep the output load constant. These adjustments also affected the frequency!

Many of these sets lasted into the ITV days, presenting quite a problem when being converted by add-on units such as the Stirling (remember them?). In good BBC signal areas the double r.f. stage picked up a lot of unwanted Band I, producing gorgeous herring bone patterning on the screen when the set was switched to ITV. The last-ditch cure for this was to snip everything from the first r.f. stage except the heater supply, and connect the converter to the second r.f. stage. In any case the first r.f. stage had an added-on look about it, as if it was tagged on to the original design to provide extra gain.

One thing we used to dread with these sets was having to adjust the focus, as there was no focus control as such. There was a permanent magnet with three screws for picture centring, and this also had to be set for optimum focus. If you had the misfortune to come across a really fussy customer you could spend literally hours on what should have been a simple job. I'd as soon converge a colour set any day!

Well, at least they tried . . .

The curious doings of a Certain Electronic Supply company have been legion over the years. The latest to come to my ears – and I warrant it's true – concerns a dealer who very conscientiously ordered a small component by its part number. Some time later he was puzzled to receive through the post a large package. Inside it he found a large, empty tray from a storage rack, bearing the part number he'd quoted . . .

Is this what Faraday strove for?

Electricity and electronics have now been harnessed, and again I use the term advisedly, in an attempt to deter would-be rapists. A concern called the Think Twice Company of California, USA, produces a battery-powered undergarment which administers a shock to unwelcome intruders. The name of this device (honestly!) is the "No-Gropes Milady Electric Bra". I can't wait to service one. In situ, preferably.

PIL TUBE FIELD TIMEBASE

continued from page 355

in one load winding increases the core magnetisation caused by the current in the control winding, the current in the other load winding reduces the core magnetisation caused by the control winding current. Due to the fact that the core saturates easily, the load winding current which *reduces* the core magnetisation has a greater effect than that which increases, or endeavours to increase, the magnetisation of the core.

So the transductor has a two-way effect, and by enabling the field scan to be modulated at line frequency and vice versa provides adequate NS and EW pincushion distortion correction with a 90° deflection tube such as the PIL tube used in this chassis.

NS Correction

Looking at NS correction first, the centre raster lines will be horizontal but without correction the lines will be increasingly bowed towards the top and bottom of the raster. To compensate for this it is necessary to modulate the field sawtooth current with varying amplitude line frequency parabolas. The idea, though not drawn to scale, is shown in Fig. 4(a). Returning to Fig. 2, the inductance and impedance of the transductor's control winding, along with the components forming the damped tuned circuit, change the line pulses applied to the circuit to a succession of varying amplitude parabolic waveforms. Since the field scan current falls progressively from the top of the scan to the centre, then increasing with reversed polarity from the centre to the bottom of the raster, the line frequency parabolas vary in amplitude to suit, being of maximum amplitude at the top and bottom of the raster, thus giving the NS pincushion distortion correction required.

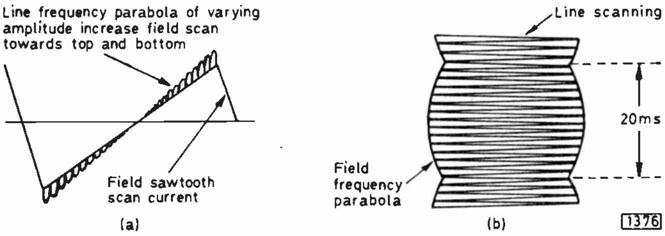


Fig. 4: (a) Modulating the field scan at line frequency to provide NS pincushion distortion correction. (b) Modulating the line scan at field frequency to provide EW pincushion distortion correction.

EW Correction

For EW correction we want to progressively decrease the width of the lines towards the top and bottom of the screen. This means varying the line width at field frequency, and can be done by modulating the line scan by a field frequency parabola. This is achieved since the transductor's load windings are effectively in parallel with the line scan coils. Halfway through the field scan, when the field sawtooth current is at zero, the impedance of the load windings will be at maximum and thus the current in the line scan coils will also be at maximum – since the parallel transductor load windings are imposing minimum loading on the line output circuit. Towards the top and bottom of the raster however the field scan current increases, increasing the loading effect of the transductor by reducing the core saturation. R1024 determines the amplitude of the EW correction.

Vertical Shift

Finally, vertical shift. Rectifiers D308 and D309 produce opposite polarity outputs across the vertical shift control R379. The d.c. output from this control, variable in amplitude and polarity, flows through the field scan coils, shifting the raster up or down as the control is adjusted. ■

LONG-DISTANCE TELEVISION

ROGER BUNNEY

FEBRUARY for me was a quiet but very busy month. Quiet because of having few aerials available, busy because I've been replacing them all and increasing the height of the lattice mast. From what other enthusiasts tell me however I've not missed much. So the decision to devote much of my spare time to more strenuous labours was perhaps a wise one!

For the record, the mast has been increased in height from 40 to 50 feet, with the aerials themselves reaching to 60 feet. The Band I array has been redesigned to cover 47-70MHz, with a different cable matching arrangement which I hope will make an improvement. For Band III I am continuing to use a Telerection wideband M10X array – this is an export model. At u.h.f. I am going to try the new Telerection "short backfire" aerial, but with a modified thirteen-element director chain. This will replace the Wolsey Colour King array at present in use and I hope will provide some extra gain. The Colour King is nevertheless an excellent wideband array and it was with some regret that I took it down. It's gone to a good DX home however!

All the arrays have masthead amplifiers. For v.h.f. I'm using a Wolsey Supa Nova mounted in an additional metal case; for u.h.f. I'm using the Wolsey MATV quality Orbit amplifier. I intend to mount a wideband Band II (TV) aerial somewhere on the lattice, aimed in an ESE direction. The arrays will be turned by the present AR22 rotor unit. Ian Beckett tells me his old AR22 has now become faulty – after over ten years' of really hard DX use! A photograph of the new system will be included in the column in due course.

Several lessons were learnt from my aerial erection experiences. For instance, avoid where and whenever possible working at 50 feet atop a lattice mast when a below freezing wind is blowing from the east! The fingers become numb resulting in spanners being dropped from great heights: not advisable when there are conservatory glass roofs in the vicinity! For those who despair of having a high mast due to only a small garden being available I'd mention that I live in an end terrace house with a typical modern garden, i.e. only about 18 feet wide, and that this is next to a conservation area. On hearing that the base of the mast is embedded in some two tons of concrete the local joke is that if it blows over I'll have the only vertical garden in Romsey!

The new EBU List of Television Stations (No. 20) recently arrived. Looking through this I noticed that the Bulgarian 5kW Ruse channel R1 and Plovdiv ch. R2 transmitters are no longer shown as operational, so it's anyone's guess whether they are still on the air. Madeira is now listed as having four Band III transmitters, the highest powered being Pico Do Silvo on ch. E5 at 20kW with horizontal polarisation. I'm pleased to note that two ch. E3 transmitters are listed as on the air at Port Said (Egypt): more on this later.

Monthly Report

Since the new aerial system has been in operation for only a few days my log this month is barren to say the least. I've managed to log something each day generally, though nearly all the signals have been MS (Meteor Scatter) ones. RAI (Italy) ch. IB is a favourite, usually received daily between 0900-1100. SR (Sweden) is another, from about 0745 GMT. I've again seen the PM5544 pattern with no identification on ch. E4, this time at 0724. Just before posting this column (morning of February 25th) there was a dramatic improvement in Tropospheric reception, with high-level Dutch signals on ch. E4 and Dutch, French and West German stations received at fair strengths in Band III and at u.h.f.

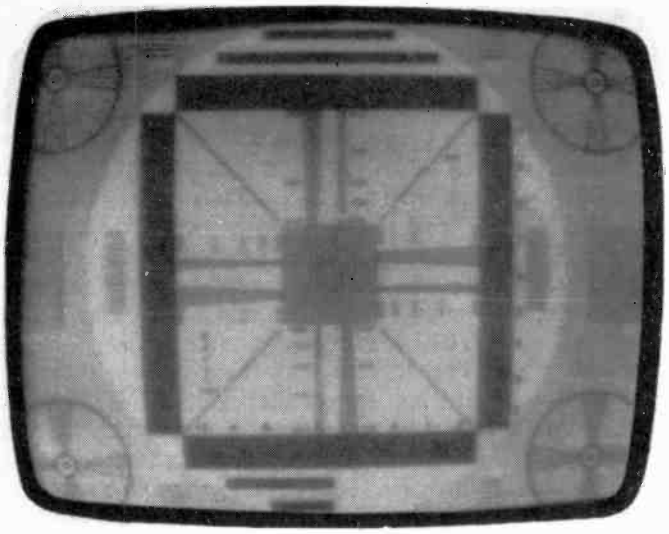
In view of the indifferent log however I'll again skip this.

New EBU Listings

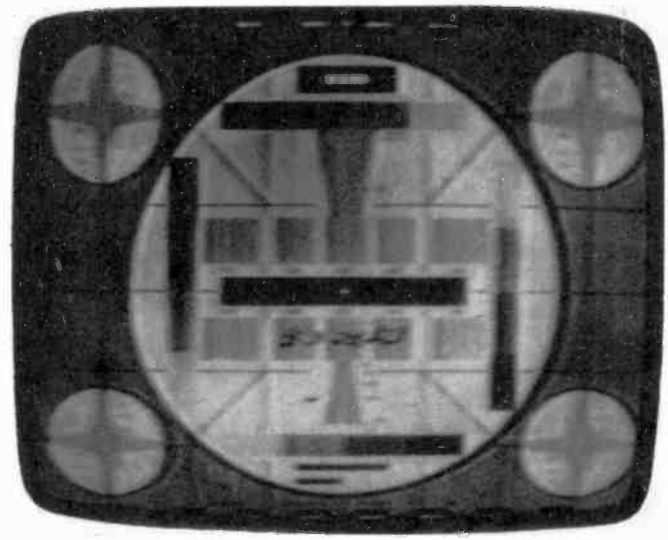
Finland: Kerimaeki YLE-2 ch. E55, 600kW e.r.p. (29E15 61N59). Horizontal polarisation.
Yugoslavia: Rozaj-Bandzovo Brdo ch. E4, 100W. Pelister ch. E4 e.r.p. increased from 1·5kW to 10kW. The Pisvir ch. E3 150W relay has been closed.

News Items

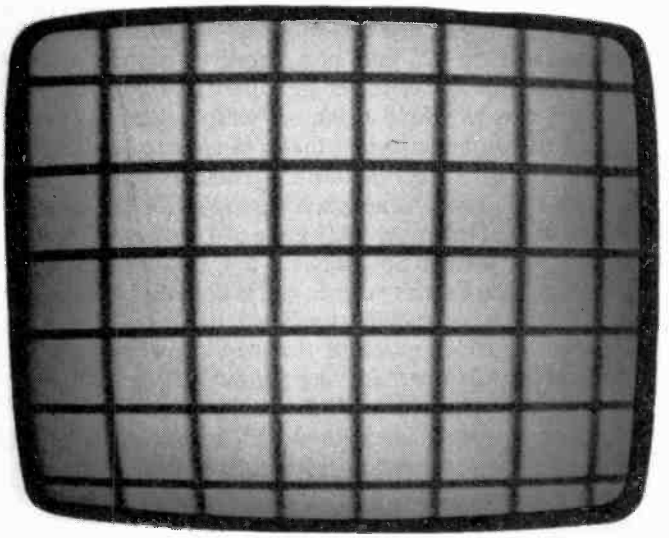
Algeria: According to the EBU, RTA has decided to adopt the PAL colour system. A limited number of programmes are already in colour. Nearby Libya is to undertake experiments this year using SECAM colour.
Oman: The TV service came into operation last November. The main programme centre is at Salalah and there are four transmitters operating in Band III, giving coverage of the whole population along the coastal region.
Switzerland: A new German language network transmitter (SRG) has come into operation at Santis. It's the highest transmitter in Europe at over 2,500 meters a.s.l.
Yugoslavia: A network in the Belgrade area radiates programmes in Serbo-Croat, Hungarian, Slovak, Rumanian and Ruthenian. Look out for some confusing captions during good SpE conditions!
Eire: Mike Allmark tells us that RTE has drawn up a revised timetable for the changeover from 405 lines to 625 lines. The earliest possible closing dates are now: Truskmore ch. B11 July 1976; Kippure ch. B7 July 1976; Donnybrook, Dublin ch. B3 July 1976; Monaghan ch. B10 October 1976.
France: Ryn Muntjewerff reports that the three networks TF1, Antenne 2 and FR3 combine between 1920-1940 CET to provide common regional programmes. Each region has its particular identification – for example the caption "Nord Picardie" can be seen over the transmissions from Lille.



RETMA test card – Port Said, Egypt.



Marconi No. 1 test card – Amman, Jordan.



Cross hatch pattern – CLT Lebanon.

Station identification – CLT Lebanon.

Above photographs courtesy Ervin Mogyorodi, Hungary.

Germany: Ryn also comments that DFF (East Germany) has for some time been transmitting from the Schwerin ch. E29 outlet at reduced power. The HR3 West German Wurzburg ch. E41 and E56 outlets are now providing "strong signals in Holland".

Bulgaria: Peter Vaarkamp has sent us the following transmitter list which he has received from the Bulgarian TV service. Botev Mountain ch. R11 12/20kW; Vidin ch. R10 19/5kW; Stramni Rit ch. R9 12/6kW; Slanchev Bryag ch. R7 19/10kW; Dulovo ch. R5 6/1kW; Varna ch. R9 12/66kW; Travnik ch. R6 24/1kW; Tolbukhin ch. R12 13/1kW; Petrokhan ch. R9 36/6kW; Sofia ch. R7 12/5kW. We assume that the double e.r.p. figures quoted denote directional aerial patterns. There are also 145 low-power (below 100W) relay stations. All the stations transmit a national programme with commercials. Times are 1800-2300 Monday, 1000-2330 Tuesday-Friday, 1800-2300 Saturday, 1000-2400 Sunday.

From Our Correspondents . . .

James Burton-Stewart has compiled an elaborate table of his Sporadic E reception during 1975. He comments that the season was generally worse than in 1974 – he logged some 50 signals less in 1975, and in 1974 was able to identify more signals. The table covers transmitter network, country, channel, frequency, times received, percentage of total, and direction. James's location is between Milton Keynes and Buckingham and from his table one can see that medium-hop signals from the south predominated there.

Last month we mentioned the results achieved by our friends in Australia during their recent SpE season. Anthony Mann has been using a special converter unit to monitor the TV channels and has now sent us details of this. The converter is crystal controlled, the crystal resonating at 40MHz so that the whole of Band I falls between the 0·5-30MHz range on his Trio 9R59DS receiver. The converter is a modified six metre amateur band unit with two field effect transistors as r.f. amplifier and mixer and a bipolar transistor oscillator. He fitted an extra f.e.t. r.f. amplifier and uses a separate two f.e.t. preamplifier! None of the tuned circuits are ganged, so for channel changing each variable – two slugs, two trimmers and two r.f. gain potentiometers – have to be adjusted. Even so to tune from one end of Band I to the other takes only thirty seconds. The set up is extremely sensitive – much more so than an ordinary TV receiver. Measurement of TV carriers depends mainly on receiver accuracy and stability, but with his Trio receiver and a reference calibrator giving 10kHz, 100kHz, 1MHz outputs to over 30MHz he can obtain exact measurements on TV carriers and offsets – usually 10 or 20kHz with Australian TV transmitters. Measurement with most signals is no problem, but with a very strong signal the "buzz" spreads over a spectrum peaking each 16kHz (i.e. presumably at line frequency), decreasing in strength away from the main carrier. A long-wire omnidirectional aerial is used. There is no problem in identifying the "big three" (ATV0, TVQ0 and ABMN0) on channel 0 during a good SpE opening since their offsets are +10, 0 and −10kHz respectively.

Bob Copeman in Sydney has again received New Zealand TV2 on channel 4 (Band III) via SpE so it seems that this could be a regular "catch" there during intense SpE openings. Apparently both the PM5544 pattern and test card F are extensively used over there but the Fubk pattern is a rare sight – only Wollongong, Wagga and a Melbourne station apparently use it.

Exotic Signals

It seems appropriate with the new SpE season about to arrive to feature the photographs shown this month. They were taken in Hungary by DXer Ervin Mogyorodi and are possible signals for us in the UK given a good double-hop opening. They also confirm that the Port Said ch. E3 outlet is actually in operation. The photos were sent to us by Hetesi Laszlo who also tells us that MTV (Hungarian TV) is using the PM5544 pattern with a digital clock superimposed.

SpE Reception

If my mail bag is anything to go by, the coming summer will introduce the delights of long-distance television (DX-TV) to a great many new enthusiasts. The following comments are mainly for their benefit.

The simplest set up for Sporadic E (SpE) signal reception consists of a reasonably high-gain receiver capable of receiving 625-line signals at v.h.f. with negative-going vision modulation, and an aerial of course. A simple dipole can be used, but a wideband Band I dipole is better. This consists of two elements, an active dipole to which the feeder is connected and a second non-active element – i.e. there is no feeder connection to it, but it's inductively coupled to the dipole. The dipole should be some 109in. overall, the non-active element 90in. overall and the spacing between them about 3in. This gives the dipole a resonant frequency of around 52MHz and the passive element a frequency of about 63MHz. Use conventional low-loss coaxial feeder cable. Aerial riggers can often supply suitable dipole insulators and half inch diameter elements – indeed they are frequently pleased to have you take old Band I arrays away. If possible take two and salvage the components in best condition.

The receiver coverage required is indicated in Fig. 1. Some 625-line receivers can be used for v.h.f. reception quite simply. All one needs is a v.h.f. to u.h.f. converter (upconverter) – suitable units are manufactured by Teleng and Labgear. They are expensive unfortunately, in the region of £15. The advantage of these units is that they make possible tuning across the complete 40-250MHz spectrum, including the frequencies "between" the UK 405-line channels. Push-button tuners are rather impractical for DX use unless there are about eight buttons. One approach worth considering therefore is to fit a slow-motion type tuner and use this in conjunction with an upconverter. Make sure that the upconverter has an r.f. amplifier stage (some do and some don't).

Some years back one had to get an old 405-line receiver and convert it to 625 lines plus negative vision before one could start DXing. With the multiplicity of dual-standard receivers now available at almost scrap prices however it seems best to obtain one of these. Models to look for are those using the Thorn (BRC) 850 chassis or those in the Bush TV125 range. Adaption of the latter for DX use was covered in the December 1973 issue of *Television*.

Next, just what is Sporadic E? The E layer is some 70 miles above the Earth's surface and is normally transparent to v.h.f. signals, i.e. they pass straight through it. This is the layer that provides much of the medium wave reception from Europe after dark (during the day the lower D layer absorbs m.w. signals). Indeed the signal distances encountered when E layer Band I TV reception occurs are similar to those experienced with night time medium wave reception. Between mid-May and late August the E layer's maximum usuable frequency is such that v.h.f. signals are not normally reflected. At times however intense patches of ionisation form in the E layer – the reason for this is not clear – and these reflect incident v.h.f. signals at frequencies which at times rise as high as 100MHz. Band III signals have also been known to be reflected in this way, though this is a rare occurrence. Generally we must concentrate on Band I where most of this signal activity will be observed – sometimes quite spectacularly.

Such conditions can happen at any time during this "season". They may appear quickly over perhaps a minute, while at other times one might start by seeing patterning for a considerable time, with short-wave harmonics being

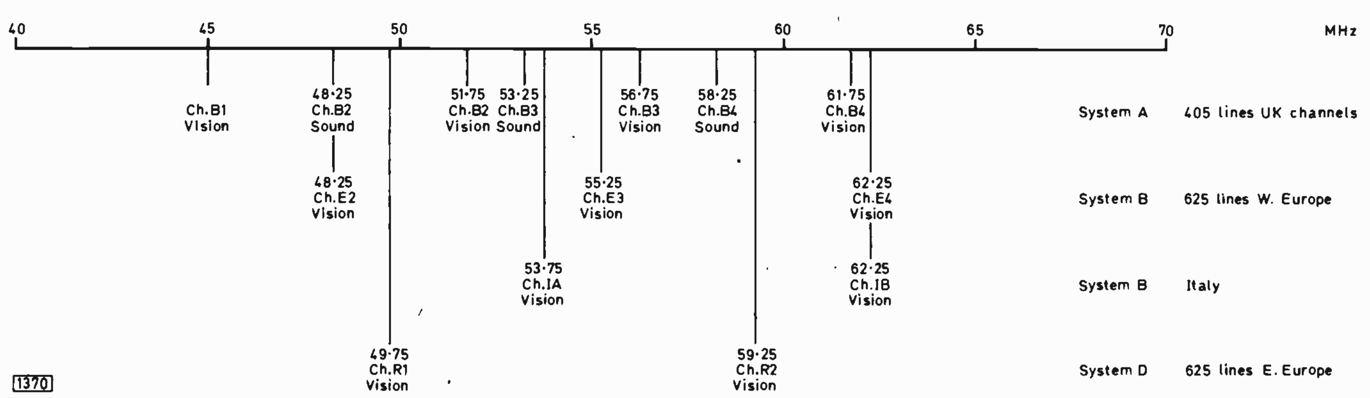
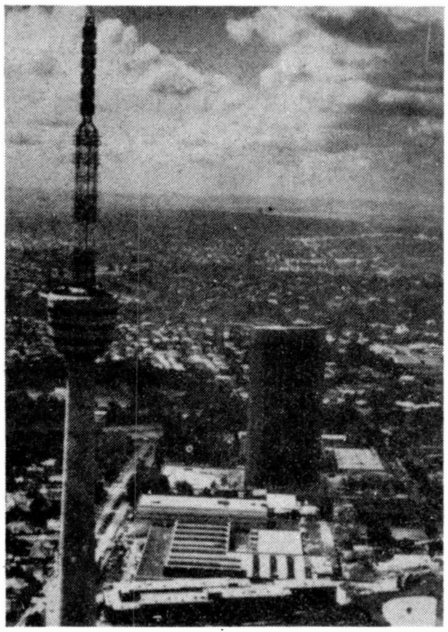


Fig. 1: European Band I vision carrier frequencies.



View of the TV tower and new TV Centre at Johannesburg, South Africa. (Courtesy EBU.)

heard and darkening of the raster. Similarly, conditions can disappear abruptly or gradually fade away. The signals can be strong, very strong, or can resemble a weak fringe signal with slow fading. Fading with a strong SpE signal can be severe, and there can be phase reversal and multiple path reception (like ghosting, but sometimes the "ghost" becomes stronger than the original signal). In a good SpE opening several signals will appear on the same channel, the signals "floating" over each other and fighting for supremacy. Consequently many countries may be received within a short period of time, and indeed as the ionised patch in the E layer moves so the reflection distance (skip distance or hop) alters bringing in new stations.

The distances travelled by SpE signals are usually between 500-1,400 miles, though hops of under 300 miles also occur (if this is noticed check the low end of Band III immediately – there may be a signal on ch. E5 etc.). Double hops can produce signals from up to 2,500 miles away. Very occasionally "exotic" signals are received here, such as Jordan, Egypt, Bulgaria, the Canary Islands and certain African stations on the Gold Coast – this latter occurs very rarely but often when no other signals are about.

An aerial rotator is a help in receiving stations from some directions and rejecting others. Another approach is to mount two similar dipoles at right angles to give omnidirectional coverage. Mount the elements horizontally since the signals are generally horizontally polarised.

In the early morning period look to the East. Polish (TVP) and USSR (TSS) signals may be received on channels R1 and R2. The whole East European bloc uses the OIRT channel spectrum (R channels) except for East Germany which for political reasons uses the West European CCIR system B (E channels). Italy differs slightly with its channel IA, and of course France has a different transmission standard which cannot be received on sets which can detect only negative-going vision signals. Belgium is another exception, using positive-going vision signals on the E channels.

Since SpE signals can be strong an aerial preamplifier is not essential when starting out with Band I reception. If you feel that a preamplifier is necessary, obtain a wideband type – covering Bands I and III and if possible u.h.f. as well. The latter will be useful when you graduate to u.h.f. DX-TV!

UHF AERIAL PERFORMANCE

continued from page 357

XG21/A was superior to the MBM88 at the h.f. end of the band, with even mid-band response, the MBM88 being marginally better at the l.f. end. The K version of the XG21, covering up to channel 48, gave similar performance to the group A version except for the addition of partial Band V coverage.

EXPERIMENTS

A feature of the MBM88 is the use of "launch" elements – two small elements mounted either side of the multidirector assembly immediately adjacent to the dipole – and we thought we'd see what effect these had on the performance. With one or both of them removed the performance dropped considerably – as did the performance of the XG21 when its "exciter" element was removed.

Another experiment we tried out was to wideband a Jaybeam group C/D PBM12 and an Antiference group C/D TC18 by replacing their original reflectors with group A ones. The results are shown in Table 1.

RESULTS

Table 1 shows how the operational results (gain/bandwidth) varied between the different types of aerial. The performance of aerials with multidirector assemblies exceeds by far the conventional Yagi with an in-line director array. Generally, for a given type of aerial the results obtained from different manufacturers' ranges were found to be very similar.

BASC REQUIREMENTS

Finally, further details of the British Aerial Standards Council's requirements should be noted. Its object is "in the absence of any current British Standard, to cover specifiable electrical and mechanical parameters and methods of measurement, together with appropriate and relevant performance minima for satisfactory service". Aerials designed by member firms have to comply with parameters laid down for nominal terminal impedance, bandwidth, directivity, cross-polarisation rejection, beamwidth, voltage standing wave ratio, forward gain, wind loading, maximum safe wind velocity, vibration tests, atmospheric environmental tests, dimensional and weight information. The maximum permitted gain variation is 2dB for single-channel Band I and III aerials, 4dB for wideband Band III aerials, 3dB for group A, B and C/D aerials, 4dB for group E aerials, 3dB for u.h.f. log-periodic aerials and 6dB for other types of wideband u.h.f. aerials. The gain variation over any single u.h.f. channel must not exceed 1dB. The maximum voltage standing wave ratio is 1·8 for single-channel v.h.f. aerials, 2 for wideband v.h.f. aerials and single group u.h.f. aerials, and 3 for wideband u.h.f. aerials. Manufacturers who are members are: Aerialite Aerials Ltd., Antiference Ltd., Jaybeam Ltd., Maxview Aerials Ltd., Telerection Products Ltd. and Wolsey Electronics Ltd. ■

Correction: In Part 1 of "TV Receiving Aerials" (page 232, March 1976) under the heading Field Strength, the Band V coverage should have read 70dB with reference to 1μV/m (i.e. just over 3mV/m).

servicing the TANDBERG CTV2-2 CHASSIS

W.S.J.Brice, B.Sc.(Eng.)

THE Norwegian firm Tandberg is probably best known for its audio and tape recording equipment. It also produces high quality colour television receivers however and two chassis have been used in the Tandberg models distributed in the UK, a hybrid one in their earlier 90° models and a solid-state chassis in their current 110° models. We are dealing with the solid-state CTV2-2 chassis in this present article.

The circuitry is typical of modern European colour receiver design, with a switch-mode regulated power supply, single transistor line output stage with diode width modulator to provide EW pincushion distortion correction, and varicap tuners, extensive use being made of i.c.s – especially in the decoder.

Most of the circuitry is carried on the hinged main chassis, which can be swung down to gain access. The line output, e.h.t. and associated components are on a printed panel on the right-hand side, the field output, luminance and RGB output stages being on the left-hand side. The tuners, i.f. strip, decoder, sound channel and line oscillator circuit are on printed circuit modules which plug into the left-hand side of the chassis.

The regulated power supply is in a screened compartment at the bottom of the chassis. It's fed from a bridge rectifier which in most models is mounted on a small board at the bottom of the cabinet, along with the c.r.t. heater transformer and the degaussing circuitry.

It is recommended that an isolating transformer is used when servicing these sets since with a bridge rectifier directly across the mains input the chassis is live to both sides of the mains supply.

Signal Circuits

The signal circuits are relatively conventional. There are separate v.h.f. and u.h.f. varicap tuners, a discrete transistor i.f. strip and a TCA270 i.c. to provide synchronous vision demodulation, a.f.c. and a.g.c.

Apart from occasional tuner trouble such as tuning drift and low gain this section of the receiver gives very little trouble, the usual complaint of poor picture due to mistuning being cured by adjusting the a.f.c. discriminator coil L16 which is adjacent to the TCA270.

No sound or intermittent sound faults have usually been rectified by changing the TBA120AS intercarrier sound i.c. (circuit reference U101), the audio preamplifier transistor Q151 (BC149) or the driver transistor Q152 (BC328). Sound distortion, often intermittent, is quite often due to the loudspeaker.

There are several transistors along with the luminance processing i.c. U200 (TBA500P) on the main printed board on the left-hand side of the chassis. Along with amplification the TBA500P carries out black-level clamping, peak white limiting and, in conjunction with Q203 (BC148B), beam limiting. Failure of Q203 results in a dark raster with no luminance, as does incorrect adjustment of its base preset control R207. If there is luminance but insufficient brightness on the other hand it is likely that the coarse brightness control R243 requires adjustment.

Intermittent loss of luminance but with the colour information still present throws suspicion on the luminance delay line FL200, especially if it is of the type which resembles a black rod. These have also proved troublesome in some other colour chassis of Scandinavian origin.

Decoder

The decoder consists of four i.c.s and their associated components. The TBA510, TBA540 and TBA990 are on one of the pluggable subassemblies: the final i.c. associated with decoding, the TBA530, is on the main left-hand panel.

Fault finding is easier if the functions of the i.c.s are understood. The TBA510 contains gain-controlled chrominance signal amplifiers, the colour-killer circuit, plus burst gating and blanking. The saturation control acts on the chrominance channel in this i.c. The TBA540 is the reference oscillator with its associated phase detector and control loop. A second detector in this i.c. produces the a.c.c. and colour-killer bias voltages and an ident bias signal. The TBA990 contains the PAL switch, the chrominance demodulators and the G — Y matrix. In addition to the three colour-difference signal outputs there is a half line frequency squarewave output which is fed back to the a.c.c./ident/colour-killer detector in the TBA540. The TBA530 simply matrixes the luminance and colour-difference signals to provide R, G, B output signals.

When working on the decoder it is useful to be able to disable the colour killer. To do this, open the link between points G1/1 and G1/2 on the decoder subpanel.

An unusual fault experienced several times has been too much colour with the a.c.c. not functioning, usually when the set is hot. On one occasion this happened on one channel only. It can be remedied temporarily by spraying the TBA510 i.c. with freezer, and is a form of thermal runaway in this i.c. To overcome the problem Tandberg recommend changing the values of R415 and R417 associated with pins 11 and 12 from 1kΩ to 2·2kΩ. This modification is incorporated in later sets.

Otherwise, the few decoder faults encountered have been straightforward, such as faulty capacitors – for instance the 18pF coupling capacitor C401 in the TBA510's input circuit.

In areas where the signal is poor we have had some cases where the decoder has been working satisfactorily but the set has suffered from colour drop-out. In such cases the

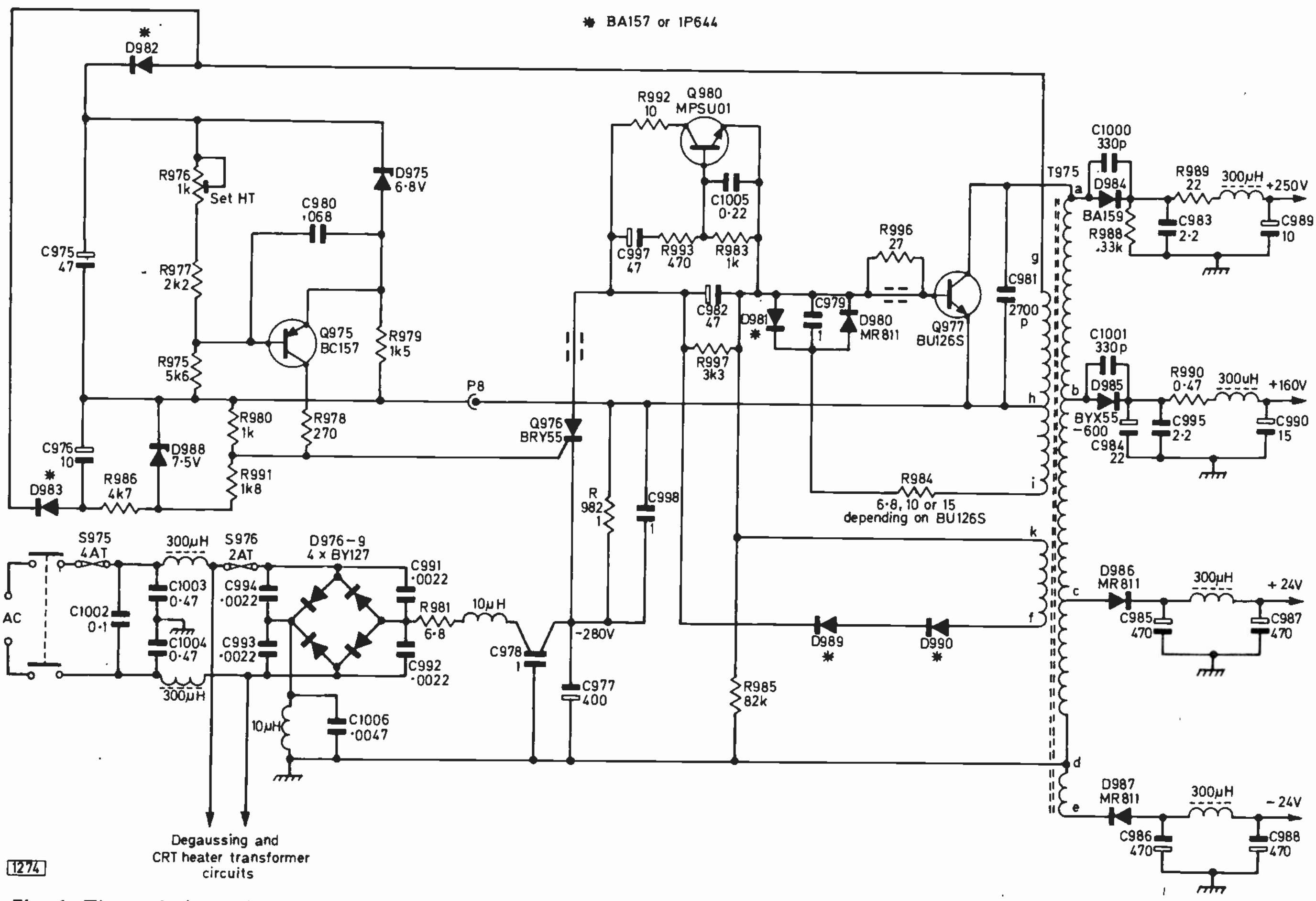


Fig. 1: The switch-mode regulated power supply circuit used in the Tandberg CTV2-2 chassis. R976 should be set for 160V h.t., a suitable measuring point being plug pin D2/6. All other output voltages will then be correct. R976 is accessible through a hole in the power supply unit cover: use an insulated screwdriver to avoid short-circuiting R976 to chassis.

threshold at which the colour killer operates can be lowered by increasing the value of R438 from 390Ω to 460Ω.

Switch-mode Power Supply

The regulated power supply uses a chopper arrangement, the chopper itself consisting of a blocking oscillator whose on/off time is varied by feedback to give the required regulation. 160V, 250V and +24V and −24V regulated supplies are given from a −280V rail provided by the bridge rectifier across the mains input. The operation of the circuit was described in detail in the October 1975 issue of *Television*. The article also provided useful fault tracing hints. The circuit is shown in Fig. 1.

Blowing of the 2A mains fuse is usually caused by failure of the BU126 chopper transistor Q977. This usually damages the BRY55 thyristor Q976 and the BC157 transistor Q975. Feedback from the blocking oscillator transformer T975 controls the conduction of Q975 which sets the firing point of Q976 thus varying the blocking oscillator's triggering. The BU126 itself can be damaged by a faulty C981 in parallel with it. And since the value of R984 depends on the gain of the BU126, it is a good idea to change all these components whenever the BU126 has to be replaced.

When presented with an overload, the oscillator frequency falls and the power supply produces a distinctive buzz. Typical faults which can cause this condition in the power supply are failure of any of the four supply rail rectifiers D984/D985/D986/D987 or their associated reservoir capacitors. A method of checking which supply rail is causing the overload is to disconnect each diode in turn and see whether the power supply operation returns to normal. Disconnect only one or two diodes at a time since if the transformer is left without a load it is possible for the BU126 to be destroyed. Outside the power supply, the line output transistor going short-circuit is the most likely cause of the overload condition arising.

A faulty BRY55 thyristor can cause a hum bar with associated line sync pulling. This is similar to the symptom when the bridge rectifier reservoir capacitor C977 loses capacitance: this shows up as hum modulation of the picture width.

Field Faults

Field faults have almost always been due to failure of the output transistors Q806 (2N5298) and Q807 (2N5107), and, occasionally, the driver transistor Q805 (SPS5384) as well. The output stage is connected across the +24V and −24V rails. Thus shorts in both transistors can be a little difficult to trace since this condition loads both the +24V and −24V rails. The result is that the power supply operates in the overload cutout mode, so you don't get the characteristic field collapse symptom. Disconnecting the power supply rectifiers one by one will not clear the overload as two supply rails are shorted.

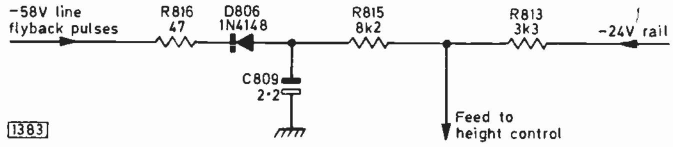


Fig. 2: Feeds to the field charging circuit.

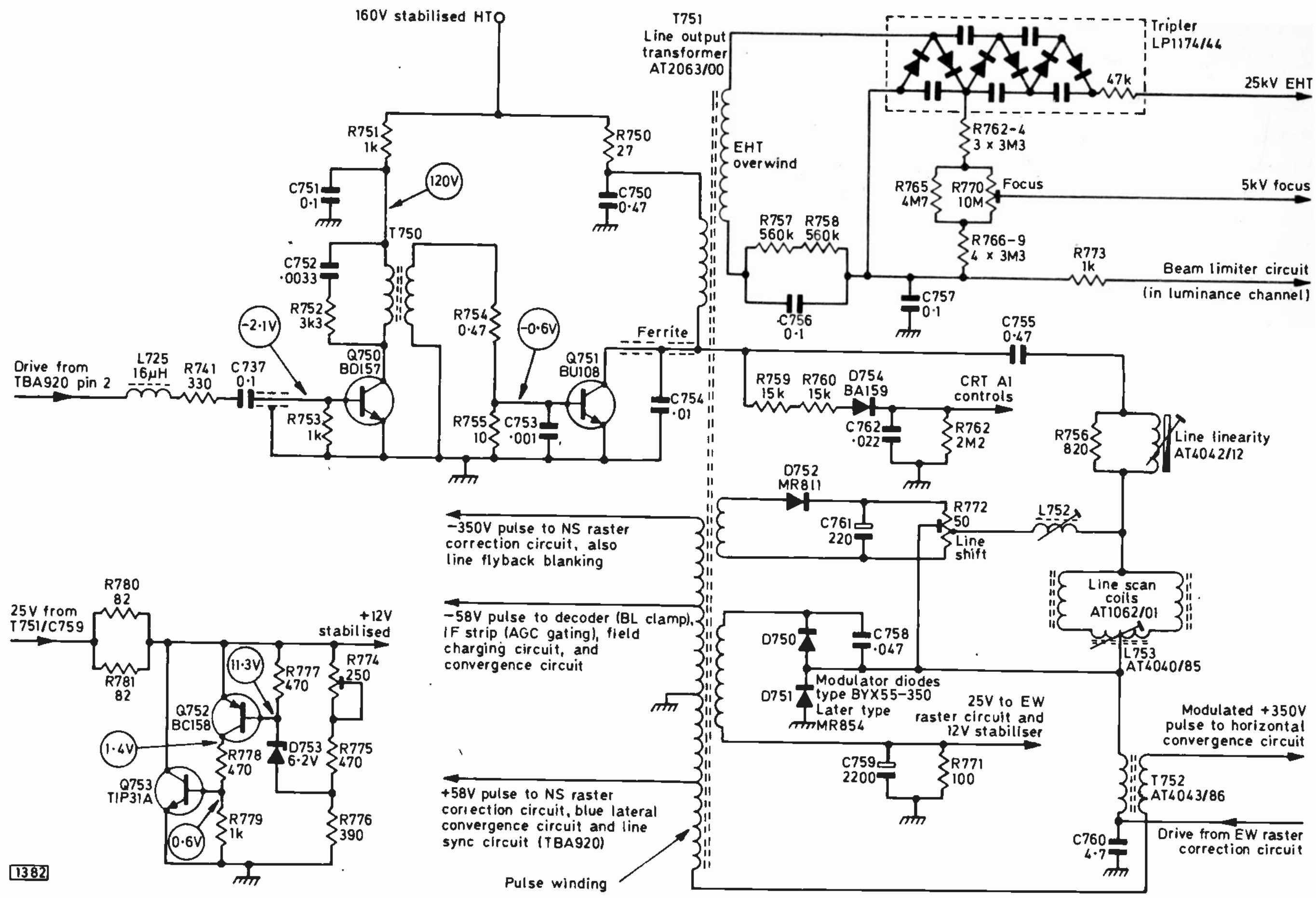


Fig. 3: The line driver and output stages. The width control is in the EW raster correction circuit. The 12V supply shunt regulator is shown below left: adjust R774 for 12V on plug pin E1/1. The burst gating, burst blanking and bistable drive pulses are derived from the +58V pulse from the line output transformer pulse winding and are shaped by Q465 on the decoder board.

The field charging circuit is fed from the –24V rail and also receives a feed obtained by rectifying the –58V line flyback pulses. The arrangement is shown in Fig. 2. Rectifier D806 rectifies the –58V line pulses, charging its reservoir capacitor C809. If D806 goes short- or open-circuit, the result will be insufficient height – with the surge limiter resistor R816 cooking in the case of D806 going short-circuit.

Line Output Stage

The line output, e.h.t. and focus hardware make up the right-hand part of the main chassis. There is a single line output transistor, BU108 in earlier production and BU208 in later versions, with an e.h.t. tripler and diode width modulator for EW pincushion distortion correction. The circuit is shown in Fig. 3.

Usual component failures in this section are, as may be expected, the line output transistor Q751 going short-circuit, and line output transformer and tripler faults. In a few instances however these failures have been due to other components being faulty. If C756 at the "earthy" end of the e.h.t. overwind goes short-circuit a high current flows in the line output transformer and this in turn can blow the line output transistor and the tripler. Change in the value of the line output transformer tuning capacitor C754 can produce high e.h.t., possibly over 30kV. This has little effect on the picture but obviously endangers the tripler, the c.r.t. and, through the increased possibility of flashovers, puts other components such as the line and field output transistors at risk. In view of the cost of some of these components, it is a good idea to check C756, the 160V h.t. line voltage and the e.h.t. when carrying out a repair in this section.

The width modulator diodes D750 and D751 have proved to be somewhat unreliable, going open- or short-circuit, frequently intermittently. The usual symptom is intermittent sound and vision, since the 12V rail for the signal stages is produced by regulating the rectified output from the modulator diodes. Thus when faulty these diodes give a dark raster with obvious pincushion distortion, no vision and sound, and the brightness control is inoperative. Tandberg have since stopped using BYX55-350 diodes in this position, substituting the Motorola type MR854 diode instead.

Conclusion

As this chassis is in many ways typical of the current generation of large-screen 110° colour receivers many of the faults described can appear in receivers of other makes. ■

BOOK NOTE

There seems to be some confusion in the minds of some of our readers over the publishers of the two books reviewed in our January issue (page 136). The *Guide to World-Wide Television Test Cards* is published by HS Publications, 7 Epping Close, Mackworth Estate, Derby DE3 4HR, at £1.30 including postage. *Questions and Answers on Colour Television* is published by Newnes-Butterworths whose address is 88 Kingway, London WC2B 6AB. The price is 75p.

TV TEST PATTERNS & SIGNALS

PART 2

CONTINUED FROM OUR APRIL 1976 SUPPLEMENT

Vertical interval test signals (VITS) (continued)

HAROLD PETERS, who compiled last month's supplement, continues this month with information on using the vertical interval test signals to assess receiver performance.

LINE 19

10μs bar

The 10μs bar is a continuous check on peak white. A standard video transmission line, as used between studios and transmitters, works to a peak signal of 1V into 75 ohms. From the top of the 10μs bar to the bottom of the sync pulse is exactly 1V and this is maintained to an accuracy of 1%, the bar being 0·7V and the sync pulse 0·3V. Anybody who is surprised at this degree of accuracy may also be astonished to realise that a 1db error on a 1V line feeding a transmitter putting out 500kW can make a difference of 100kW to the e.r.p.

The bar also checks the l.f. and transient responses. Its top is quite flat, and the sides are band limited by sine-squaring (of which more anon) so that its corners are undistorted. The effects of l.f. distortion will be seen on pictures if the top of the bar has a slope of more than 2% of its total height, and transient distortion will show as rounded bar corners or overshoots.

2T Pulse

Next to the bar the 2T pulse represents the finest detail the system is capable of resolving. It is transmitted at the same amplitude as the 10μs bar, so if the response of the circuitry is flat the bar and the pulse will be the same height. Like the bar, the pulse is sinesquared, and there now follows a slight digression for those who would like to know more about T and sinesquaring.

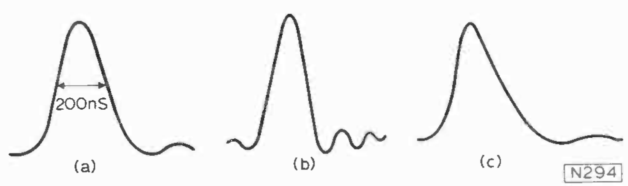


Fig. 7: (a) The 2T sinesquared pulse as generated. (b) After passing through a circuit with a sharp h.f. cutoff. (c) Passed through a circuit of poor overall response.

To gain some concept of the finest possible detail available, try to visualise the bottom 5·2MHz frequency gratings of Test Card F. These are sinewaves – and thus have no harmonics which would fall outside the bandwidth of the system. They represent the time it takes the scanning spot to move across the screen by an amount equal to its own width. The time the spot takes to move this distance, i.e. from white to black or vice-versa is called T. Accordingly 2T is the time it must take for the spot to move from white through black to white again – in other words one complete cycle. If we call the fine detail bars of the test card 5MHz, a single cycle of 5MHz will take 1/5 of a microsecond or 200 nanoseconds. This makes T 100 nanoseconds and 2T 200 nanoseconds. Now about sinesquaring.

A sinewave cycle begins at zero, rises to a positive maximum, passes back through zero to a maximum negative and falls to zero again. TV signals, however, start from the bottom at black and rise to their maximum which is white. Looking, then, at our 5MHz fine detail bars, our datum line for a single cycle starts at baseline (black), rises to white and falls back to black. Mathematically a sinewave starting from one extremity instead of the middle attracts another sine function and becomes sinesquared. It's just like looking at a horse on a roundabout from the deck rather than from an adjacent horse. To generate such a wave it is only necessary to gate out one cycle of a sinewave train starting at the negative peak, but in practice it is more convenient to pass a sharp transient through a band-limiting Thompson filter and take what comes out. The same filter is used to shape all transients in the two lines of waveforms, so that nothing is present with harmonics in excess of 5MHz and nothing enters the system capable of producing distortion. Therefore if what goes in does not come out, something must have altered it in between, Fig. 7.

LINE 19 (continued)

Chrominance pulse

The third pulse is a 10T Chrominance/Luminance pulse. This consists of a half amplitude luminance pulse added to a half amplitude subcarrier envelope. The result is a full height broad pulse; filled with subcarrier and with a flat bottom, but only if there is no difference in amplitude or delay between the two component pulses. What happens if differences arise is shown in Fig. 8. Note that these differences can only be used to evaluate circuitry carrying a composite luminance-chrominance signal, such as the vision detector stage of a receiver, and yet most readers would need a signal of this sort to check that the delay of the luminance chain matches that of the colour circuits, in other words Colour Fit. This check is best carried out off the tube face rather than by a 'scope.

Drop the scan without misconverging until the v.i.t.s. appear, and note the position of the luminance part of the pulse. Then turn up colour (you may need to disable the killer) and a twinkling blue or green line should overlay itself on the luminance pulse. This coloured part is a little larger than the luminance pulse, but should sit directly over it without extending a tail too far out to the right. The signal on line 20 can obscure this test a little and if you are an early riser the signal is radiated in full field at about 8.30a.m. on BBC1 for a few minutes most weekdays – a tip worth remembering if you are eager to check any of the features mentioned here.

Staircase

The last signal on line 19 is the 5 riser staircase, used to check the greyscale and line/time linearity. All steps should be the same height. A simple way to check this accurately is to pass the output through a differentiating circuit which will turn the steps into spikes of equal height. Any non-linearity will show immediately. Broadcasters use a complex filter of greater accuracy.

A small amount of subcarrier can be seen on each step (nominally 140mV for a 1V signal) allowing checks to be made on differential chroma gain, that is to say, change of chroma signal due to change of luminance. These tests are done in conjunction with the extended burst on line 20.

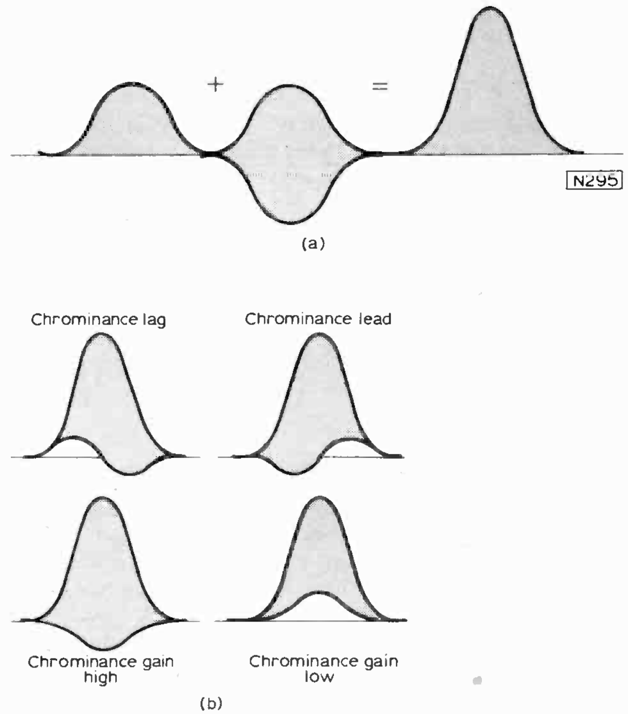
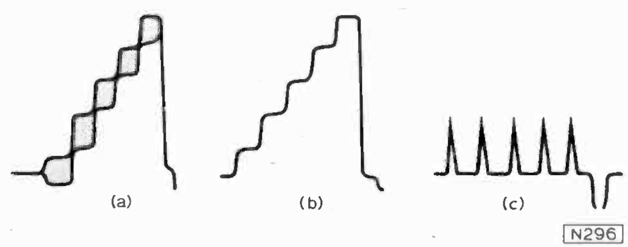


Fig. 8: (a) The 10T luminance/chrominance pulse, showing its build-up from its two half amplitude components. (b) Some typical fault indications.



LINE 20

Full Chroma Burst

Subcarrier fully modulated from 0-100% and of 14 microseconds duration is laid on part of a 50% (mean grey) luminance pedestal. The test here is for Chrominance/Luminance cross-talk, or the amount by which the luminance signal is altered (mostly during detection) by the presence of a colour signal. It is seen as a change of level of the luminance pedestal with the chroma pulse filtered out.

Extended Burst

The final signal is a burst of extended subcarrier laying directly beneath the 5 riser staircase on line 19. Its amplitude is the same as the conventional burst on the back porch. If the chrominance from the staircase on line 19 is filtered off and passed through a 64μs delay line like the ones used in PAL decoders, it can be added to the extended burst on line 20. Any differential chroma gain on line 19 due to the luminance staircase will show as bumps on the resultant trace, whilst differential phase shows as a hue change on the screen or, more precisely as a shift on a vector display.

The subcarrier used for the checks on lines 19 and 20 is usually unlocked deliberately from the transmission so as to provide a full envelope to the waveforms displayed on a 'scope. A locked subcarrier would give a jagged outline to all chroma/luminance checks. To resolve these signals in detail a good bright oscilloscope is needed, either with a delayed sweep, or triggered by an extractor unit such as one of those described by A. C. Ainslie in *Television* November 1973 or April 1974. You will, even then, need to exclude all daylight from the display, since it will be running at 1/625th of its normal brightness at best.

Fig. 9: (a) The 5 riser staircase on line 19. (b) The staircase with chrominance filtered out. (c) After passing through a differentiating network, the spikes should all be of equal height.

"K" RATINGS

To use the signal in an organised manner some yard-stick of goodness is required. A system of "K" ratings was devised by N. W. Lewis and others of the Post Office as far back as 1954 and remains valid to this very day.

Until then picture impairment measurement was a very subjective affair using the BREMA impairment scale:

Group 1 Imperceptible
Group 2 Barely Perceptible
Group 3 Perceptible but not disturbing
Group 4 Somewhat Objectionable
Group 5 Definitely Objectionable
Group 6 Unusable

This impairment scale is not be be decried. It is still widely used and provides the most accurate way of describing a fault condition when no measuring gear is to hand. You can try it for yourself one night when the 'continentals' come rolling in over the top of your wanted signal. Compare your ratings with those of your companions. But to return to K ratings.

A special graticule is needed for the oscilloscope, and a typical one is shown in Fig. 10. Three ratings are derived from line 19: Kpulse, Kbar, and Kpulse/bar.

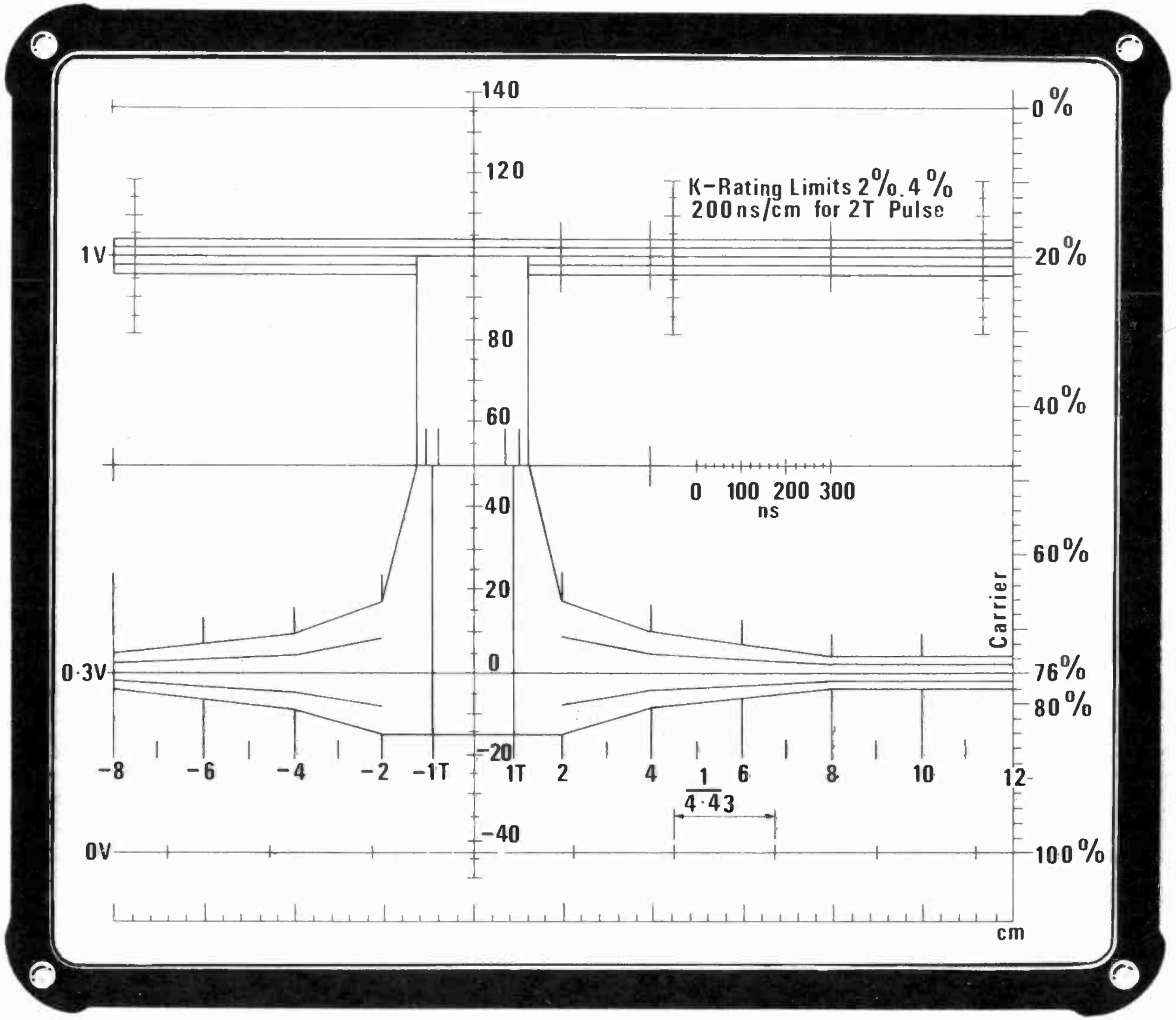


Fig. 10: A typical K rating graticule, as used by the Independent Broadcasting Authority.

Reproduced from the IBA Technical Review, No. 2.

"K" RATINGS (continued)

Kpulse (Kp) measures the distortion of the 2T pulse including smears and echoes. The 2T pulse is centred in the 'submarine' graticule, adjusted to fill it, with its half amplitude points cutting the two 200ns markers (Fig. 11(a)). If the outline of the pulse lies within the inner contour of the graticule the Kp rating is better than 2%. If the outline of the pulse lies within the outer contour, Kp is between 2% and 4%. Some idea of how this affects the picture itself can be gained by approximating the K rating to the BREMA impairment scale. This means that an engineer observing a pulse of Kp4% on the graticule would assess the pulse response of a test card as group 4, with respect to pre-shoots, overshoots or smearing.

Kbar (Kb) measures the tilt at the top of the bar. The bar is laid in the 'goalpost' of the graticule so that the rise and fall cross the half amplitude markers, with the top of the bar running centrally through the lines at the top of the grating (Fig. 11(b)). Poor l.f. response will tilt the bar, but if it is straight enough to be within the inner pair of lines it rates better than Kb2%, or within the outer pair, better than Kb4%.

Kpulse/bar(Kp/b) The amplitude relationship between the pulse and the bar provides a measure of the overall response of the system. The bar is set inside the goal-post as before, and the scope triggered so as to display the pulse inside the submarine (Fig. 11(b)). The height of the pulse is measured against the height of the bar, and the Kp/b rating is given a negative value if below bar height, positive if above.

The sort of tolerances expected to be realised by the broadcasters are:

From main transmitters: Kp better than 4%, Kb better than 4%, Kp/b better than 4%. From rebroadcast transmitters: Kp better than 11%, Kb better than 9%, Kp/b better than 8%. Most broadcast receivers are designed to a K rating of better than 4%.

Impairments are (like lead poisoning) cumulative, so K ratings should be added to give a total impairment value. The summing follows a mean between linear and square-law, and the power 3/2 is used.

Thus $K_{tot} = Kp^{3/2} + Kb^{3/2} + Kp/b^{3/2}$.

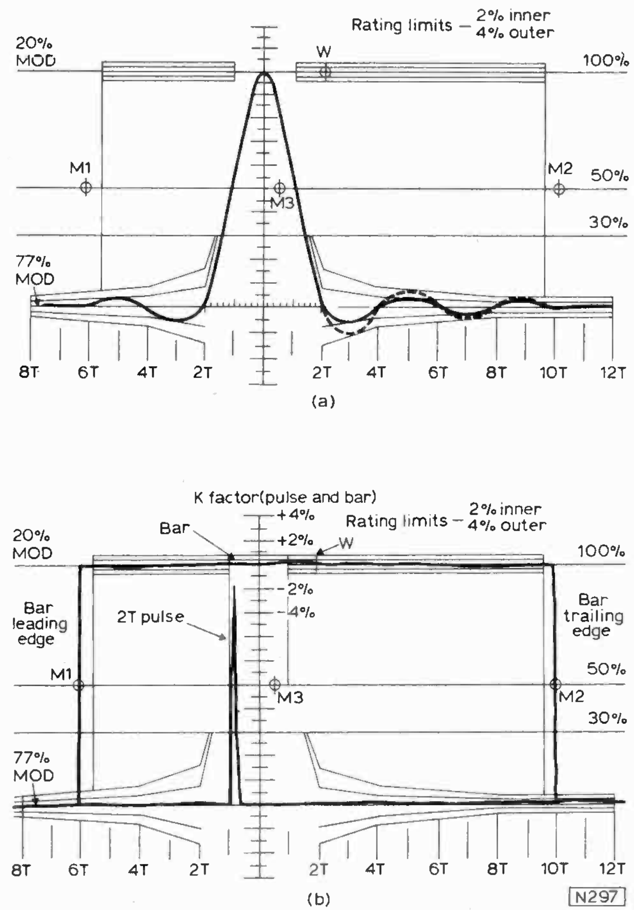


Fig. 11: (a) The 2T pulse sitting in the "submarine" part of the graticule, showing Kp2% (full line) and Kp4% (broken line).
(b) The 2T pulse lined up with the bar, showing Kp/b –2%.

Black Pulse

At the back end of the bar there frequently sits a negative-going 2T pulse, Fig. 12. This is displayed on the oscilloscope to sit over the 2T positive-going pulse. In theory the two should cross in the middle, but in practice due to quadrature distortion in vestigial sideband modulation they cross somewhere above the centre line. The amount by which crossover is above centre becomes the measure of quadrature distortion.

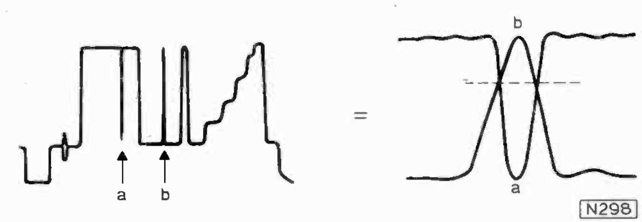


Fig. 12: The "black pulse" (a) which is inside the bar is used to check quadrature distortion of the vestigial sideband network. When lined up with the 2T pulse (b), the displacement of the crossing point from the mid-height is a measure of the distortion present.

FURTHER READING

If you are interested in taking measurement techniques further we commend:

Television Measurement Techniques L. E. Weaver (Peter Peregrinus Ltd.), *IBA Technical Review No 2* (IBA), and the *Joint TV standards specification for 625-line System-I transmissions* (BBC & IBA).

WHICH PATTERN?

TV TEST EQUIPMENT REVIEW

PART 4

E. TRUNDLE

EVEN more than the oscilloscope, the pattern generator is a child of colour television. Virtually every aspect of colour TV performance can be checked and adjusted with the aid of a good pattern generator, and any television workshop worthy of the name should sport at least one full-specification colour bar generator, especially since test card transmissions have been curtailed. When studying prices, it is fair to bear in mind that unlike domestic equipment, test gear of this nature has a very long life, having as it does, no c.r.t. to wear out, and no high or pulse voltages to cause premature failure.

Unlike the DVMs and oscilloscopes previously featured, the choice of pattern generators available in the UK is surprisingly limited, with only four full-function PAL generators for bench use being widely advertised. Every one of these is of foreign manufacture, although handled by large UK-based firms, mostly television manufacturers.

Ignoring such exotic hardware as the PM5544 colour test card generator (which has been the subject of many a workshop daydream, but would cost more than the workshop did!), pattern generators fall into three distinct groups, in which inevitably the price reflects the facilities offered. At the top end of the price range comes the bench type full-function colour generator, and two such instruments are reviewed here. Less comprehensive colour bar generators are available for rather less, and in one case, for about half the price of the 'supersonic' type, while in the lowest price bracket come several monochrome crosshatch/ grey scale generators intended purely for setting up c.r.t. displays.

Bench-type Pattern Generators

Usually costing in excess of £200, these generators offer a wide range of test signals, including specially encoded chroma signals to facilitate decoder alignment without the need for an oscilloscope. With these special patterns, such adjustments as delay-line matrixing and synchronous demodulation phase can be made with great accuracy. The remaining patterns comprehensively cover requirements for setting up the c.r.t. display, usually providing a circle for scan linearity adjustments in addition to the usual crosshatch and step-wedge patterns. Other special facilities include a red raster for purity checks and a sound carrier which can be switched off or modulated with an audio sinewave signal. Originating as they do in Europe, these generators usually provide r.f. outputs in v.h.f. bands I and III, which is useful for sets operating in these bands on communal aerial systems, and will become invaluable when 405-line transmissions are finally banished from v.h.f. and replaced by 625-line colour transmissions.

A variable burst level control is usually provided with which the amplitude of the colour-burst signal can be varied above and below normal, and this provides an instant check on the functioning of the ACC, burst-phase detector and colour-killer circuits. The video signal is usually available in the standard 1V/75Ω form from a front panel socket, and line and field synchronising pulses are similarly available.

These instruments are usually mains-powered, and in spite of the fact that they are designed to work without the need for an oscilloscope during decoder alignment, they are generally limited to bench use because of their cost.

Simple Colour-bar Generators

These are ideal for the field technician, as opposed to the panel-pusher, because despite their modest cost, they provide a standard colour-bar signal in addition to the crosshatch and grey-scale patterns. The field technician is likely to carry an oscilloscope anyway, and decoder fault-finding and alignment is thus quite practicable without heavy investment in test-gear.

Crosshatch Generators

Monochrome pattern generators may be purchased for about £50 upwards, and commonly offer all the signals necessary for setting up shadowmask tube displays. A fixed frequency output on u.h.f. is usual. Early models were dual-standard, with multi-band outputs, and this, together with their use of discrete circuitry, made them expensive. Later versions are small and light, and while mains-powered types are available, battery operation is becoming the norm, one model being small enough to fit into a tool-box or pocket. This type of instrument may be regarded as the very minimum standard required by the field technician or installation engineer.

General Characteristics

All commercial instruments have an output at u.h.f., so that it is unnecessary to delve into the set's circuitry to inject the signal. In our experience, too much reliance should not be placed on the calibration accuracy of any r.f. attenuator fitted.

The u.h.f. modulator used is invariably of the double-sideband type, which means that the correct sideband must be selected for proper chrominance reproduction. As a receiver is tuned through a broadcast transmission, going towards the top of the u.h.f. band, the sequence is: monochrome picture, colour picture, chroma-sound (1·57MHz) beat pattern. To ensure correct sideband tuning on a pattern-generator signal, ensure that these events happen in the same sequence for *the same direction of rotation of the receiver tuning control.*

The receiver's a.f.c. circuits often become confused when confronted with a double-sideband signal, in which case the a.f.c. can be simply switched off. Also on the debit side, pattern generators in our price range seldom if ever provide fully standard interlacing field sync pulse trains. While this is not important in most applications, any work on receivers or VCRs which involves precise sync or timing measurements are best carried out on a broadcast transmission.

Outputs available

1. Crosshatch: This consists of a white grid on a black background, and is the basic signal for adjustment of static and dynamic covergence. Being electronically generated, the lines are perfectly straight, square and evenly spaced, so that pincushion and scan linearity adjustments may be made.

2. Dots: Ideal for static convergence. Some generators provide a single white dot which marks the screen centre.

3. Step-wedge or Sawtooth: This is the basic signal for adjustment of grey-scale tracking. A luminance-only signal is provided which extends, either continuously or in steps, from black level to peak white. Normally, the first anode potentials are adjusted for neutral grey near black-level, then cathode drive amplitudes are set for a true white in the bright area.

4. Circle: Often in combination with 1. Provides a check on the linearity of both scans, and of picture centring.

5. Checker-Board: Performance check on video amplifier characteristics especially at low frequency, also sync separator performance.

6. Frequency Gratings: These provide a check of i.f. and video performance at high frequencies, and permit adjustment of focus.

7. White Raster: Intended for the checking and adjustment of purity in conjunction with the gun-killer switches in the receiver.

8. Red Raster: As above, but encoded red so that gun switching is not required. Some generators also provide pure green and blue fields.

9. Standard Colour-bars: The basic diagnostic colour-signal on which all decoder oscillograms in service data are based. These can also be used for adjustment of colour-difference drives by off-screen inspection. Sometimes provided as part of a split-field display in which the remainder of the field forms a reference white to simplify colour-difference drive adjustment.

10. Special Patterns: These may be of two basic types. The first consists of a specially-encoded signal which enables delay-line phase and amplitude adjustments, and demodulator phase adjustments to be made while observing the screen of the receiver under test. The pre-sets are trimmed for a specific display condition. The second type is designed to produce easily decipherable oscilloscope waveforms at specific points in the decoder.

11. Sound: The unmodulated sound carrier is useful for adjustment of 6MHz traps in video amplifiers, and realignment of intercarrier i.f. amplifiers. The audio tone may be used for adjustment of f.m. demodulators and diagnosis of distortion in audio amplifiers.

As in previous 'Survey' features, each instrument reviewed was used in everyday bench and field service in a busy service department for some weeks.

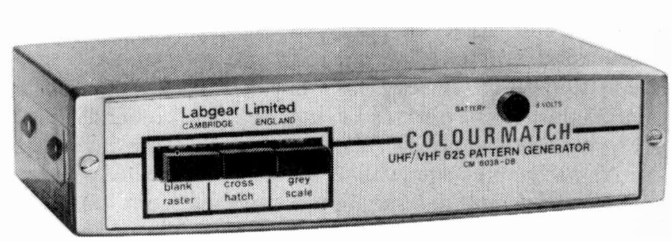
Labgear CM6004 and CM6038

The CM6004 is a compact mains-operated monochrome pattern generator. It has a fixed-frequency output at u.h.f., and offers all patterns necessary for c.r.t. setting-up. The grey-scale pattern is of the 'sawtooth' type, with a gradual transition from black to white. Most engineers prefer the step-wedge or staircase type of signal for this test, but careful adjustment of the brightness and contrast controls, so that the transition from black-level to peak white occupies the full screen width, gives satisfactory results. The modulator provides a clean noise-free pattern without too many confusing harmonics, and is tunable over a limited range in case the pre-set output frequency clashes with a local transmission.

The unit's internal construction is of discrete components on an SRBP board, while the case is of tough plastic with a recessed control panel. We did not succeed in damaging the instrument during several months of rough and tumble use in field service, and for installation and first-line service work, the CM6004 was found very useful.

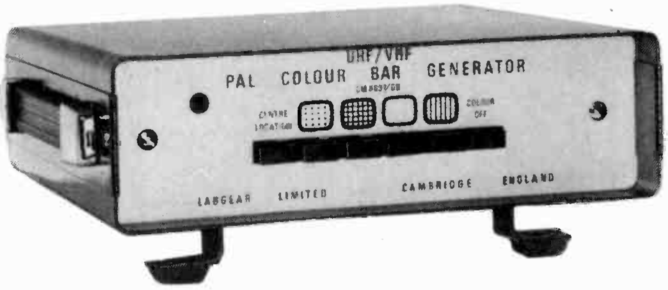
A recent addition to the Labgear range, model CM6038 provides similar patterns to the CM6004, but without the dot and line facilities. It boasts a staircase type grey-scale, and has the great advantage of being pocket-size, so that it will easily fit into the toolbox. Normally mains operated, provision is made for external battery operation, and the price tag is very attractive. ●

CM6004-PG ⬆ ⬇ CM6038-DB



WHICH PATTERN?

Labgear CM6037



The Labgear bar generator is a small and light instrument offering a standard colour-bar signal and red raster in addition to monochrome patterns. It is mains powered with fixed-frequency outputs at u.h.f. and v.h.f.

Two of these instruments have been in use for field servicing for many months, and have been found most satisfactory. The dot and crosshatch patterns are modified by the 'centre location' button to give a single dot or cross at the screen centre for setting static convergence. A word of warning here – efforts to centre a picture by means of the centre location facility are usually frustrated by scan non-linearity in the receiver, and this pattern is best confined to static convergence adjustments.

The red raster is not fully saturated, but a slight readjustment of the brightness and colour controls was found to give a satisfactory purity check. The 75% saturated colour bar signal is first class. It is important to remember that chroma waveforms in service data are often given for 100% saturated bars, in which case chrominance oscillograms taken from a receiver working from this instrument will be at three-quarters the quoted amplitude. The colour can be removed from the bar signal to give a monochrome step-wedge for grey-scale tracking.

The fact that the output is not tunable over the whole of the u.h.f. band is a little inconvenient, but simplicity is the essence of the CM6037, and this accounts for the very reasonable price. The fixed amplitude output gives a clean picture without any tendency to overload the receiver under test. A composite sync signal is provided at a rear-mounted coaxial socket which, when coupled to the external trigger input of an oscilloscope, gives stable displays for decoder setting up.

Although no service manual is supplied with the instrument, and we found that Labgear were surprisingly reluctant to supply one, servicing should be a simple matter, as virtually all the circuitry is embodied in eighteen pluggable i.c.s. The generator is housed in a tough steel case, with the front panel deeply recessed to prevent damage to the selector buttons. A great deal of thought has obviously been put into the design of this instrument, and one has to look very hard to find any criticism of the CM6037.

If a field technician were to specify his ideal pattern generator at the lowest practicable price, the result would be very similar to the CM6037. In fact, we understand that this instrument is the result of liaison between Labgear and a major TV rental company. This speaks for itself, and we can only endorse the high esteem in which this instrument is generally held. ●

Abridged specifications

CM6004-PG

Test signals:
1. Blank raster.
2. Crosshatch.
3. Dots.
4. Grey scale (sawtooth).
5. Horizontal lines.

Frequency range: 157-215 and 470-860MHz, the u.h.f. output being the 3rd, 4th and 5th harmonics of the v.h.f. oscillator which is adjustable by means of a front panel-mounted preset.
R.F. output: Greater than 1·5mV on v.h.f., 1mV on u.h.f.
Other outputs: None.
Power supply: A.C. mains 210-250V, 50Hz.
Size: 90 x 184 x 134mm (3·5 x 7·25 x 5·25in).
Weight: 1 kg (2·2 lb).
Price: £58·80 (plus VAT).

CM6038-DB

Test signals:
1. Blank raster.
2. Crosshatch.
3. Grey scale.

Frequency range: 185-215 and 555-645MHz; the u.h.f. output is the third harmonic of the v.h.f. oscillator which is normally preset to 200MHz.
R.F. output: Greater than 1mV.
Other outputs: None.
Power supply: A.C. mains 240V, 50Hz or an external 6V battery.
Size: 45 x 175 x 100mm (1·75 x 6·9 x 3·9in).
Weight: 0·68kg (1·5lb).
Price: £46·60 (plus VAT).

CM6037-DB

Test signals:
1. Red raster (100% saturation).
2. Crosshatch.
3. Dots.
4. Centre cross.
5. Centre dot.
6. Grey scale.
7. Colour bars.

Frequency range: 185-215 and 530-630MHz. One preset channel in each band, supplied set to 200 and 600MHz respectively.
R.F. output: Greater than 2mV on v.h.f., 4mV on u.h.f.
Other outputs: Oscilloscope triggering pulses at line and field rate.
Power supply: A.C. mains 200-250V, 50Hz, 8VA.
Size: 90 x 235 x 230 mm (3·5 x 9·25 x 9 in).
Weight: 3 kg (6·6 lb).
Price: £125·15 (plus VAT).

Further details are available from Labgear Ltd., Abbey Walk, Cambridge CB1 2RQ, telephone Cambridge (0223) 66521. Above prices are nett trade.

Decca EP685

This is a modern design of full-specification bench colour-bar generator with a very reasonable price tag. It is of Italian manufacture, and is marketed in the UK by Decca, who also offer a technical back-up service should it be required.

When the instrument was unpacked, we were disappointed to find that a 3-prong mains plug of strange design was fitted, and that the r.f. output lead was terminated in a BNC plug.

We were a little unlucky with our review model in that the band selector buttons failed to lock in. On investigation, this proved to be due to a small foreign body lodged in the works, and was easily removed. Our enforced entry gave us an opportunity to inspect the 'innards' which, as with most high-quality test equipment is an education for those brought up on domestic equipment. The electronics are beautifully laid out on three parallel glass-fibre boards. Ten i.c.s are used in the logic section, which generates the basic sync and bar waveforms, while most other functions are handled by discrete circuitry.

The very comprehensive operating manual and circuit diagram supplied with the generator includes full and precise decoder alignment instructions for use with the special patterns. Decoder waveforms are also given for correct and maladjusted operation.

The standard colour-bars are combined with a white reference in a split-field display. This can detract from the oscilloscope display, and a switch to remove the white reference would have been appreciated. This is, however, a fairly minor point and depends largely on the integrity of the oscilloscope used. No less than three special patterns are available for decoder setting-up, including one designed for checking colour matrixing at the 'back-end' of the decoder.

While it could be argued that this particular check is becoming irrelevant as colour matrixing is carried out inside an i.c. in modern receiver designs, the special pattern facilities in this generator are more comprehensive than on any similar instrument. The red-field pattern gave a bright and cheerful display due to the fact that it is encoded at full saturation. The burst amplitude control varies the burst level from zero to 200% of normal, thus checking the full a.c.c. range of the receiver under test. We found that our particular model produced about 115% of correct burst level when the control was set at 100%, and in view of the importance of correct burst amplitude in the test signal, a 'click-set' arrangement for normal (100%) burst amplitude would have been a worthwhile feature.

The crosshatch signal is superimposed on two concentric circles in the EP685, so that scan linearity and picture centring adjustments may be made. The usual dot matrix and checker-board patterns are provided along with a grey-scale step-wedge. We would rather have seen this button given over to a definition-grating test similar to the Philips 'multiburst', in view of the fact that a step-wedge signal for grey-scale tracking is available from the colour-bar signal when the chroma is removed. This would then have provided the last word in versatility.

Sound performance was excellent with very little trace of cross-modulation. The sound generator circuits of this model are more elaborate than some instruments, and a 'fussy' receiver whose intercarrier strip and demodulator had been aligned on the test signal gave good results off-air. A video output socket is provided, along with sync and subcarrier outputs, but modulation by externally generated signals is not catered for. We had no complaints about the modulator, which handled peak signals with no trouble.

All TV bands are covered by four band selector/tuner buttons. Coverage on u.h.f. reaches up only to channel 43, which was a minor irritation in our area, where the local transmissions are all in group C-D, so that the receiver under test had to be tuned down to come within the output range of the generator. The r.f. output is in the order of 10mV, which may be tamed by five switched attenuators. While calibration in true millivolts might have been more practicable for the down-to-earth technician, one quickly becomes familiar with the behaviour of a normal receiver at various attenuator settings.

The EP685 represents very good value for money, and can be heartily recommended for bench and field use. It is an example of all that is best in modern test-equipment design, and the criticisms we had are far outweighed by its many advantages. ●

Abridged specification

Test signals:
1. Colour bars with white reference.
2. Colour matrix test pattern.
3. Colour demodulator test pattern.
4. Delay line test pattern.
5. Crosshatch with two circles.
6. Dots.
7. Grey scale.
8. Red raster (100% saturation).
9. White raster (100% saturation).
10. Checkerboard.

Sound carrier with optional internal 1kHz modulation.
Frequency range: 48-82, 175-230, 470-660MHz. Four preset channels.
R.F. output: Greater than 10mV, reducible by 76dB using stepped attenuator.
Other outputs: Video; subcarrier; line sync; field sync.
Size: 122 x 290 x 210mm (4·8 x 11·4 x 8·25in).
Weight: 4kg (8·8lb).
Power supply: A.C. mains 220-240V, 50Hz, 25VA.
Price: £212·50 (plus VAT).

Further details are available from Decca Radio & Television, Educational & Industrial Products, Ingate Place, Queenstown Road, London SW8 3NT, telephone 01-622 6677.

WHICH PATTERN?

Philips PM5509

This is a full-specification pattern generator with all facilities. It is rather expensive by comparison with similar generators by other manufacturers, but offers full coverage of the u.h.f. band and a useful VCR test pattern.

As the specification shows, ten patterns are offered, five in monochrome and five in colour. The 'demod' pattern is used for alignment of three decoder functions, and the standard colour-bars form part of a split-field display with the bottom third of the screen as a white reference. It is possible to extend the colour-bars to fill the whole screen by means of an internal link, and we fitted a switch so that this could be done at will. The red raster provides a rather washed-out red field due to the fact that it is at 50% saturation, and we were happier to use the white raster in conjunction with the gun switches when setting purity.

The VCR test pattern consists of a chrominance definition grating extending from 100kHz to 1MHz with an 8-step wedge of increasing saturation. Apart from its intended function, this was found useful during experimental decoder work, during which the signal was taken from the video output socket.

Unusually, the chroma amplitude control adjusts the level of burst and chrominance signals together, so that if the a.c.c. in a receiver is functioning correctly, the saturation should remain reasonably constant over most of the range of this control.

Turning to the monochrome patterns, the 'multiburst' as Philips call it was found most useful, offering a check on bandwidth and definition. This feature was absent from the other instruments we tested. By pressing both the relevant buttons, the electronic circle can be superimposed on the crosshatch pattern to form a composite pattern which may be used to centre a picture in the absence of a broadcast test card.

The sound facility on the PM5509 was not the best of the generators we reviewed, being marred by vision on sound effects depending on the pattern in use. Both sound and vision may be fed into the generator from external sources to be modulated onto a u.h.f. carrier, and this is a valuable point. Outputs at r.f. are available in all TV bands, being selected by five push-buttons with corresponding tuning potentiometers. The range and frequency are displayed on two illuminated meters, a seemingly unnecessary refinement which must contribute to the final cost of the instrument.

The u.h.f. modulator in our review instrument tended to overload on peak white and peak chroma leading to signal crushing. This, in all fairness, may have been a quirk or maladjustment of this particular instrument, and if so, could account for the cross-modulation on sound referred to earlier. A calibrated r.f. attenuator is provided, but it was found that when the attenuator was set to 1mV, the displayed pattern was very much more grainy than with a measured 1mV off-air signal.

Front panel sockets provide line and field trigger pulses, video in/out and r.f. output. The video output socket provides a composite video chroma and sync signal at about a volt peak to peak – this is similar to the signal obtainable from a conventional video detector, and as such can be very useful. Another bonus point with this instrument is that the Band I coverage extends down to the standard vision i.f. frequency, so that signals can be injected into an i.f. strip direct.

The PM5509 is a most desirable instrument, and its highish price is offset by the many facilities it offers. While it is eminently suitable for general workshop use, it is particularly recommended where a wide range of equipment is serviced, and lends itself well to experimental work on all types of TV equipment. ●

Abridged specification

Test signals:
1. Checkerboard.
2. Circle.
3. Crosshatch.
4. Dots.
5. Grey scale with definition lines 0·5 – 5MHz ("multiburst").
6. Red raster (50% saturation).
7. White raster (100% saturation) with colour burst.
8. Delay line/demodulator test pattern.
9. Colour bars with white reference.
10. VCR test pattern.

Sound carrier with internal/external modulation.
Frequency range: 38-85, 170-250, 470-790MHz.
Five preset channels.
R.F. output: Greater than 10mV, reducible by 60dB using the continuously variable attenuator.
Other outputs: Video; Sync; VCR.
Power supply: A.C. mains 115 or 230V ±15%, 50-60Hz, 16VA.
Size: 195 x 235 x 270mm (7·7 x 9·25 x 10·6in).
Weight: 3·7kg (8·2lb).
Price: £350·00 (plus VAT).
Further details are available from Pye Unicam Ltd., Philips Electronic Instruments Dept., York Street, Cambridge CB1 2PX, telephone Cambridge (0223) 58866.

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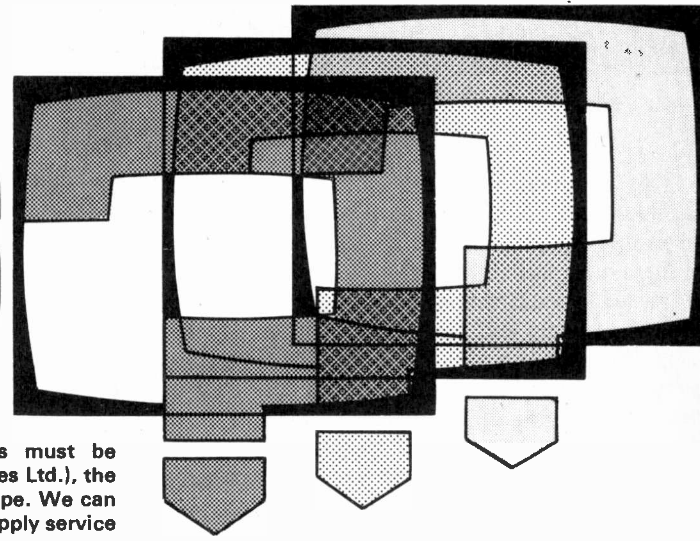

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DECCA CS2213

This receiver has always tended to lack saturation, i.e. the colour intensity control is permanently flat out and only marginally achieves sufficient saturation. The decoder has been carefully realigned in accordance with the procedure set out in the official service manual, but with little improvement.

Low saturation in this chassis can be due to a faulty colour-killer transistor (TR214) or a leaky or low-value saturated during a colour transmission. Possible faults here are inadequate output from the ident stage, defective colour-killer transistor (TR214) or a leaky or low-value base bias electrolytic C236. Deterioration of the electrolytic C230 which decouples the emitter of the second chrominance amplifier transistor TR212 is another possibility. For correct chrominance gain the base current of the first chrominance amplifier transistor TR210 is critical: check whether its base bias resistor R248 (180kΩ) has changed value. (Decca series 10 chassis.)

NATIONAL PANASONIC TC85HA

The problem with this Japanese colour receiver is a tendency for the picture to change to complementary colours, i.e. green faces.

Unlike many Japanese sets, National Panasonic models all use standard PAL decoding techniques. The bistable switching circuit is falling out of synchronisation due to lack of output from the ident circuit. Simply tweaking the ident coil L610 for maximum output should put matters right. If not you will have to check back through TR602 and TR605 to the reference signal i.c. IC602 to find out why the ident signal amplitude is low.

GRANADA 916/2

This v.h.f. only mains portable set looks like a Thorn chassis, but I've been unable to track down the correct chassis type number. The problem is field slip as the set warms up. Adjusting the field hold control or turning up the contrast corrects the slip for a while: if the controls are not touched at all the slip gets faster until a white line across the centre of the screen appears, about twice a second. If the field is relocked the raster is perfectly linear. The EF80 video and sync separator valves and the 30PL14 field timebase valve have been replaced without making any improvement.

The set is fitted with the Thorn 980 chassis as used in several Ferguson, HMV and Ultra models. When servicing one of these the condition of the resistors associated with the video amplifier EF80, in particular the 10kΩ anode load resistor R27 to the left and the 39kΩ bias stabilising resistor R26 which is behind, should always be checked. The present trouble is more likely to be due to a component fault in the field timebase however. Check the components associated with the pentode anode (pin 6)/triode grid (pin 1) circuit of the 30PL14. These are C54 (0·01μF), R71 (68kΩ), R72 (68kΩ) and the hold control itself which we have known to be responsible for the fault.

ALBA TC2222

After about two hours' operation there is slight picture blurring which then slowly increases. Whether the picture is bright or dim does not affect the fault. A new e.h.t. tripler has made no difference.

This fault is often due to a minute discharge across the spark gap associated with the focus pin (9) of the c.r.t. Clean up in this area, and slightly enlarge the gap with a file. If the fault persists, replace the focus control assembly. (Thorn 3000 chassis.)

ITT CK651

The fault usually appears after the set has been on for about two hours, and takes the form of a patch of yellowish-green lines superimposed on the raster in the lower left-hand section of the screen. The lines show up most vividly against a plain red background, and vanish when the picture is black or white. On a plain blue background they change colour to purple. The lines seem to be on alternate scan lines. The right-hand vertical edge of the patch is fairly well defined and is always in the same position, about a third of the way across the screen. The height of the patch varies erratically however. Increasing the contrast control setting reduces the height of the patch.

Check the phasing of the subcarrier traps L71 and L72 – the direction of the windings should be clockwise when viewed from above. Check the 8μF decouplers C219 and C152 on the decoder board. Ensure that the leads to the convergence box are dressed tight against the degaussing shield. If necessary replace the speed-up capacitors C220 and C225 in the bistable circuit with 68pF ceramic ones. (ITT CVC8 chassis.)

BUSH CTV184S

To start with there was no blue picture content. This was corrected by fitting a new blue output transistor. Following this however there are horizontal lines, spaced approximately an inch apart but closer at the top of the screen. They show up as blue behind a blue scene and yellow on lighter shades. At times the lines are not visible: also they are stationary, i.e. moving neither up nor down the screen. None of the customer controls has any effect on the lines. The decoder panel fitted is the later two i.c. type.

The problem is almost certainly coming from the blue channel, around transistors 3VT6/3VT9. Check the new output transistor by substitution, then check the BC148 driver transistor, the ITT2002 (3D7) blue clamp diode and the input coupling capacitor 3C44 (6·4μF). The point can be proved by swapping over the blue and red cathode feeds to the c.r.t., whereupon the fault should appear in red/cyan instead of blue/yellow. (RRI A823A chassis.)

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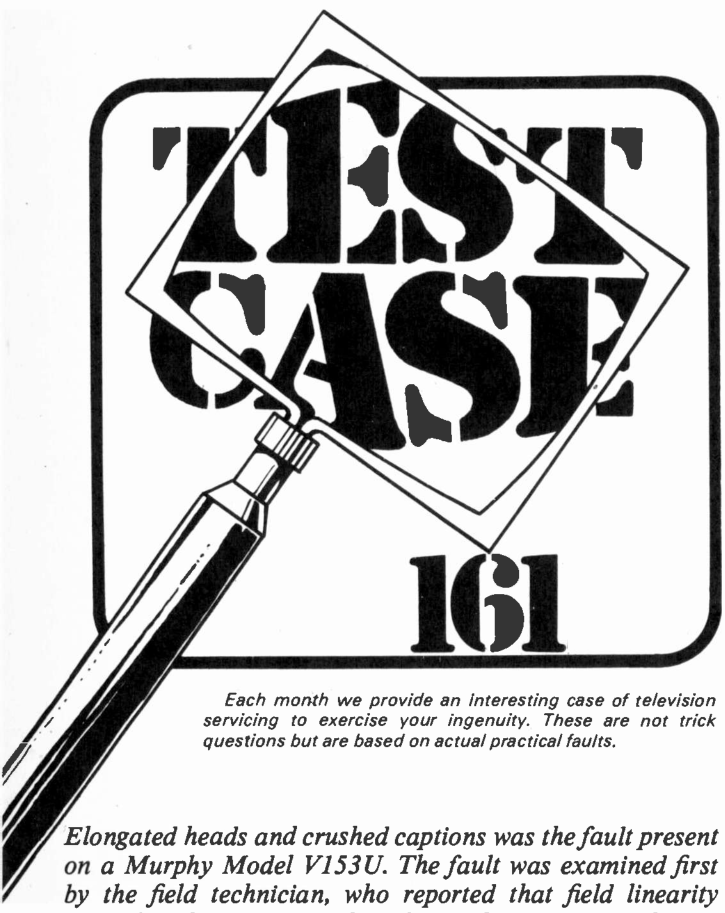
TELEVISION MAY 1976



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.

Elongated heads and crushed captions was the fault present on a Murphy Model V153U. The fault was examined first by the field technician, who reported that field linearity control adjustment and valve substitution made no difference.

In the workshop a test pattern display certainly revealed rather bad vertical non-linearity, and while the top field linearity control 3RV7 modified the non-linearity the control arrived at the end of its range before correction was complete. As similar symptoms had been encountered due to a low-emission PCL85 field timebase valve it was decided to note the change in non-linearity after replacing this.

The replacement valve gave a marked improvement in the linearity, which could then be almost competely cured by adjusting the linearity controls. On inspection, the output stage cathode components appeared to be in good condition. At this stage it was noticed that the field lock was below par; also that as the receiver increased in temperature, so the vertical linearity became worse.

On changing back to the original valve it was noticed that the replacement had been running at a higher temperature than normal for this circuit.

One or two resistors associated with the field hold and linearity controls had changed value and were replaced, but with only minimal effect on the results obtained. The circuit was then examined in greater detail, and with an Avo Model 8 connected across one component in the linearity correction feedback circuit the symptom became very much worse. This gave the technician the clue to the cause of the trouble. The component was replaced and perfect linearity and improved locking were then achieved.

What was the most likely component at fault? See next month's Television *for the solution and for another item in the* Test Case *series.*

SOLUTION TO TEST CASE 160
(Page 331 last month)

The clue to the problem was the rain storm! Although this was not immediately obvious to us – or indeed the mechanism responsible – it nevertheless became apparent that wet weather had a significant bearing on the symptom.

After the storm the aerial was examined for ingress of moisture at the point of feeder connection, but all was bone dry here. It took several calls and much head scratching to come up with the answer. Since the aerial was mounted fairly close to the sloping roof, the distance between the dipole and the slates was critical with respect to the wavelength of the channel affected. Under wet conditions the roof tended to act as a relatively efficient signal reflector, and on the channel affected the distance was just right for almost complete cancellation of the direct signal picked up by the aerial!

The aerial was raised in order to decrease the angle relative to the roof, and this completely cured the trouble. Since this event a second case with virtually identical factors has been cleared in the same way.

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BC135	0.19
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147	0.13
BC148	0.12
BC149	0.14
BC152	0.25
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BC157	0.15
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BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
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BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
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BF182	0.44
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BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.90
BPX29	1.70
BPX52	1.90
BRC4443	0.68
BRY39	0.47
BRY56	0.40
BR101	0.47
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BSY95A	0.27
BT106	1.24
BT116	1.20
BU105/02	1.95
BU108	3.25
BU126	2.99
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40NI	0.45
E1222	0.55
E5024	0.20
ME6001	0.16
ME6002	0.17
ME8001	0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.85
MJE3055	0.74
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76

Type	Price (£)
MPSU56	1.26
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.59
OC36	0.64
OC42	0.55
OC44	0.25
OC45	0.32
OC70	0.32
OC71	0.32
OC72	0.32
OC73	0.51
OC75	0.25
OC76	0.35
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.25
OC171	0.30
OC200	1.30
OCP71	0.92
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.95
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
TIS90	0.23
TIS91	0.23
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1164	3.60
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.51
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.26
2N2905A	0.28
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N2955	1.12
2N3012	0.91
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60

Type	Price (£)
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3250	1.02
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3501	6.99
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3766	0.99
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.43
2N4033	0.54
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4392	2.84
2N4871	0.24
2N4902	1.30
2N5042	1.05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2N5294	0.35
2N5296	0.57
2N5298	0.58
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	0.85
2N5496	1.05
2N6027	0.65
2N6178	0.71
2N6180	0.92
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

MATCHED PAIRS

Type	Price (£)
AC128/AC176	0.52
AC141K/AC142K	0.56
AC187/AC188	0.60
AC187K/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70
TIS90M/TIS91M	0.50

Any other transistors can be matched at a supplement of 20p per pair.

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
AAZ17	0.12
BA100	0.15
BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BAY72	0.11
BB104	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.50
BY100	0.22
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.68
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY11A	0.45
FSY41A	0.40
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.85
IN914	0.07
IN914E	0.06
IN916	0.10
IN1184	0.92
IN1185	1.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07

Diodes can be supplied balanced at a supplement of **5p** per device – e.g. four balanced OA91 would be **£0.48** per set.

Variable capacitance diodes can be supplied matched at a supplement of **3p** per device.

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3045	1.35
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN76001N	1.45
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
SN76227N	1.46
SN76530P	1.05
SN76533N	1.20
SN76666N	0.90
TAA300	1.76
TAA320	0.94
TAA350A	2.02
TAA435	0.85
TAA450	2.70
TAA550	0.55
TAA570	2.02
TAA611A	1.70
TAA611B	1.85
TAA630Q	4.18
TAA630S	4.18
TAA661B	1.32
TAA700	4.18
TAA840	2.02
TAA861A	0.49
TAD100	2.66
TBA120S	0.99
TBA240A	2.97
TBA281	2.28
TBA480Q	1.90
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	3.34
TBA530	2.71
TBA530Q	2.71
TBA540	3.21
TBA540Q	3.21
TBA550Q	4.10
TBA560C	4.09
TBA560CQ	4.10
TBA570	1.17
TBA641	2.30
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA810AS	1.75
TBA920Q	4.23
TBA990	4.10
TBA990Q	4.10
TCA270Q	4.18
ZN414	1.25

Please enquire for linear op. amps, 709, 710, etc.

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7425	0.37
7430	0.20
7440	0.20
7441	0.85
7445	1.95
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7489	4.32
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

MOUNTING KITS

Type	Price (£)
TO-3	0.06
TO-66	0.06

VALVES

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

ZENER DIODES

400mW 3.0-33V **12p** each
1.3W 3.3-100V **18p** each

VDR'S, PTC & NTC RESISTORS

Type	Price (£)
E295ZZ/01	14
E295ZZ/02	14
E298CD/A258	7
E298ED/A258	6
/A260	6
/A262	6
/A265	6
/P268	6
E298ZZ/05	7
/06	6

Type	Price (£)
E299DD/P116-P354	all 8
VA1015	50
VA1026	41
VA1033	8
VA1034	8
VA1040	8
VA1053	8
VA1055S	10
VA1077	12
VA1104	35
VA8650	110

RESISTORS

Carbon Film (5%)	ea
¼W 5.6 Ω-330k Ω (E12)	1.5p
⅓W 10 Ω-10M Ω (E24)	1.5p
1W 10 Ω-19M Ω (E12)	3p
2W 10 Ω-10M Ω (E6)	5p

WIREWOUND (5%)

2½W 0.22 Ω-270 Ω	15p ea
5W 10 Ω-8.2k Ω	13p ea
10W 10 Ω-25k Ω	18p ea

CAPACITORS

Full range of C280, C296, tubular ceramic, pin-up ceramic, miniature electrolytics, mica, mixed dielectric and TV electrolytics stocked. – Please see catalogue.

MASTHEAD AMPLIFIERS

Labgear uhf group amplifier complete with mains power unit CM6001/PU. Groups A, B, or C/D please specify **£12.65**

Labgear CM6030 WB vhf/uhf ultra wideband amplifier (channels 1-68). Complete with mains power unit CM6001/PU **£18.95**

Labgear CM6019 WB uhf wideband amplifier (channels 21-68). Complete with mains power unit CM6020/PU **£9.85**

PATTERN GENERATORS

Labgear CM6004/PG giving crosshatch dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays) **£58.80**

Labgear CM6038 DB Pocket size vhf/uhf generator. Outputs as CM6004 PG above but can be used either on mains or battery **£46.60**

COLOUR/BAR GENERATORS

Labgear CM6037/DB: Dual standard band generator gives standard 8 band colour bars + greyscale step wedge + red raster + centre cross + centre dot + crosshatch + dot pattern + blank raster. Sync output also provided **£125.15**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems. Type 6022/RA **£15.90**

OUR NEW CATALOGUE IS AVAILABLE AT 30p (refundable).

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Overseas: At cost.
Please add VAT at 25% on all items except test generators which are at 8%.
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