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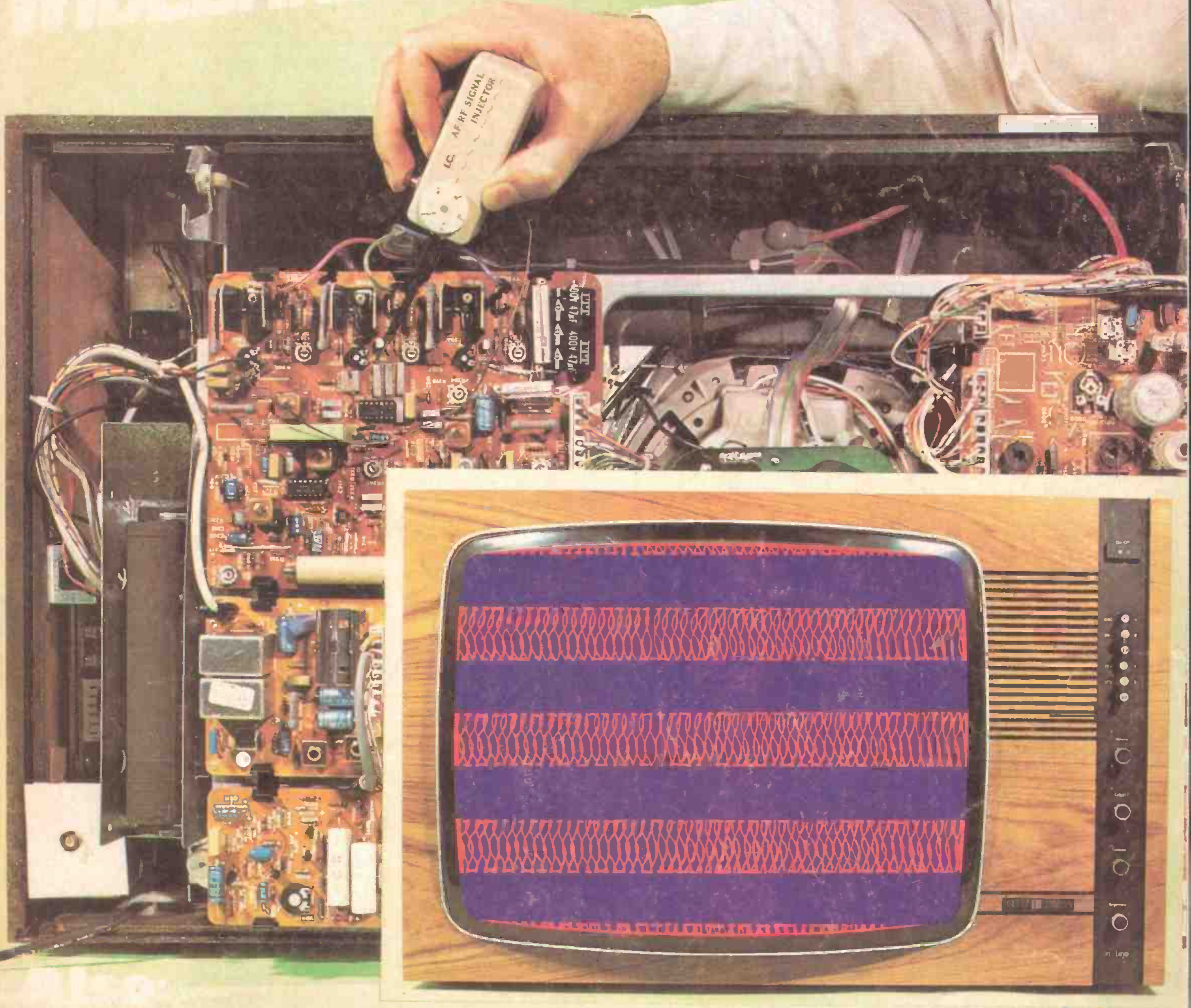

FREQUENCY SYNTHESISED TUNERS
SERVICING THE BAIRD 700 CHASSIS

TELEVISION

June 1977

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All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Fleetway House, Farringdon Street, London EC4A 4AD. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

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TELEVISION

WHAT TO DO WITH TV-4

The Annan Committee's report on the future of broadcasting in the UK has been worth waiting for. Such a large, and unfortunately politically sensitive, subject requiries time for the assessment and consideration of various alternatives and the formulation of proposals for future action. So far as television is concerned of course the main interest lies in what to do with the fourth channel – when we can afford it, that is. Here the Committee has proposed a new organisation, the Open Broadcasting Authority, to operate alongside the BBC and the IBA but, by being given a different brief and method of obtaining programme material, to broaden the scope of TV broadcasting. The idea seems to us to be excellent, despite the loose ends that have been left – in particular the financial arrangements for the new Authority.

The proposals that have emerged from the Committee are very similar in fact to the views reported and commented upon in our January 1976 leader. We don't claim to have a unique crystal ball however: there have been leaks a plenty in the national press and of course the evidence presented to the Committee received wide publicity.

So far as TV broadcasting is concerned, the present arrangement of one ITV channel and two BBC channels would remain largely as at present. The fourth channel would be operated by the Open Broadcasting Authority, which would be funded differently from the BBC and ITV and have different objectives. It would not produce its own programmes but would act as a "publisher", selecting and commissioning programmes from outside sources. Its programmes would fall into three main classes: educational material, programmes made by the ITV companies including ITN (they are said to have plently of talent which doesn't find sufficient outlet in the present set up), and from a variety of independent sources and producers. What better way could there be of going about trying to provide a genuine alternative programme rather than one that merely competes with the other three for as large a chunk of viewers as possible? The present three channels have much too great a likeness to one another. It's certainly not before time to try a fresh approach, although the Committee recognises that it might not be possible to get the OBA going before the 1980s, i.e. until the economic climate is more favourable. Apart from the ghastly name Open Broadcasting Authority, the main problem lies in arranging its financing. Suggestions here include a mixture of direct grants for educational purposes, block advertising, sponsorship, and if necessary a block grant from the government, possibly channelled via the Arts Council. The use of diverse sources of finance should encourage independence, though it could produce some fiendishly tricky problems – who pays for what and so on.

Will the Authority come into existence? This of course is a political problem, and the way things are at present leads one to have considerable doubt. The ITV companies firmly believe that the fourth channel should be theirs, and they are a very strong lobby with a great deal of political weight. Why shouldn't they have the fourth channel? Let's first ask why they should want it so much. If they didn't think they could make money out of it, they wouldn't. Nothing inherently wrong in that of course. But what would they do with it? There is a curious mechanism that operates in commercial publishing and is very relevant here. What happens is that a situation arises where there is more advertising than can be accommodated within say the magazines covering a particular field. The only way of laying your hands on it rather than turning it away is to start up a new magazine in order to mop it up. So you then get the cart before the horse situation of a magazine being concocted because advertising is there rather than because there is any genuine need for it as a service to a particular readership. This is a sure way to the publication of pap: uninspired material that simply aims never to offend. A fourth ITV channel handed over to mop up extra advertising would be the saddest possible solution to the problem of what to do with TV-4. But to try to prevent this happening is likely to be a battle indeed.

teletopics

A FOOTHOLD IN EUROPE

The uproar over the suggestion that Hitachi might be going to establish a colour TV set plant in the UK – now officially denied by Hitachi's UK subsidiary – nevertheless has interesting implications. The news first broke when Lord Thorneycroft, chairman of the Radio Industry Council, wrote a letter of protest to the Industry Minister Eric Varley expressing the industry's "grave concern". With the UK colour TV setmaking capacity well over two million sets a year and deliveries to the home market in 1976 barely in excess of one and a half million sets, alarm is only to be expected at any suggestion of a foreign multinational setting up additional plant here. But what, you may ask, would be the motive for Hitachi considering making such a move in the present depressed conditions? One can only guess of course, but several factors stand out.

The main markets for colour TV sets are the US, Japan and Western Europe. The Japanese have already taken a substantial share of the US market, with a considerable increase in 1976. As briefly reported last month, the US is considering heavy tariff increases on imported sets in order to avoid serious damage to its own domestic TV industry. The proposed increases would take effect over a five year period: the tariff during the first two years would be increased from 5 to 25 per cent, with a further 15 per cent increase over the next two years and a final 10 per cent increase in the final year. Several Japanese TV manufacturers – National Panasonic, Hitachi and Sony – have their own plants in the US and would not therefore be greatly affected. If the tariff increases, in what is the world's largest TV market, do come into effect however Japanese setmakers will be looking hard elsewhere – and that means Western Europe.

National Panasonic and Sony already have TV plants in the UK. There are two good reasons why Hitachi should consider following suit. First because the UK is a member of the EEC. To have an EEC based plant would assure Hitachi of continued access to the W. European market, whose member states may well take a less liberal attitude to imports in the event of an all out export drive by Japanese setmakers. Secondly there is the fact that the UK has become a low-cost centre for production. Several interesting developments bear this out.

There is the announcement for example that the well known importer of audio equipment and radio sets J. Parkar (Binatone) has bought a UK factory which is understood to be producing 1,000 music centres a week, and has done so because British labour is now "much cheaper than Japanese". Then there is the fact that Tandberg are extending their Haddington (near Edinburgh) colour TV plant for exactly the same reason – because UK labour costs are a lot less than Scandinavian costs.

Looked at this way a move by Hitachi to set up plant in the UK despite the existing excess capacity makes sense. It follows a tradition by international electronics firms to set up plants in countries where labour costs are low. It was in the late fifties that major US manufacturers started establishing plants in Japan, and later Taiwan. Subsequently the Japanese themselves started setting up plants in Taiwan and Korea and firms from all over got going in Singapore and Hong Kong. Within Europe, many plants were set up in Portugal and Spain for precisely the same reason.

It would be hasty in the present economic climate to conclude that the UK faces a rosey future as a European electronics manufacturing centre however. Whatever thought Hitachi may have given to setting up a UK base looks decidedly like an exercise in keeping their options open. For the present the home UK colour TV market remains shakey, with little likelihood of improvement over the next twelve months. Last year both Rank and Pye made multi-million pound losses on their colour TV set operations. Exports – the traditional Japanese way of dealing with this problem – remain the only likely way out, but with excess plant in most countries there's no great scope for this and it's not surprising that UK manufacturers show alarm at the prospect of another major Japanese setmaker setting up here.

UK setmakers now have the advantage of low labour costs by international standards – that after all is what the whole exercise of heavily devaluing the pound last year was all about. There is also another plus point (not before time), the increasing success of UK TV setmakers in achieving high reliability rates for their products. Thorn's service manager Ron Murphy, commenting on the closure of Thorn's Glasgow service depot and the staff reduction from 400 to 300 over the last eighteen months at their main Edmonton depot, due to the reduced demand for spares and repairs, says "the fact that has contributed most to this fall in service demand has been the Thorn 9000 chassis, which is undoubtedly comparable to the best of Japanese sets for quality and reliability". We commented some months back on Pye's success with their 713, 731 and related solid-state chassis. The failure rate that Philips have achieved with the latest versions of their G8 chassis is now below 0·2 – one service call every five years. Figures like these are precisely what Japanese manufacturers have been renowned for, and indicate that the latest generation of cool working, solid-state colour chassis are setting new standards.

RUNNING OUT OF CHANNELS

The broadcasting authorities claim that the u.h.f. TV service will be available to 99 per cent of the population of the UK by 1979. Of the remaining 600,000 or so it's estimated that a further 200,000 living in identifiable groups of 500-1,000 could be served by constructing some 270 more very low power transmitters. But the channels available in the UK if co-channel interference is to be avoided are rapidly running out – and there are still a number of stations to be built in the programme up to 1979. The authorities are pressing therefore for additional channels to be made available for TV broadcasting. The present upper limit to Band V is 854MHz, though frequencies up to 960MHz can, under the present international agreements, be used for TV broadcasting. At present they are assigned to other purposes in the UK. What the authorities want is a further group of four channels above 854MHz in order to successfully complete the programme they at present envisage. From the reception point of view there is the problem that u.h.f. tuners are not designed to operate above 854MHz, while to produce modified receivers to meet the limited demand would hardly be economic. The IBA suggests that the only practical solution would be the production of a converter for use with existing sets. This would convert the new channels to channels within the present frequency allocation.

TRANSMITTER NEWS

The BBC's **Arfon** (Gwynedd) BBC-Wales and BBC-2 transmitters are now operating at full power. The BBC comment that viewers using the **Ffestiniog** and **Llandecwy** relay stations will also notice an improvement in picture quality.

The following relay stations are now in operation:

Glaisdale (N. Yorks) BBC-1 channel 40, ITV channel 43 (Tyne Tees Television), BBC-2 channel 46. Receiving aerial group B.

Jedburgh (Roxburgh) ITV channel 41 (Border Television), BBC-2 channel 44, BBC-Scotland channel 51. Receiving aerial group B.

Laxey (Isle of Man) BBC-1 channel 58, ITV channel 61 (Border Television), BBC-2 channel 64. Receiving aerial group C/D.

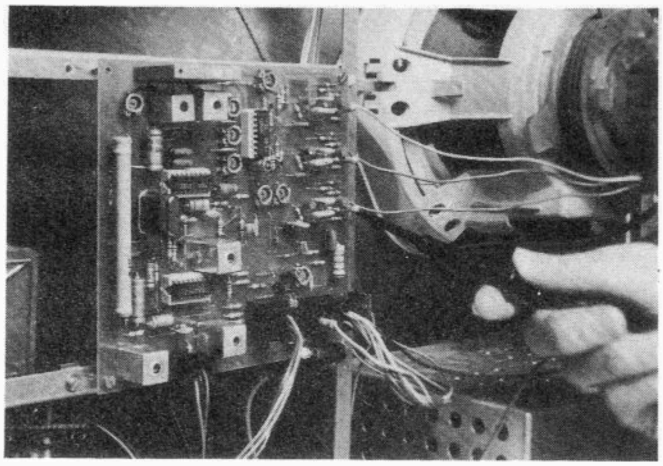
Peel (Isle of Man) BBC-1 channel 40, ITV channel 43 (Border Television), BBC-2 channel 46. Receiving aerial group B.

Rhayader (Powys) ITV channel 23 (HTV Wales), BBC-2 channel 26, BBC-Wales channel 33. Receiving aerial group A.

The above transmissions are all vertically polarised.

UK SATELLITE CHANNEL ALLOCATION

The World Administrative Radio Conference held in Geneva earlier this year produced an agreement and plan for direct satellite broadcasting services in Regions 1 and 2 (most of the world except for the Americas). The frequency band concerned is Band VI (11·7-12·5GHz), which could provide 40 television channels for direct to viewer transmissions in Region 1 (roughly Europe, Africa and the USSR). The agreed plan allocates to each country a number of channels at one or more orbital positions – the satellites would be at 22,300 miles above the Equator in order to rotate in synchronism with the Earth. Each



A prototype decoder panel designed by Mullard engineers, using their latest three-i.c. circuit. The panel also features the new compact Mullard chroma delay line.

channel would provide for an f.m. television transmission with its accompanying sound. The UK's allocation is five channels at orbital position 31°W, and would enable the entire country to receive good quality signals. Remember that 31°W: it's where your s.h.f. aerial will have to be directed! It seems unlikely however that the UK's allocation will be used within the foreseeable future, since the terrestrial service has been so extensively developed. At present the agreement is to have a nominal life of fifteen years from January 1st, 1979.

TELETEXT PROBLEM FOR ITV

So you're sitting there watching your favourite ITV programme on your new set equipped with its Teletext decoder and the ads come on. Jangle, jangle, jangle. . . . What do you do? Traditionally, many people have made the tea, let the cat out, etc. But you now have another option, to switch over briefly to Teletext for the latest news or whatever. Maybe this wasn't foreseen, but the IBA now comment that "a lot of thought is going into it". . . .

NEW SETS

Philips have now announced the first model to be fitted with their new colour chassis, the G11, which is based on the Mullard 20AX in-line gun c.r.t. The model is the 660 and uses the 22in. version of the tube. We plan to publish a more detailed account of this interesting new chassis shortly. It will eventually supersede the current G8 and G9 chassis.

Another first from Nordmende, this time an up-market 26in. colour set which has its own built-in TV games facilities. Ten different games can be played, in colour, and the two hand controls simply plug into sockets at the front of the set. The modular chassis uses an in-line gun c.r.t. and the set is known as the Spectra Teleplay. An electronic rifle is available as an extra. The suggested retail price is in the region £700-800.

DOMESTIC VTR DEAL SOUGHT

Matsushita (National Panasonic) are understood to be engaged in negotiations with RCA in America and Philips in Europe with a view to joint production of their new VX2000 domestic videotape recorder. The VX2000 was launched in June last year and Matsushita claim to have sold 60,000 during 1976. Like Sony (see report last month) Matsushita clearly consider that the domestic v.t.r. market is about to take off.

New Products

'OWNERSHIP COST' CUT ON NEW SCOPE RANGE

A new series of oscilloscopes, including a miniature portable scope, has been introduced by Tektronix UK. The T900 series includes five models: the T921 and T922 single and dual-trace 15MHz instruments, the T923 and T935 dual-trace 35MHz oscilloscopes with single and dual timebases, and the T912 10MHz dual-trace bistable storage oscilloscope.

All models have an 8 × 10cm display and the instruments measure 17·8 × 25·4 × 48·3cm and weigh between 6·8 and 8·2kg. The four non-storage models operate at 12kV e.h.t. with a p.d.a. c.r.t., providing the high brightness required for low repetition rates and high sweep speeds. The storage oscilloscope has a stored writing speed up to 250cm/ms. Prices range from £500 to £1,000 excluding VAT.

The new portable oscilloscope from Telequipment is an extremely compact dual-trace model. The D34 has a 2mV/div maximum sensitivity right up to its 15MHz bandwidth capability. Sweep speed extends to 0·2μs per division and the observation of very fast leading edges is made easier by a built-in vertical signal delay. A ×5 magnifier operates on all horizontal sweep ranges and increases the maximum sweep speed to 40ns/div. Accuracy is ±5% on both voltage and time ranges. It incorporates full triggering facilities including a.c. and TV modes, with automatic selection of field or frame triggering, and an auto free-run facility to provide trace visibility even when there is no signal present. There is a fully variable triggering control which operates over 8 vertical divisions on all waveforms. The dual-trace vertical system provides completely automatic selection of either chopped or alternate modes depending on the sweep speed setting.

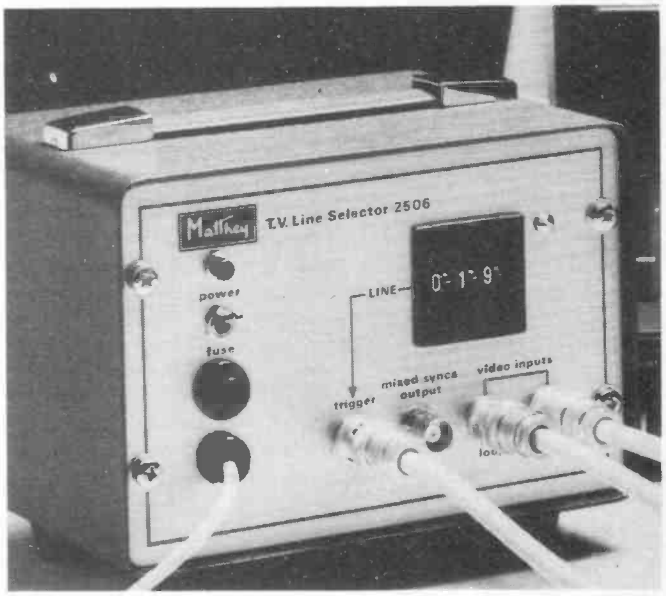
Complete with its internal rechargeable batteries and a built-in trickle charger, the D34 weighs only 12lb.

For further information contact Tektronix UK Ltd., PO Box 69, Beaverton House, Harpenden, Herts. Tel: 058 27 63141.

The Telequipment D34 is one of five new models in the Tektronix range.

LOW-COST LINE SELECTOR

Matthey have introduced a low-cost TV line selector, Model 2506, which enables any line of the TV waveform to be selected and fed to an oscilloscope for display. More details are available from: Matthey Printed Products Ltd., William Clowes Street, Burslem, Stoke-on-Trent, Staffs. ST6 3AT. Tel: 0782 85631.



The new Matthey TV line selector, model 2506.

NEW RANGE OF ITALIAN INSTRUMENTS AVAILABLE IN THE UNITED KINGDOM

Advid Electronics have been appointed the British agents for the complete range of television service equipment manufactured by the Italian Company Start-Unaohm. Only a few of the many items in the Unaohm range have previously been available in the United Kingdom, but most of the 57 units in the range are now being held in stock. The range includes scopes, colour bar generators, field strength meters, signal generators and general purpose multimeters. A brochure giving further details may be obtained from Advid Electronics, 30 Baker Street, London W1M 2DS.

COMPACT SIGNAL INJECTOR

The Puntac "Usijet" is a small, light universal signal injector in the form of a pen. It consists of two signal generators, one operating at a.f. and the other at r.f. The waveform from a blocking oscillator circuit produces a signal with a wide range of harmonics up to 500MHz. The fundamental frequencies are 100Hz and 500kHz, with an output voltage of 20V peak-to-peak. The maximum permissible voltage at the probe tip is 500V d.c. The unit is powered by a self-contained 1·5V cell and the current consumption is 25mA.

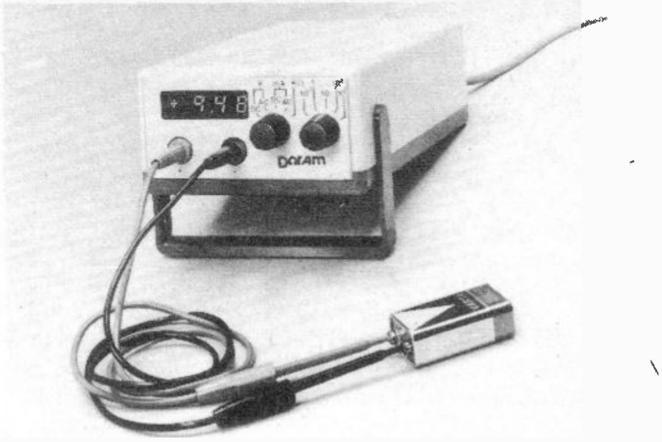
DIGITAL MEASURING INSTRUMENTS FROM DORAM

Doram Electronics has extended its range of constructional kits and the additions should be available from May 1st. Two items of particular interest to *Television* readers are a digital frequency meter kit and a digital multimeter kit.

The frequency meter features a four digit readout and measures from 10Hz to 50MHz in three ranges with an accuracy of ±1Hz. The kit comes complete with case, power supply and full instructions and is priced at £54.50 plus VAT at 8%.

The digital multimeter kit has a 3½ digit LED display, measures voltage from 100μV to 1000V either a.c. or d.c., current from 100μA to 2A, and resistance from 0·1Ω to 2MΩ. Again, the kit comes complete with case, power supply and full instructions and is priced at £54.50 plus 8% VAT.

Further details may be obtained from the distributor Doram Electronics Ltd., PO Box TR8, Wellington Industrial Estate, Wellington Bridge, Leeds LS12 2UF. Tel: Leeds (0532) 452548.



The digital multimeter kit available from Doram, shown here assembled. The order code is A6-347.

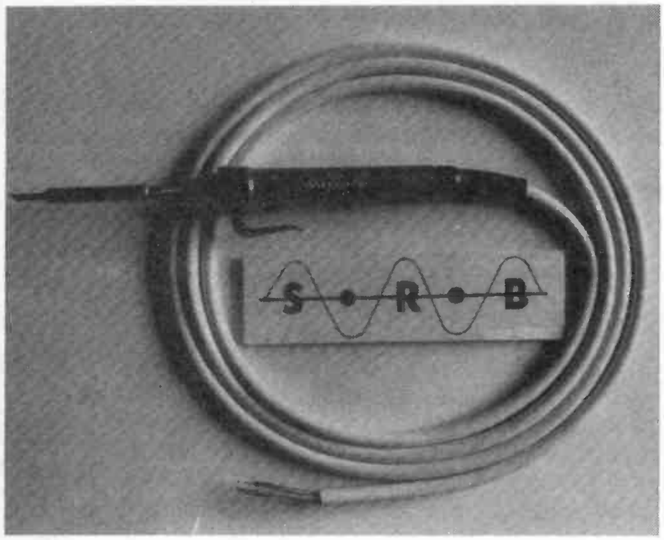
The Doram digital frequency meter shown assembled. The order code for the kit is A6-361.

COMING NEXT MONTH . . .
TV GAMES IN FULL COLOUR

You've seen many games projects in other journals but the project in next month's Television *gives you six TV games in full colour. The single p.c.b. makes construction easy. Despite the simplicity there are many novel features – see page 435 for further details. Don't commit yourself to lesser projects till you've seen ours!*

MINIATURE SOLDERING IRON

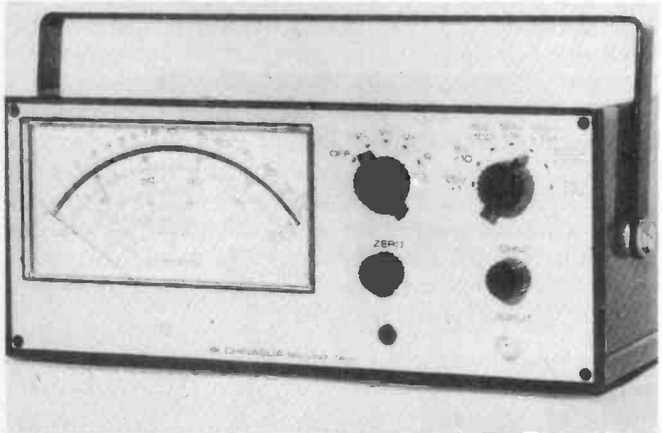
The new S. & R. Brewster lightweight, slimline, miniature soldering iron has a new bit securing method which provides high efficiency heat flow and permits rapid interchange from the standard 3mm bit to alternative 1·5, 4·5 and 6mm bits. All components are easily replaceable. The iron costs £3.24 including VAT plus 20p for postage and packing for orders of less than six. Spare bits are 38p each. Further details are available from the manufacturers, S. & R. Brewster Ltd., 86-88 Union Street, Plymouth PL1 3HG. Tel: 0752 65011.



S. & R. Brewster's miniature soldering iron.

ELECTRONIC MULTIMETER AND POWER MULTIMETER

Alcon Instruments have introduced a new multimeter, the Chinaglia VTVM 2002, which is particularly suited to electronic servicing and similar applications. The wide 100° mirror-scale movement displays 21 ranges with an input impedance of 22MΩ on d.c. and 1MΩ shunted by 30pF on a.c. It can display d.c. volts, peak or r.m.s. a.c. volts, power in dB and resistance in ohms. Accuracy is ±2·5% on the d.c. and resistance ranges and 3·5% on a.c. The frequency range is 25Hz to 100kHz ±1dB and can be extended to 250MHz by using an optional r.f. probe. The resistance ranges are from 0·2Ω to 100MΩ and the unit is mains powered. There is an optional high-voltage probe extending the upper voltage range to 30kV. Price, complete with leads and instructions, is £98.60 including VAT, postage and packing. Alcon Instruments Ltd., 19 Mulberry Walk, London SW3 6DZ. Tel: 01-352 1897.



The 21-range Chinaglia multimeter, available from Alcon Instruments.

TWO NEWCOMERS FROM AVO

Two new pocket sized multimeters have been announced by AVO. Model 71 is a 21-range instrument measuring, with an accuracy of ±2·5%, up to 1kV on both the a.c. and d.c. ranges and current up to 1A d.c.. Resistances up to 20MΩ can be measured over three ranges, using the self-contained batteries. The sensitivity is 20kΩ/V d.c. and 1kΩ/V a.c., and the instrument features a robust centre pole movement and fuse protection.

The other newcomer is a model capable of measuring up to 750V f.s.d. and up to 3A f.s.d. on both a.c. and d.c. ranges. Resistances up to 20MΩ can be measured using the self-contained batteries. Sensitivity is 20kΩ/V on d.c. and 2kΩ/V on a.c. Accuracy is ±2·5% on all d.c. voltage and current ranges, and operation is maintained up to 75kHz. The full mains voltage can be applied on any range for up to 10 seconds without damage. The instrument is priced at £24.10 plus VAT and includes a set of leads and clips. Optional accessories include a carrying case, a 30kV d.c. probe and plug-in current shunts.

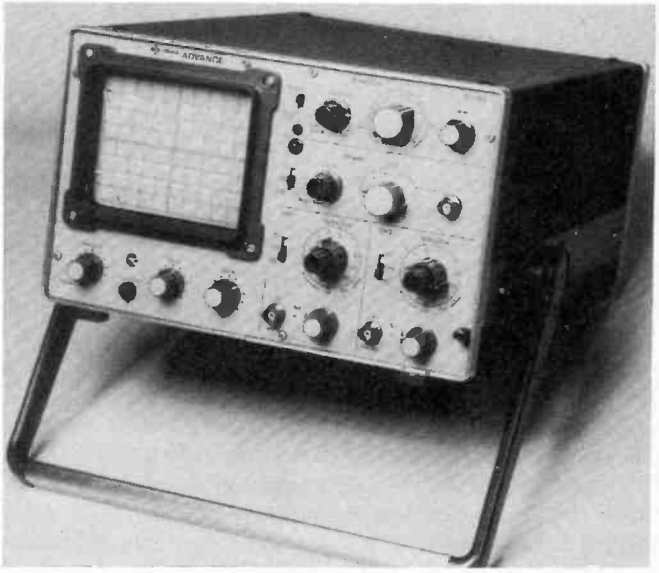
Further details may be obtained from AVO Ltd., Archcliffe Road, Dover, Kent CT17 9EN.

TWO DUAL-TRACE SCOPES FROM GOULD ADVANCE

Gould Advance have introduced two more dual-trace oscilloscopes. The OS260 15MHz oscilloscope uses a 10kV high-brightness split-beam tube. The sensitivity is 5mV/cm – 20V/cm, selected in a 1:2:5 sequence, and the use of a fine-gain control gives a 2·5:1 increase in gain from the switched calibrator position giving a maximum sensitivity of 2mV/cm. Maximum speed is 50ns/cm, achieved by using the × 10 expansion on the 0·5μs/cm – 0·2s/cm timebase. The tube display measures 10 × 8cm, with an illuminated graticule.

The OS3000A is a dual-trace 40MHz oscilloscope with sensitivity from 5mV/cm to 20V/cm and a × 5 facility giving 1mV/cm between d.c. and 10MHz. Timebase speeds can be as high as 20ns/cm. The 8 × 10cm rectangular-faced c.r.t. runs at 10kV with an illuminated graticule. P31 phosphor is standard, and P7 is optional. The instrument weighs 12kg.

Further information is available from Gould Advance Ltd., Roebuck Road, Hainault, Essex IG6 3UE. Tel: 01-500 1000.



The 15MHz OS260 scope from Gould Advance.

When You Meet a Stranger . . .

Les Lawry-Johns

DEALING with colour sets you've either sold or serviced regularly is one thing. Dealing with a colour set you've not seen before is a different kettle of fish altogether and requires a different approach – particularly if it's getting on a bit. You might say it's much the same thing as buying a second-hand colour set, which is true except for the economic factor. It's one thing to buy a used set and go through it from stem to stern to restore it, with loving kindness, to its original condition – if nothing else in order to obtain a good deal of job satisfaction from doing this. When one is presented with a strange set purely as a quick servicing job however, probably with a ceiling price of a few pounds, a different problem emerges. It's one which has given us pause for thought on many occasions, and no doubt will, or has, you.

There are two viewpoints to consider. The set owner or customer – if you're not the owner – whose primary considerations are to get the set back into working order as quickly as possible and at the least possible cost. And yours, if you're the repairer, whose primary considerations are to get the set working properly as quickly as possible with no come backs and hopefully to show a small profit on the deal. Unfortunately, meeting all these considerations is only rarely possible, so some compromise has to be reached. In reaching this compromise one has to consider a couple more points.

If you succeed in pleasing the customer you will almost certainly meet the set again. Therefore the initial repair should be carried out bearing in mind that it is going to be your baby from now on. But do you want this particular baby?

If you do it may be as well to suffer some initial loss of time and money so that you can service it efficiently and profitably at a later date and obtain a regular customer with probably their word of mouth recommendation to their friends and relatives . . . which may or may not be a good thing.

It's absolutely astounding what some people will look at in the name of colour television and what they consider an acceptable picture. They'll continue to look at a frightful jumble of images on the screen, and only cease to do so when the thing fails completely.

So when it's presented to you the owner has the viewpoint that "the picture valve has gone" or "a wire has come off", and you have the problem of what to do and what to leave undone.

A Case in Point

This was brought home to us most forcibly only the other day. We were asked to call to see a Bush Model CTV182S. The complaint was that the picture had failed, leaving the sound normal. Now this could be due to almost anything, so bearing in mind the fact that we hadn't seen this particular set before and that time was limited we packed our bags with care, leaving out only the kitchen sink. Pondering for a moment, we put the kitchen sink in just in case and started off.

On the way we also pondered upon another aspect. Here we were, driving an expensive vehicle loaded with expensive gear to enable us to deal with almost any contingency, all of which had to be paid for in advance and with a great deal of thought from an ordering point of view, so as to satisfy someone who would probably say to another someone "They don't half know how to charge nowadays, they want four quid just to set foot over the doorstep".

Dismissing these dismal thoughts, we set foot over the appropriate doorstep and confronted the Bush colour set. It wasn't a burning Bush by the way, and it wasn't up a mountain either. Switching on confirmed that the sound was in order. But there was no sign of e.h.t. (no friendly rustle when the set was switched on). A quick check revealed that most supplies were in order – 200V at the h.t. fuse, with most of the l.t. lines intact. There was no 20V supply to the scan drive panel however, due to the 6·8Ω feed resistor 8R2 being open-circuit – quite a common one this, with no contributory cause.

Replacing 8R2 restored a picture. But what a picture. Lacking an inch either side, colours anything but right, convergence a mile out. "Oh that's lovely dear", said the lady of the house. "That, madam, is not strictly true", we said bitterly. "The colours may be lovely but they're not where or what they should be."

This was to put it mildly, but we had no desire to spend an hour or more doing things we hadn't been asked to to. So we tweeked up the convergence and left the reds pink and the blues mauve. Cowardly? No, just prudent.

Sets Brought In

Similar sorts of things occur regularly with sets brought into the shop. The proud owner will loudly proclaim that his set has never given a spot of bother and that only now has a fuse or something gone. When you have painstakingly put together the upper right side power supply panel (GEC 2028 series) in order to get the set working you may find a dull, poorly defined picture of a pinky green hue when it should be black and white, changing to mauve as the brightness is advanced. Any attempt to set up the grey scale is doomed to failure from the outset and tuning in a colour transmission is a laugh.

"That picture was perfect before it went off", maintains the owner. "Well it wants a new tube for a start, and then a lot of work done on it after that", you confide. "No, I'll take it as it is: it suits me and the missus."

The Basic Problem

So there it is. This is what you may well come across when you meet a stranger. Better the devil you know. . . .

Having accepted this truism, the basic problem remains.

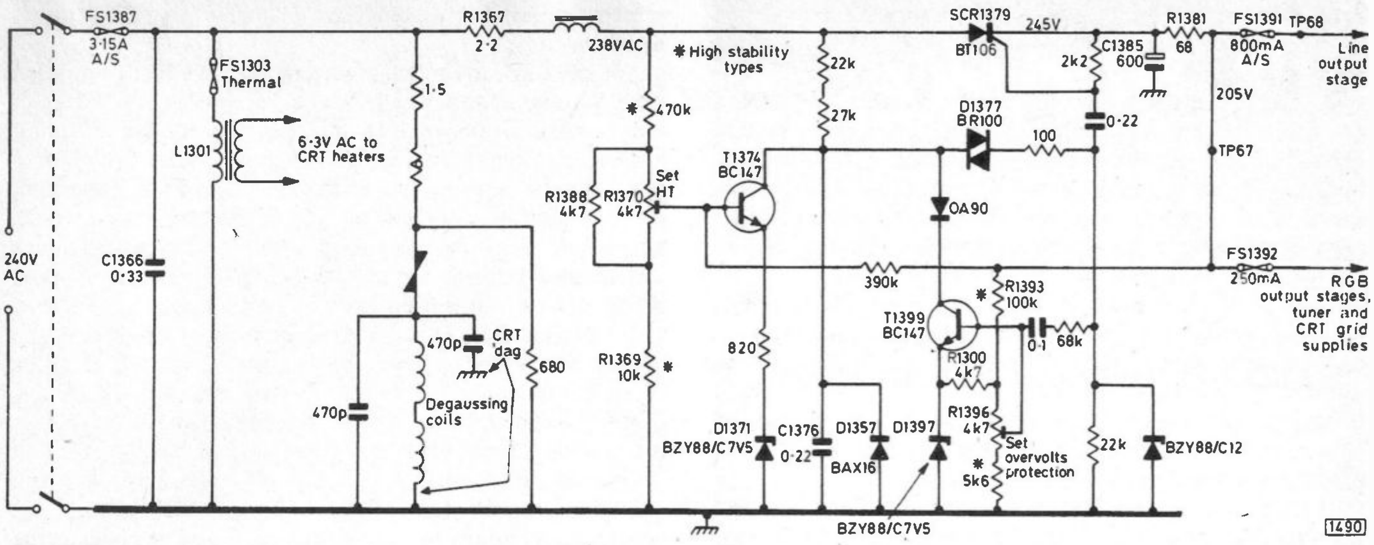


Fig. 1: Power supply circuit, recent version. There have been several modifications during production.

If the cards are stacked against you but you don't want to throw your hand in, take another close look at the cards you have.

In the first place, the customer probably doesn't expect perfection and, in spite of all the work which should be done, he probably wouldn't appreciate it because money is usually (not always) the paramount consideration.

In the second place, you may have one or two good cards, not the least of which is experience. You've probably met the type of set before, and have a pretty good idea of what the stock faults are. This is probably your ace in the hole. If the set wants a lot of faults put right it's almost certainly old enough for the stock faults to be tabulated in your mind – or if you have time you could look up the relevant write up on the particular model in a past issue of *Television.*

Some Examples

We haven't had many articles on the Philips G8 chassis, so let's imagine that one comes in, or you go out to it, the complaint being that it's not working at all – this is the most common complaint.

Your first action should be to remove the back cover and the lower left side plug, and lift the paper cover to expose the mains fuse (3·15A anti-surge). If this is clean and intact the trouble is probably due to an open-circuit dropper (front left) which has two sections, R1367 and R1381 (see Fig. 1). The lower section is wound with heavy wire and has a value of 2·2Ω. This is the surge limiter and it doesn't often fail. If it's in order the supply to the thyristor (SCR1379), which may be a BT106 or an alternative, is intact and a pretty high d.c. will be found at the cathode (reservoir capacitor C1385 charged, so look out because it packs a powerful wallop which has nowhere to go if the next assumption is correct). In all probability there will be no such voltage at the two rear edge fuses, and if this is so the 68Ω upper dropper section is open-circuit. This is an extremely common fault. Your first action must be to discharge the reservoir capacitor in compliance with the rules of the society for the prevention of cruelty to service engineers. A fully charged 600μF electrolytic is a fearsome weapon which must be treated with respect. Discharge it with any convenient wirewound resistor, having first switched the set off of course.

With these things done you can afford the luxury of examining the dropper. It will probably have a distinct mark on it to show where the fracture is. Incidentally, this is often the cause of intermittent operation, where the set sometimes works for hours at a time and at others it appears to be as

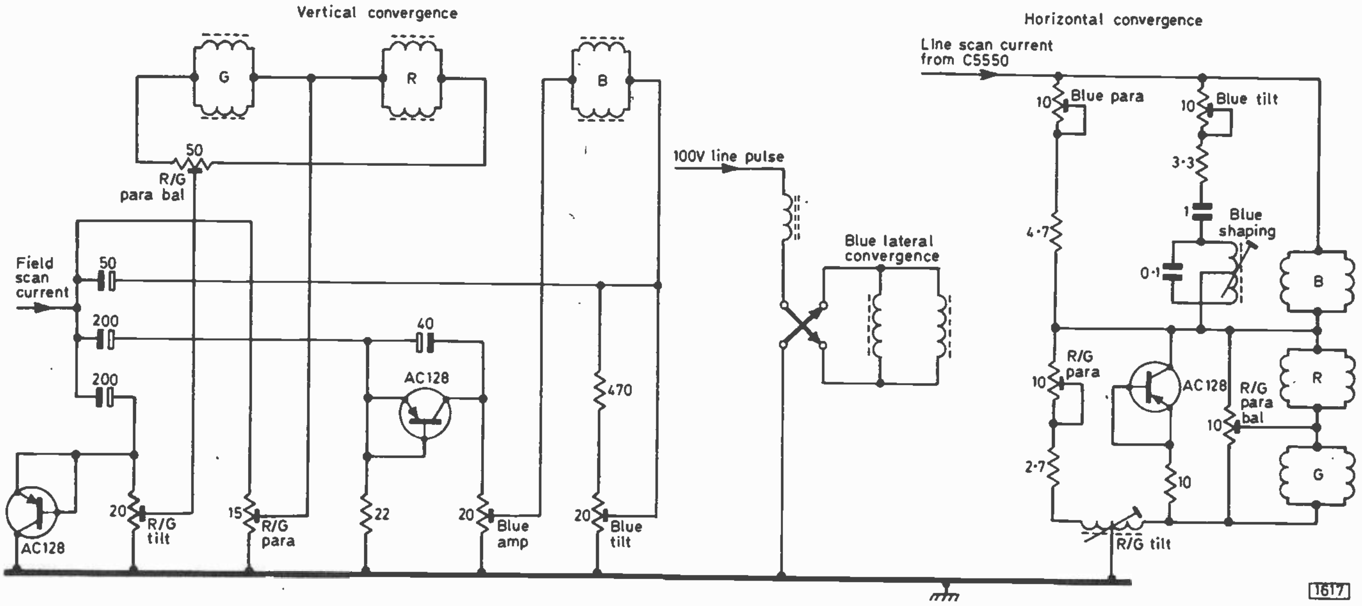


Fig. 2: The convergence circuits. There have been several modifications during production.

dead as a bottle of light ale with a leaky top. Sometimes you may be lucky enough to see a pretty little bright spark at the point of fracture.

Anyway, either you have the correct replacement at hand or as a temporary expedient you can disconnect the section and fit two 33Ω RS dropper sections in series. These are the thick ones with a rating of 0·7A, so they are well within specification. We say these items because they are the ones most likely to be in the spares kit, also because they do the job well.

Now: having restored the supply, your next action must be to ensure that it is correct. The voltage at the two fuses on the rear edge of the upper left panel should be 205V – no more. If it is set (by R1370) too low, all sorts of funny things can show up. Not only lack of width, as you would expect, but also some pretty weird effects too numerous to describe and varying with individual sets.

Having made sure that the voltage is right you are permitted to look at the picture. If you are lucky it may need only a few fine touches to produce a good black and white picture with the colour off, and if this is so the chances are that when the colour is turned up everything will be fine. If this is a stranger however it is equally on the cards that at least part of the convergence procedure will have to be carried out in order to achieve acceptable results. We mention convergence in particular because this is the thing that's most often found to be way out yet not mentioned by the customer. In all probability only a few tweeks on the right controls may be needed, but there are times when no amount of adjustment will produce an acceptable picture.

In such cases you can save a lot of time and patience by checking a few items on the convergence panel. There are three AC128 transistors and four small electrolytics on this particular panel (see Fig. 2). Disconnect each and check it with an ohmmeter. Very roughly you could say that the suspects are the ones nearest the controls which will not come into line. It can save a lot of time if you check the lot plus the controls themselves however – this can be done quite quickly. Faulty electrolytics on the convergence panel are more common than one may think, possibly because they are often ignored.

Blown Fuse

Now let's go back to that 3·15A input fuse (FS1387). Say it's not clean. Say it's a nasty black colour. Here you take a different course. First check the other fuses to make sure that some joker has not put a heavier fuse in a position where it is clearly marked, say, 800mA. Remember that you haven't seen this set before, so you can't take chances. If they are all correct, the cause of the blow out is almost certainly a shorted thyristor or a shorted mains filter capacitor (C1366). Check the thyristor first. If it's at fault there will probably be a short from its anode (body on a BT106) to its cathode (the longer prong). If the thyristor is in order and there are no other obvious shorts it is reasonable to suspect the large blue and white or plain blue filter capacitor which is wired on the reverse side of the input fuse panel.

Worn Tube

Having restored the set to an operating condition, what might we find this time? Remember the set was in working order before it failed altogether, therefore the sound is most probably in order and some sort of picture must be on the screen – and in this instance we'll consider that the set may be of any make.

We have already mentioned some of the effects of a worn tube. Wrong colours which can be put right at one setting of the brilliance control but change due to the differing emissions of the three guns. In addition, one or two colours may spread out as the brilliance control is advanced, making good convergence an impossible task. Even worse, one colour may be present at only the lowest brilliance setting, not responding as the control is advanced even though the tube base voltages may be spot on.

To clarify this, let's say that at normal brightness the picture consists of only two basic colours, say red and blue to make magenta, or purple as the majority of people describe it, green being absent. Turning down the brightness may restore a faint vestige of green, and turning the red and blue first anode supply switches off may leave a green background with faint flyback lines which cannot be controlled by adjusting the brightness. If you've checked the tube base voltages, the answer can be only an open-circuit electrode in the tube.

Back to the G8

Returning to the G8 chassis, let's assume that the complaint is one of no picture and no sound but the tube heaters are glowing. This means the input fuse is intact. The fuses on the power unit may all be intact, but it may well be that the 800mA fuse (FS5557) on the right side line scan panel has blown.

In this case we must proceed with caution. Disconnect whatever can be done without. The first and most obvious choice is the tripler, which needs only to be pulled off the nipple on the line output transformer. Indeed you may hit the bullseye first time. The tripler is often the cause of the fuse on the line scan panel failing, but often it isn't. It's worthwhile checking the two line output transistors (see Fig. 3) on a meter in the usual way (for collector to emitter shorts etc.) Also make a quick check on the diodes and their attendant electrolytics.

One would normally do these things of course but one item which is often overlooked is the pincushion correction transductor (T4485). This is on the right side of the lower right side timebase unit, and appears to be a small transformer with three separate windings. It could well look a little poorly, with little bubbles of discoloration on one or more of its windings. If there is doubt, merely pulling out the red plug H – from the line scan unit to the timebase panel – will prove the point as the set may then function quite well without the transductor being in circuit. This happens not nearly so often as say defective line output transistors, a defective tripler and the like, but it's worth bearing in mind. So removing plug H is an essential part of the "clearing the decks operation" when checking for shorts which have blown the fuse on the line scan unit.

Another defect which may be obvious after the original complaint has been cleared is lack of width. Be careful with this one, because it can hang round your neck like a stone. You've already checked the supply voltage as part of the initial operation (haven't you?). Therefore your trouble is almost certainly on the line scan unit, although the line oscillator components are on the lower right timebase panel. If you have a spare line scan unit it is only a matter of plugging this in to prove the point, and this action will almost certainly restore full width and leave you with the problem: what to do, what to do?

It is a fairly easy job to replace the line output transistors, and whether these are BU105, BU204 or BU205 types we

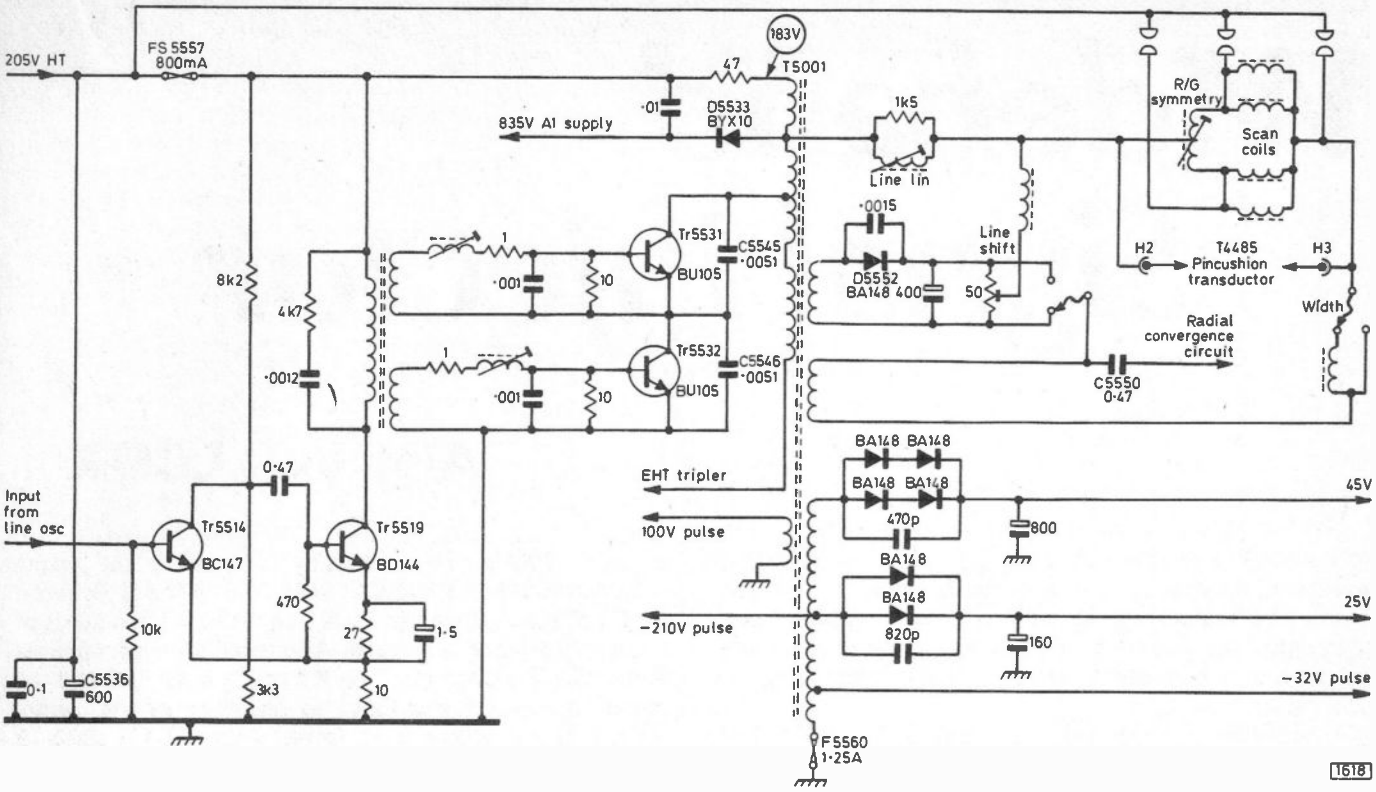


Fig. 3: The trigger amplifier (Tr5514), driver (Tr5519) and line output stages. The beam limiter circuit is also mounted on the line scan panel but is not shown here. There have been several production modifications.

keep 2SC643A types in stock since they replace all these and a few others and so are very handy transistors to have around. But it's quite likely that the transistors are not at fault. You can check the capacitors, and the trigger amplifier and driver transistors, but by this time it will be sinking in that the culprit is that thing on the rear end with all the windings on it. Yes, just one shorted turn is all you need to cause the transistors to pass excessive current and dampen things down a bit. Now tell the customer how much that nice simple job is going to cost.

Colour Drop-out

One of the habits of the G8 is for the colour to disappear suddenly after several hours of faultless performance. This can be very irritating and time consuming since it won't happen (probably) when the back cover is off. It can be due to a lot of things, and we don't propose to list them here. What we do propose is that you hare off out and get yourself one of those small hand-held hairdryers with a narrow nozzle on the end to concentrate the heat on to one particular area. With this in one hand and your aerosol freezer in the other, heat up the area of can 008 which is next to the CAQ370 crystal, to the left of the luminance delay line (see circuit, Fig. 4). If this causes the colour to drop out just check the setting of the core of 008: half a turn may restore the colour no matter how much heat and freezing is applied. You may need a new crystal or maybe any number of other things, but it's worth checking the core first to save an awful lot of time and frustration.

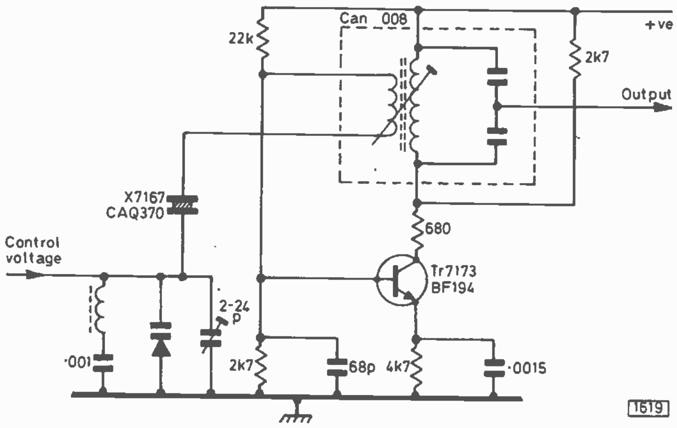


Fig. 4: Decoder reference oscillator circuit.

It Didn't Do That Before!

Talking about frustration, say you've been called in to do a job and this has involved swinging up the chassis and lowering the side supports to prop it into the service position. You've done the job you were asked to do, so you lower the chassis down and switch on with a satisfied smirk on your face. Maybe the picture does come on in glorious colour, but the sound which was perfect before isn't there any more. "The sound was all right before you came" says the lady of the house, and so it was. The point is that all too often a potential sound fault has existed ever since the set was new, but it just needed you swinging up the chassis to show it up.

It may be only a loose fitting sound output plug and socket (follow speaker leads to the front end), but it could well be a joint which was never soldered properly in the first place. A prime source is the intercarrier sound i.c. which in the earlier models was of the round variety (TAA570). Time after time we have found one leg improperly soldered, just lurking there waiting for you to be the one to disturb it.

Mind you, things like this can happen all over the place and needn't concern the sound. If it's difficult to trace, a little judicious tapping around will often reveal the source of the dry-joint or whatever and temporarily restore what was missing, be it a primary colour, line hold or what have you.

This is the sort of thing that can happen when you have dealings with a stranger. So be warned!

Wideband Signal Injector

Alan WILLCOX

ALTHOUGH there is no substitute for a good signal generator, nevertheless in cases where there is complete failure of a signal stage in a TV receiver a signal injector which provides a whole band of frequencies simultaneously can be a very convenient means of rapidly identifying the faulty stage.

Traditionally, simple signal injectors have consisted of just a square wave a.f. oscillator – a.f. because of the need to test audio stages, and square wave so that the harmonic frequencies due to the steep sided waveform will cover the wide range of frequencies used in television. Although this type of instrument is quite useful, the pattern on the TV screen is sometimes ambiguous and leaves a lot to be desired, particularly at low levels.

The instrument described here produces a definite pattern of horizontal bars on the screen by using an r.f. signal which is 100% modulated at a.f. Although the r.f. signal itself is fixed at about 1MHz it has a very irregular waveform, and in consequence has component frequencies covering a wide range. These component frequencies, or harmonics, enable the instrument to be used in every signal stage of the TV receiver, whilst the a.f. component is operational in the audio sections. An attenuator is also incorporated to increase the versatility of the instrument.

The circuit consists basically of two timer i.c.s. IC1 (Fig. 1) is connected so as to operate as an a.f. oscillator running at about 300Hz. The frequency is fixed by the timing components R1, R2 and C1. When the circuit is switched on, C1 proceeds to charge via R1 and R2 until two thirds of the supply voltage is reached. At this point the i.c. changes state and C1 is discharged via R2 through pin 7. When the voltage across C1 has fallen to one third of the supply voltage the i.c. returns to its former state and C1 starts to charge again. The cycle continues at a rate given by the formula $f = 1/0{\cdot}7(R1 + R2)C1$, (approximately 300Hz in this case).

On every half cycle, pin 1 of the i.c. is switched to pin 3. A supply is therefore provided for IC2 on these half cycles. IC2 now functions as an r.f. oscillator – and must be one of the simplest that could be devised. Although it is connected in the same astable mode as IC1, the timing resistor between pins 6 and 7 has been replaced by a direct connection and the timing capacitor is absent. It must still oscillate however because it is so connected that it has no stable state. The result is that oscillation takes place at a frequency limited by the internal resistance and capacitance of the i.c. This frequency will vary somewhat from one i.c. to another, but will be typically around 1MHz. As previously pointed out, the output waveform is very irregular and is thus rich in harmonics. This ensures that there is sufficient energy to give a good output regardless of where in the receiver the signal is injected.

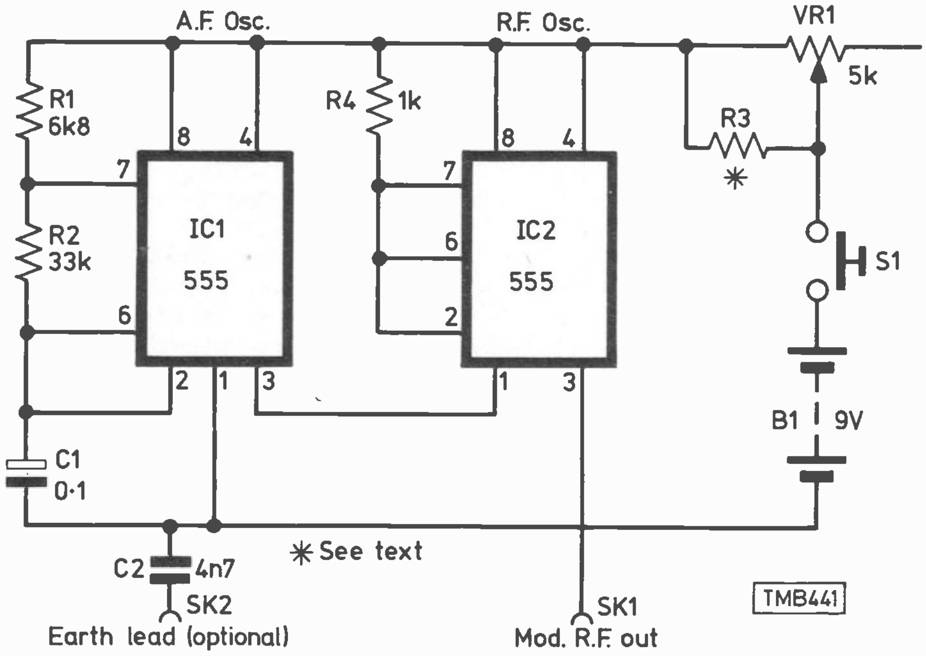


Fig. 1: Circuit diagram of the unit. It is recommended that the timers are type LM555 and not NE555. The latter tend to give a rather narrow pulse which is not particularly suited to this application.

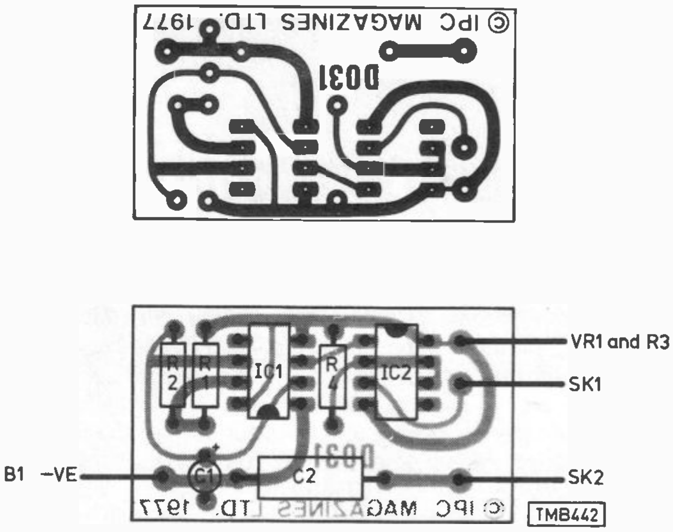


Fig. 2: Printed circuit board details (top) and component location diagram. The board is available from the Television Readers PCB Services Ltd.

Attenuator

An instrument such as this needs some means of reducing the output – otherwise with a strong signal it is difficult to decide whether or not a particular stage is providing any gain. The attenuator VR1 works simply by reducing the supply voltage to the circuit and hence the amplitude of oscillations. This method is simpler and more effective than trying to attenuate the output directly. It has the disadvantage of varying the frequency slightly, but this is unimportant in the present application.

Construction

The circuit is built on to a printed circuit board 1" x 1·8" in size, and housed in a small diecast box. Construction should not present any problems whatsoever to the average constructor. Although a sub-miniature potentiometer was used for the attenuator control these are not so readily available in linear versions as are the larger types, but there is ample space in the case specified for larger types such as the R.S. Components midget range.

If the attenuator works out in practice to be too effective, reducing the signal to zero before the end of the control is reached, the potentiometer can be bridged by a fixed resistor (R3 in Fig. 1) of 6·8kΩ to 15kΩ. A 3·5mm jack socket was used to support the probe which was built into a jack plug body.

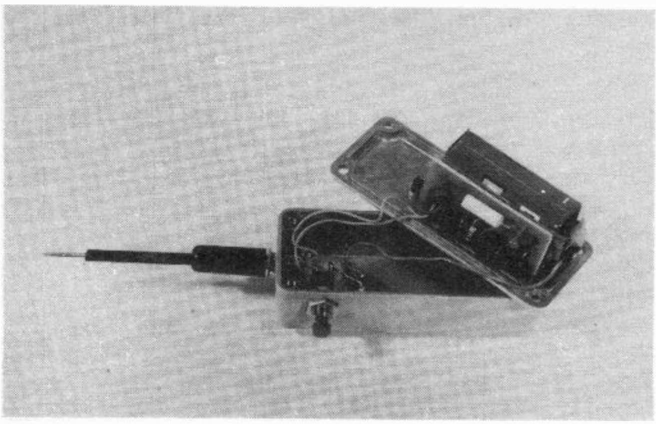


Fig. 3: The instrument with its cover removed showing general construction.

Using the instrument

When checking whether a particular stage of the receiver is providing gain it is good policy to inject the signal first at the output of the stage and reduce the signal to a low level, then transfer the signal to the input of the stage and check whether there is an increase in monitored output.

Most of the time when the injector is in use there is no need for an earth lead connection to the receiver chassis. The chassis connection may be required in the output stages in order to give a good output.

★Components list

Resistors: (all ¼W, 5%)
R1 6k8
R2 33k
R3 see text
R4 1k
VR1 5k lin. midget potentiometer

Capacitors:
C1 100n 35V tantalum bead
C2 4n7 400V polyester

Semiconductors:
IC1, IC2 LM555 (It is preferable *not* to use the more common NE555 in IC2 position).

Miscellaneous:
Diecast box, 89 × 30 × 35mm
S1 push-to-make switch
PP3 battery
3·5mm jack plug and socket
Printed circuit board reference D031.

Service Notebook

G.R. WILDING

Incorrect Aerials

The first problem with a Bush colour receiver we were called to see was simply no results. It was noticed that there was a momentary buzz from the mains transformer when the set was first switched on, so obviously the mains fuse was intact. The next step was to check the h.t. and l.t. fuses, the latter in the a.c. feed from the transformer to the bridge rectifier. Both fuses were intact, but as the audio section and the line oscillator/driver stages are fed from the l.t. supply it was clear that the complete loss of sound and raster was due to a fault here. There was zero d.c. at any of the l.t. smoothing resistor/capacitor networks, so it seemed likely that one of the diodes in the bridge was open-circuit. This proved to be the case, but on fitting a replacement and connecting up again the picture was only fair, with weak field lock. The sound was o.k.

Readjusting the field hold control was tried, but the tendency to slip with camera changes continued. The set was tuned to the local BBC-1 channel but on changing to ITV there was perfect field lock, though the picture was slightly more grainy. BBC-2 wasn't transmitting at the time. In this location most viewers tune in to the low-power relay transmitter put into service a couple of years ago, though due to the hilly terrain many viewers still get best results from the high-power transmitter almost thirty miles away. The relay transmitter requires a group C aerial whereas the high-power one requires a group A aerial. In cases where a set was installed before the relay transmitter came into service we always check that the push-buttons are tuned to the best signal – usually the local one. In this case however we found that the weakly locking BBC-1 signal was coming from the local station while the perfectly locked ITV signal was coming from the main station. The latter signal was rather grainy, but completely free of the faint ghosting apparent on the local transmission. A quick look outside revealed that the aerial was a group A type. On replacing it with a group C aerial and carefully aligning this, really first class results were obtained from the local relay.

On another occasion we were called to service a second-hand set fitted with the Thorn 1400 chassis. This set was fed from a high-gain outdoor aerial which had been supplied with the set. Reception on BBC-1 and ITV was good but BBC-2 was virtually unwatchable. The cause again was the use of a group A aerial instead of a group C one.

The use of incorrect aerials can also cause an effect comparable to ringing in a video or luminance circuit, while if the aerial favours the sound channel of one or more of the transmissions the result can be sound-on-vision effects. Sometimes one can get away with using the wrong type of aerial, but generally an incorrect aerial will result in wide disparity between the strengths of the signals delivered to the receiver on the three channels and can introduce visible ringing effects.

No Colour

A Decca Model CS2030 (30 series hybrid chassis) gave a perfect monochrome picture but no colour. The first step was to check the voltage at test point TP206, i.e. at the collector of the colour-killer transistor. When operating normally on a colour transmission this transistor is saturated so that its emitter and collector voltages should be approximately the same at around 20V – it's a pnp type with its emitter connected directly to the l.t. rail. As expected there was zero voltage, so the next step was to over-ride the colour-killer by shorting across between TP206 and the adjacent test point TP205 which is connected to the l.t. rail. This action produced colour noise and a few half inch wide yellowish bars spaced about two inches apart across the screen, indicating that the chrominance channel was operative and that the reference oscillator was working, though well away from its correct frequency. As in so many decoders, a d.c. amplifier is present between the burst detector and the reference oscillator, the burst ripple appearing at the collector of this d.c. amplifier being taken to the ident amplifier stage whose output, in addition to being used to synchronise the PAL switching, is rectified to operate the colour-killer circuit. Since this d.c. amplifier is common to the two faults found – no colour and the reference oscillator being off frequency – the next obvious step was to check the voltages in this stage. The normal working collector voltage is 10V, though due to varicap diode and crystal tolerances in the reference oscillator circuit it can range between extremes of 5-15V. It was found to be only about 1·5V however, while the base voltage was considerably above the correct figure of 0·5V. The likelihoods were a fault in the preceding burst detector circuit, a defective resistor, or the transistor itself being faulty. The burst detector diodes were in order, though it's worth mentioning that since the leads seemed to be coated with an invisible insulating material it was necessary to check them from the print side of the board. The resistors all looked new, so the next step was to replace the transistor. This restored normal results – after readjusting the burst detector balance control – and on test the transistor was found to have a collector-base leak. Even a very slight collector-base leak has a major effect on a transistor connected in the common-emitter mode, since the leakage current gives rise to a very heavy collector current.

Field Collapse

Apart from the PCL805 field timebase valve the most common cause of field collapse in the ITT CVC5 series of receivers is simply that the diode in the triode section's cathode lead (see Fig. 1) is open-circuit – when it goes short-circuit, as it does quite often, there is complete lack of field lock since the sync pulses are then shorted out. In one of these sets suffering from field collapse changing the valve and shorting out the diode produced no effect, so the next step was to check voltages. Roughly normal voltages were present at the anode and screen grid of the pentode, so we moved on to the triode anode. This section of the valve is self-biased by grid rectification. If there is no oscillation there is nothing to rectify, so the anode voltage will

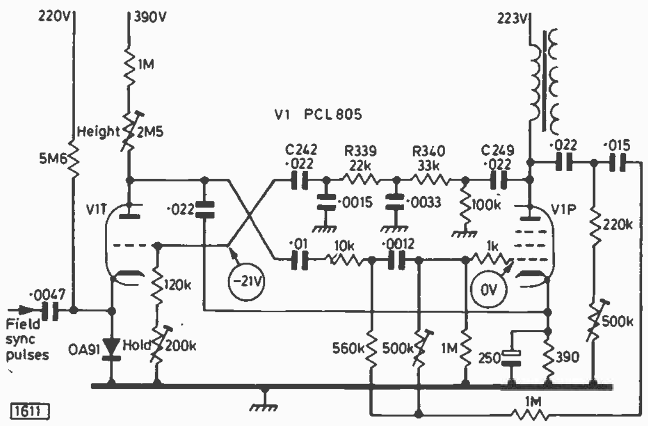


Fig. 1: The cross-coupling networks between the triode and pentode sections of the PCL805 valve which forms the field timebase in the ITT CVC5 and related chassis. The OA91 diode is a common cause of field collapse or no field sync.

inevitably be incorrect. As expected, the anode voltage was low, but even more important was the fact that contacting this point with the test probe resulted in a definite though small movement of the displayed line. The grid voltage was zero instead of –21V, proving lack of oscillation. We then switched the meter to the ohms range and the small voltage thus applied to the grid produced a momentary movement of the horizontal white line.

The triode and pentode sections of the valve are connected as a multivibrator, with *RC* coupling between the two anodes and control grids. The tests so far had shown that both sections of the valve were capable of amplification and that the coupling between the triode anode and the pentode control grid was intact. Suspicion was directed therefore on the coupling between the pentode anode and the triode grid – via C249, R340, R339 and C242. The resistors were quickly found to be o.k., so the next move was to try shunting each of the capacitors in turn. A full raster was obtained on bridging C242, and the triode then developed its normal negative grid voltage while the pentode's control grid remained at the correct figure of 0V. Why this disparity?

The pentode section acts as an amplifier during the forward scan, when the triode is cut off by its negative grid voltage. This voltage is produced by grid rectification when the positive-going pulse fed back from the pentode anode drives the triode into saturation: the grid current which then flows results in a negative charge being developed across C242. When the triode is driven to saturation its grid and cathode act as a diode. Since the cathode is only about 0·6V above chassis potential it's easy to drive it fully on. In the case of the pentode however the flow of current through its 390Ω cathode resistor results in its cathode being at 20V above chassis potential. Its control grid is always effectively at –20V with respect to the cathode therefore, and the cathode and grid fail to operate as a diode.

Faulty Scan Coils

The problem with a Thorn monochrome set fitted with the 1400 dual-standard chassis was no raster due to lack of e.h.t. – only the weakest suggestion of a spark was obtainable at the anode of the PL504 line output valve. As this valve was running hotter than usual it was clear that its screen feed resistor and the valveholder base connections were intact. On disconnecting the tripler, only a very weak spark could be obtained at the pulse output on the line output transformer, while as there was about –40V at the control grid of the PL504 it was obviously getting plenty of drive. The valve was almost certainly all right, but a new one was tried just in case. The results were much the same, so it looked like a faulty line output transformer. These Thorn jelly pot transformers seldom break down however, so we decided to disconnect the line scan coils. This can be done by simply removing one of the leads to the wrap-round tags on the yoke. On doing that and switching the set on again normal sparks could be obtained at the PL504 anode and the e.h.t. pulse output point on the line output transformer.

Since scan coils are expensive while this was a fairly old model we thought we'd try scan coils from scrap sets in the workshop. Those on the contemporary Philips dual-standard sets seemed to be of similar pattern, and on fitting one of these yokes an absolutely first class picture was obtained. We've tried spare scan coils in the past, but never completely successfully since the field coils usually introduce unacceptable cramping. It's always worth a try on an oldish set however if you happen to have scrap coils about.

Momentary Loss of Power

After fitting a replacement power supply panel in a set fitted with the Thorn 3000 chassis and then making the usual setting-up adjustments we obtained a good picture but with noticeable misconvergence. After about 20 minutes however, while we were carrying out the convergence procedure, the set seemingly switched off and on again in a fraction of a second. The mains plug was fitted into a multi-way adaptor, so both this and the connections were checked in case moving the set had placed a strain on them. These proved to be o.k. however, and after another half hour or so there was another momentary loss of output. The fault was evidently in the power supply, and after checking the chopper rail voltage etc. we decided to change the over-voltage crowbar thyristor W621. Following this there was no further trouble.

Clicking Noises

Soon after switching on a GEC Series One receiver a regular series of clicking noises would usually come from the set, suggesting e.h.t. sparking. It was noticed however that adjusting the field hold control would either cure the effect or increase the frequency of the clicking. This suggested sparking over at the primary of the field output transformer or from the primary to chassis, possibly as a result of the field flyback pulse limiting v.d.r. being faulty or dry-jointed. Close examination in this area failed to reveal any signs of sparking however, but on changing the PCL 805 field timebase valve the fault completely disappeared. Evidently the pentode section of the valve had been sparking across internally.

Blown Mains Fuses

The ITT CVC8 colour chassis certainly carries a full complement of fuses and fusible resistors in its power supply. On two occasions recently we've come across sets with the 4A mains input delay type fuse blown. This often places suspicion on the mains filter capacitor – C257, 1μF in this case – since it's generally connected between the set side of the mains fuse and chassis. When this capacitor fails however the fuse cartridge shatters, and this wasn't the situation in either of these cases. Both times the trouble turned out to be a short-circuit h.t. rectifier.

Miller's Miscellany

Chas. E. Miller

IT just had to happen, I suppose. After some weeks of getting away with nice simple faults I got clobbered with a real beauty. It was a 26in. colour set whose name sounded as if it had come from the Caribbean rather than central Europe! When first switched on, after a long period in store, it exhibited a picture marred by an obvious hum bar. This appeared to improve after a while, so I left the set running for a time until I left the workshop for lunch. On my return the set came on automatically with the main switch, and was unnoticed until it went off with a bang like a 12-bore shot gun. The rectifier had gone dead short, and due to shortcomings in the line of fuses a sizeable length of printed wiring had been blown out. This matter was put right and after a day long test the set was deemed fit to be sent back to the customer.

That was on Saturday. On Monday came the complaint that the picture had gone faint. A quick test revealed that the brightness control had no effect, the picture, such as it was, showing only when the colour control was advanced. O.K., so it was obviously a lack of luminance information, and a new PL802 would put things right. But it didn't, and I spent a fruitless couple of hours with the circuit diagram and meter before trying another PL802 "just in case". Why don't I ever learn, and do this first instead of last? Anyway, with the picture back to normal the set was taken off again, this time in heavy rain.

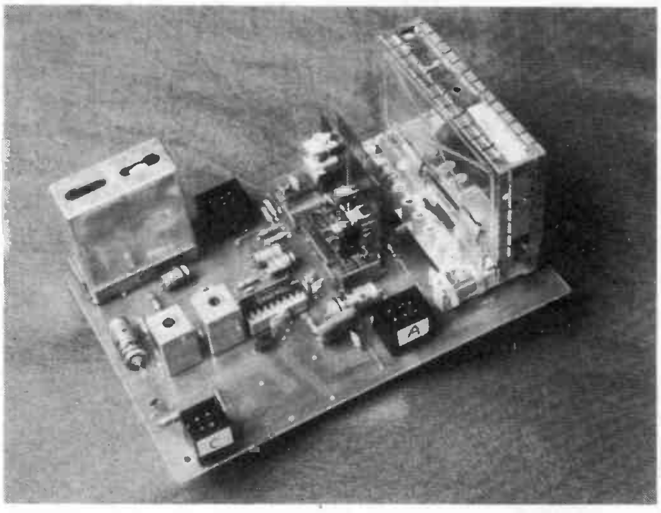
Whether some of this penetrated inside the set, despite a cloth covering, I don't know: but the fact remains that seconds after being switched on it emitted the most awe-inspiring series of bangs and flashes imaginable. They seemed to be coming from various points around the timebase panel, but subsequent investigation indicated that it was just another case of a shorted rectifier. Until, of course, I found that another chunk of print had gone for a Burton. Vowing that this sort of thing had to stop, I fitted an extra h.t. fuse on the a.c. side of the rectifier, mounting it on a little panel on top of the auto-transformer. By this time the panel was festooned with gaily coloured wires taking the place of the burned-out bits of print.

This time the set ran reasonably well, but with a curious field roll which was coupled with excessive cathode volts on the PL508 field output valve – 30V instead of the 17V quoted in the manual. It was not, as might be imagined, due to the main smoothing capacitors having been damaged as a result of being subjected to raw a.c., but to further leakage of volts across the print. If the set was left to its own devices for twenty minutes or so it settled down quite happily, and in fact it carried on for the rest of the day until I closed up shop for the night. During the evening I returned to the workshop to refer to a book and, as usual, everything else came on with the main switch. Immersed in study, I failed to notice that something had gone wrong once again, and that smoke was pouring from the colour set! When the smell became so pungent as to be noticeable I was too disgusted to do anything but switch off until the morning.

Next day I discovered that a 330kΩ resistor had burnt black, due once again to a leak across the print. With this replaced and the print cleaned off, pictures were restored for a few more hours – until the pay-off. After another devastating flash a small diode, a resistor and the plastic cover of a transformer burst into actual flames, to burn merrily whilst I admired the rather pretty effect. Eventually I decided that I'd better switch off and investigate, although I had a pretty shrewd idea of what I'd find. As expected, large amounts of charred paxolin had to be scraped out with a sharp screwdriver, and the wiring made good. When at last I managed to get a picture there was a considerable amount of flashing on the screen, accompanied by a powerful hiss of discharging e.h.t. The inordinate amount of flexing which the tube anode connector had had to put up with had caused the internal limiting resistor to come unsoldered. This final (I sincerely hope) repair seems to have finally done the trick. Now, if you happen to know of anyone about to emigrate to Australia and who would like to take a colour TV with him at a bargain price. . . .

In a Spin

Did you know that as from the end of last September it has been illegal to sell twin-tub washing machines which do not have a built in safety device to avoid any chance of an arm going into a still-spinning dryer? I didn't, until recently. This piece of legislation seems to have been enacted with a minimum of publicity. When can we expect a similar arbitrary date for the closing down of the 405-line TV



Prototype tuner/i.f. strip combination developed by Mullard engineers. The varicap tuner is on the right, with space for a second tuner to meet continental requirements. The coupling is via an acoustic surface-wave filter which forms the i.f. bandpass characteristic. The active part of the i.f. strip is the TDA2540 i.c. which incorporates a three-stage i.f. amplifier with a.g.c. applied to each stage, synchronous vision and a.f.c. demodulators, a gated a.g.c. system, white spot inverter and video preamplifier.

service? I know this would be a blow to viewers in certain difficult reception areas, but if it led to their being able to get 625-line colour programmes on Bands I and III it would surely be worthwhile. I would imagine that the only real obstacle to quickly re-engineering the v.h.f. network to a smaller number of 625-line transmitters would be the economic climate. And as the pound sinks slowly in the west, I fear that it's going to be cloudy and cold for some time yet!

Back to Square One

It's a pity, really: I'm sure all you happy engineers would enjoy fitting Band I/III tuners into single-standard sets, just as the old sweats were doing 20-odd years ago. There's something deeply satisfying about being able to drill holes in a highly polished cabinet and get paid for it! And what about you aerial erectors, forsaking fiddling little u.h.f. arrays for really manly Band I three-element aerials mounted on 3in. poles with triple chimney lashings? I know you can't wait, but you'll just have to be patient....

The Sets that Never Were – 2

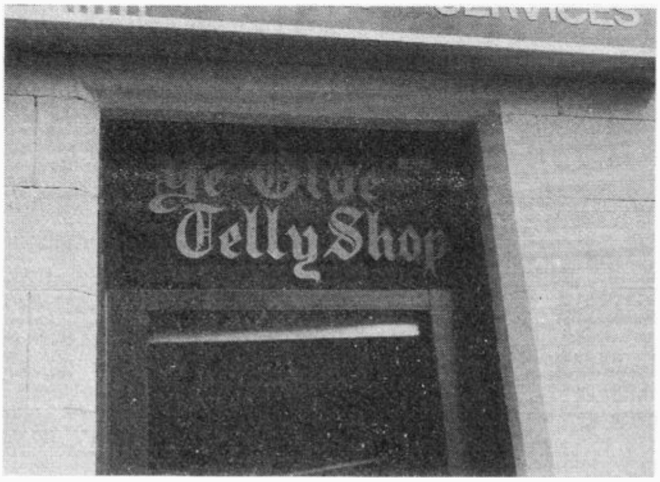
As the 50s marched on, more and more of the once independent setmakers were absorbed into the groups set up by their more successful rivals. For instance, the prestigious RGD concern came into the hands of the then Regentone company, owned by Lloyds Packing Warehouses, thus producing another fruitful source of "badge engineering". Plessey chassis were continuing to be used by this concern, and were now appearing in fully tunable form for all the BBC channels in Band I. By choosing to employ Mazda valves, Plessey committed themselves to the inevitable complication of using three lots of heater chains – 0·1, 0·2 and 0·3A, as a single comprehensive range was not then being produced by this valve firm. Furthermore, the tube was still of the 2V heater type, necessitating a small transformer to supply it. Gone were the simple timebases of the earlier sets. Both the line and the field timebases employed blocking oscillators, again of course with transformers. It seems strange, from the point of view of costs, that Plessey should have opted for more rather than fewer wound components. One feature retained from the old single-channel chassis was the electrical picture shift system.

Later on, a switch to Mullard valves was made, and the use of a series-heater c.r.t. made it possible to dispense with the heater transformer. This chassis, though far more sophisticated than the previous single-station model, was still simple enough when compared with other maker's products. As usual, this led to a good record of reliability – if only because there wasn't as much to go wrong! A comparison between the Plessey circuit and that of, say, the contemporary Pye V4 chassis, is very instructive. The latter had six more valves, and almost twice as many capacitors and resistors.

When ITV arrived on the scene, a chassis was produced which closely resembled the BBC-only one but had an inductively tuned Band I/III front end. It employed a system of cams to slide the tuning slugs back and forth and to operate a band-change switch. One of the sets fitted with this chassis had control knobs of such a distinctive shape that we immediately christened it the "Marilyn Monroe"...

From that time onwards the Plessey chassis became more and more complex as such features as automatic picture control and flywheel line sync were added.

The next big breakthrough was the appearance in the late



No, this is not the entrance to the Les Lawry-Johns, Chas Miller or George Wilding service departments. It was spotted by Eric Measures on a retail TV shop in Inverness.

50s of 110°, printed circuit models. Simplicity was once again back in favour, for the number of valves had been reduced to thirteen – plus four crystal diodes. Multi-vibrators appeared to take the place of the blocking oscillators, that in the line timebase being particularly simple and efficient.

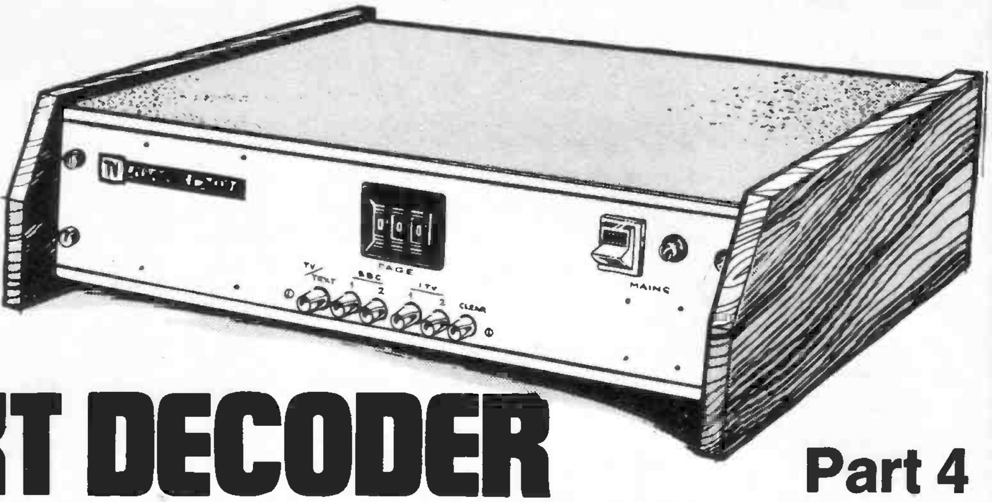
Trouble in the line output stage was mainly confined to what I term "visual faults". The snowy-white top of the output valve would advertise the fact that its screen grid feed resistor had gone low (confirmed at a glance by its blackened appearance), causing the valve to over-heat badly. As the sets aged however, a rather strange fault manifested itself. This was inability to lock the picture horizontally, the correct speed being out of the range of the hold control. This was due to massive deposits of grot on the print, lowering the resistance between the conductors. A good scrub with Servisol and a toothbrush was normally effective! The h.t. rectifier in some versions was the old PY32, which not only took ages to warm up but also had a bad habit of dropping its output to about 110V without prior warning. I think few engineers were sorry to see it supplanted by the PY33 and then the silicon diode.

Although the printed panels used in this series of models were in the main very reliable, the same unfortunately could not be said without qualification of the later dual-standard types. It was certainly not unknown for an overheated resistor to lead to a charred hole in this panel!

Speaking purely personally, I never felt the same respect or admiration for Plessey's last chassis as I did for those made fifteen years earlier. Nevertheless, they still found their way into a lot of cabinets, including those of a very famous continental marque (Grundig). I was once asked to inspect one of these latter sets with a view to replacing the "works", as the cabinet itself was too good to part with. It certainly was of remarkable quality, with folding doors and a matching stand. You can imagine my surprise when on removing the back I found not some complicated Teutonic masterpiece but the dual-standard Plessey chassis! The only modification for this august brand name was the use of an auto-transformer in place of the usual mains droppers!

The mid 60s was a time of significant change in the television industry. Takeovers and mergers (e.g., Regentone/RGD becoming part of ITT) drastically reduced the number of manufacturers and with it the need for a "standard" chassis. Regentone/RGD naturally started to use the same chassis as KB, while Defiant (the Co-op) went over to using those made by Rank. It was, as they say, the end of an era.

THE TV TELETEXT DECODER Part 4



Steve A. MONEY T. Eng. (CEI)

AFTER the complexity of the input logic board we now come to the relatively straightforward circuits which make up the page memory of the decoder.

In order to generate a text display, all the data for the selected page of text must be presented to the display logic during every field scan of the TV receiver. For any particular page, however, the data will be received only at about thirty-second intervals. To ensure a continuous supply of data to the display circuits some sort of memory is required which can store the data for the 960 characters which make up a page of text.

RANDOM ACCESS MEMORIES

The heart of the memory board is a set of integrated circuits known as Random Access Memories (RAMs), each of which contains a large array of memory cells.

Fig. 1 shows the basic structure of a typical RAM device which, for simplicity, is shown with only sixteen memory cells. Each memory cell consists of three or four transistors arranged to form a simple flip-flop circuit which can be set to either the 1 or 0 state. The cells are laid out in a matrix of rows and columns as shown, so that any one cell in the array can be selected by means of the row and column address circuits.

To reduce the number of address leads on the memory device the row and column addresses are coded as binary numbers on the address input pins. Thus for our simple 16 bit memory shown in Fig. 1 there will be two input lines R1 and R2 for the row address and two more, C1 and C2, for the column address. In the actual memory card the integrated circuits used are type 2102 memories which have 1024 cells arranged in a 32 row by 32 column array and there are ten address inputs (A0 to A9) five for row selection and five for column selection.

When both the row and column address inputs for a particular cell in the array are activated, the cell is connected to the data input and output lines of the memory circuit. The state of the selected cell can now be read out without altering the data stored in the cell. If we wish to change the state of the memory cell then another control line called Write Enable is activated and this will cause the cell to take up the state of the input data line of the memory circuit.

Fig. 2 shows the complete circuit diagram of the memory board. It will be seen that there are seven 2102 memories which have all of their address and write control lines connected in parallel so that the same cell in each 2102 is selected simultaneously. This allows the 7 bit data code for a character to be loaded in parallel to the 2102s and similarly the data can be read out in parallel. Writing data into the memory is controlled by a Write pulse (WR) from the input logic card. This goes to 0 when data is to be written into the memory.

ADDRESS GENERATION

The function of most of the other logic devices on the memory card is to produce the address signals for the 2102 memory circuits.

Unfortunately, the Teletext page format is not entirely compatible with the layout of the cells in a 2102 memory since the memory array is a 32 × 32 matrix whereas the Teletext page has only 24 rows but contains 40 characters in each row. However, since the total number of characters to be stored is only 960 and the memory has 1024 locations it is not too difficult to arrange the address system so that the character data is packed into the memory array.

Taking one row of text we can simply write the first 32 characters into the 32 locations of one row of the 2102 memory. This leaves us with eight more characters of the text row which will need to be packed into the memory at some other point.

Since there are only 24 rows of text to go into the memory there will be eight rows of memory spare at the end

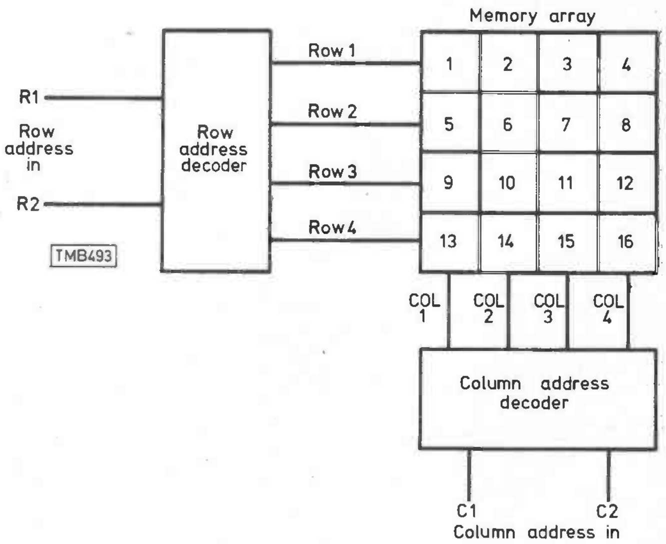


Fig. 1: A simple memory circuit showing how the memory array is addressed by the row and column decoders.

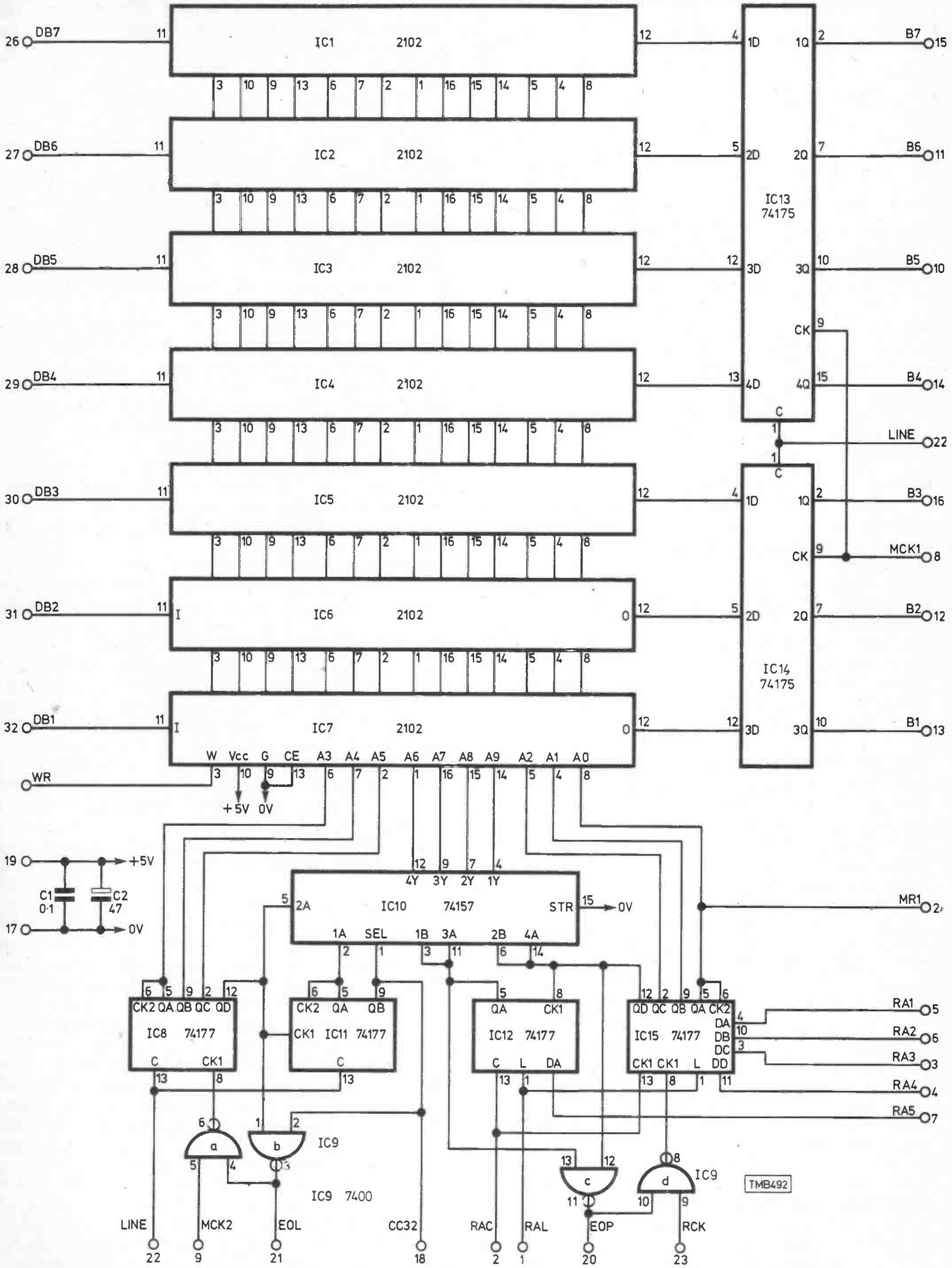


Fig. 2: Complete circuit diagram of the memory board.

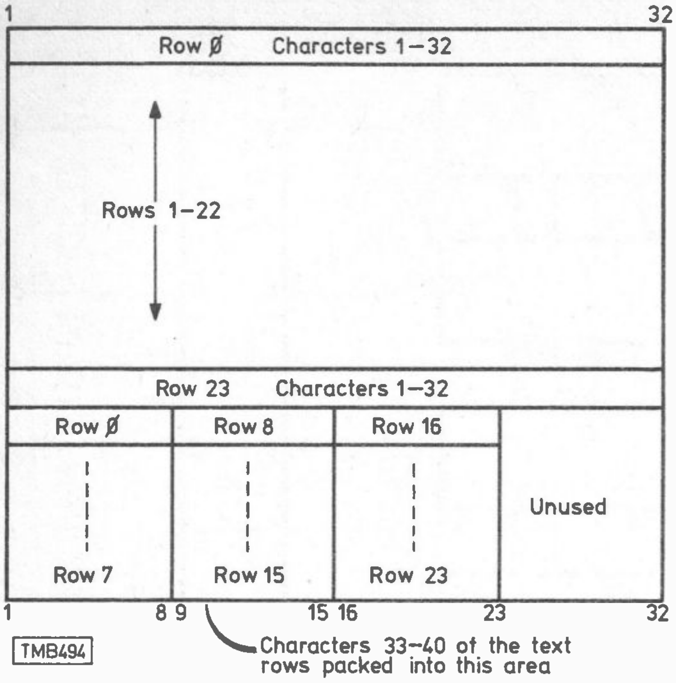


Fig. 3: Diagram of the memory packing arrangement used in the decoder.

of the memory array as shown in Fig. 3. By switching the row and column address signals when the last eight data words of each row are being selected, we can arrange that they are packed into the unused space below row 24 of the memory array.

In practice it doesn't really matter too much which of the address lines of the memory are used for rows and columns because as long as the address input is the same for both write and read modes the correct data will always be selected. It will be noted from the circuit diagram that the address lines A0 to A9 are not taken in logic order but were selected for convenience in board layout rather than for logical use of the memory address codes.

CHARACTER ADDRESS

The first part of the address selection is concerned with the character position in the text data row. There are 40 characters in the row and to generate the memory address a simple six-stage binary counter system is used. Two 74177 four-stage binary counters are used with feedback gating to produce a count of forty.

At the beginning of each row of text the line sync pulse is used to reset the counters IC8 and IC11 so that their outputs go to 0. This will apply the address 000000 to the memory address circuits and select the position for storing the first text character of the row. After the data for the first character has been written into, or read from, the memory, a clock pulse MCK is applied to the clock input of IC8 and this advances the counter to give address code 000001. This action repeats for each character until the counter reaches a count of forty where output QB of IC11 and output QD of IC8 are both at 1. At this point gate IC9b is activated and its output goes to 0 which closes gate IC9a and stops the clock input. As a result, after counting off the forty characters of the row, the counter stops and will not be restarted until the next line sync pulse which will reset the counter and release gate IC9a.

The character address counter operates in the same way for both the input and display phases of operation; the only difference being that the clock MCK comes from either the input or display logic as required. The switching of the clock is carried out at the input logic.

A signal taken from the output of gate IC9b provides an End of Line (EOL) signal for the input and display logic. The output from QB of IC11 goes high after the 32nd character has been selected and this signal (CC32) is used to control the input of the clock display information of the header row.

ROW ADDRESS

A similar counter system is used to generate the row address for the memory circuits.

Considering first of all the display mode of operation, the counter is reset to zero by a Row Address Clear (RAC) pulse from the display logic. This pulse occurs at a point in the field scan just before the first row of text is to be displayed and it ensures that the row address 00000 has been selected on the memory ready for the first row of text to be read out and displayed.

After the ten scan lines required to display the row of text on the screen, a clock pulse called the Row Clock (RCK), derived from the display logic, is used to advance the row address by clocking IC15. After each row of text is scanned out on the screen the counter is advanced ready for the next row until all 24 rows have been displayed. At this point QA of IC12 and QD of IC15 will both be at 1 and the reset gate IC9c operates closing IC9d and stopping the counter.

The output from IC9c provides an End of Page (EOP) pulse from the display logic. Output QA of IC15 produces a Memory Row 1 (MR1) pulse to reset the Clear Page circuits of the input logic board.

Because the Teletext signal defines which row of text is being transmitted the two 74177s IC12 and IC15 are used as simple latch circuits when data is being written into the memory. Here the five stages of the counter are loaded directly with the row address code from the input logic board and are held in that state whilst the data for the row is written into the memory. The Row Address Load (RAL) signal from the input logic controls this function, and Row Address data from the input card is applied directly to the D inputs of IC12 and IC15.

IC10 is a 74157 quad changeover gate which is used to modify the address signals to the memory in order to pack the last eight characters of each row into an unused part of the memory below row 24.

When QB of IC11 goes to 1 after the first 32 characters of a text row have been dealt with the 74157 is switched to change the addressing mode. Now address lines A6 and A7 are set to 1 to shift the memory address into the unused part of the array. At the same time the address lines A8 and A9 are switched so that they are driven from the row address counter instead of the character counter. This action causes the last eight characters of each row to be packed neatly into the unused part of the memory.

Text data from the input card on lines DB1 through DB7 is applied in parallel to the input pins of the seven 2102 memory devices. Since the 2102 has a limited drive capability a set of output latches IC13 and IC14 is provided between the outputs of the 2102s and the display circuits. These output latches are cleared to zero at the start of each line scan to ensure that no illegal symbols are displayed in the left-hand margin of the screen.

CONSTRUCTION

The memory system is built on a double sided printed circuit board with a 32-way 0·1in. pitch edge connector at one end. Fig. 4 shows the layout of the circuit tracks on each side of the board, whilst Fig. 5 illustrates the layout of the components.

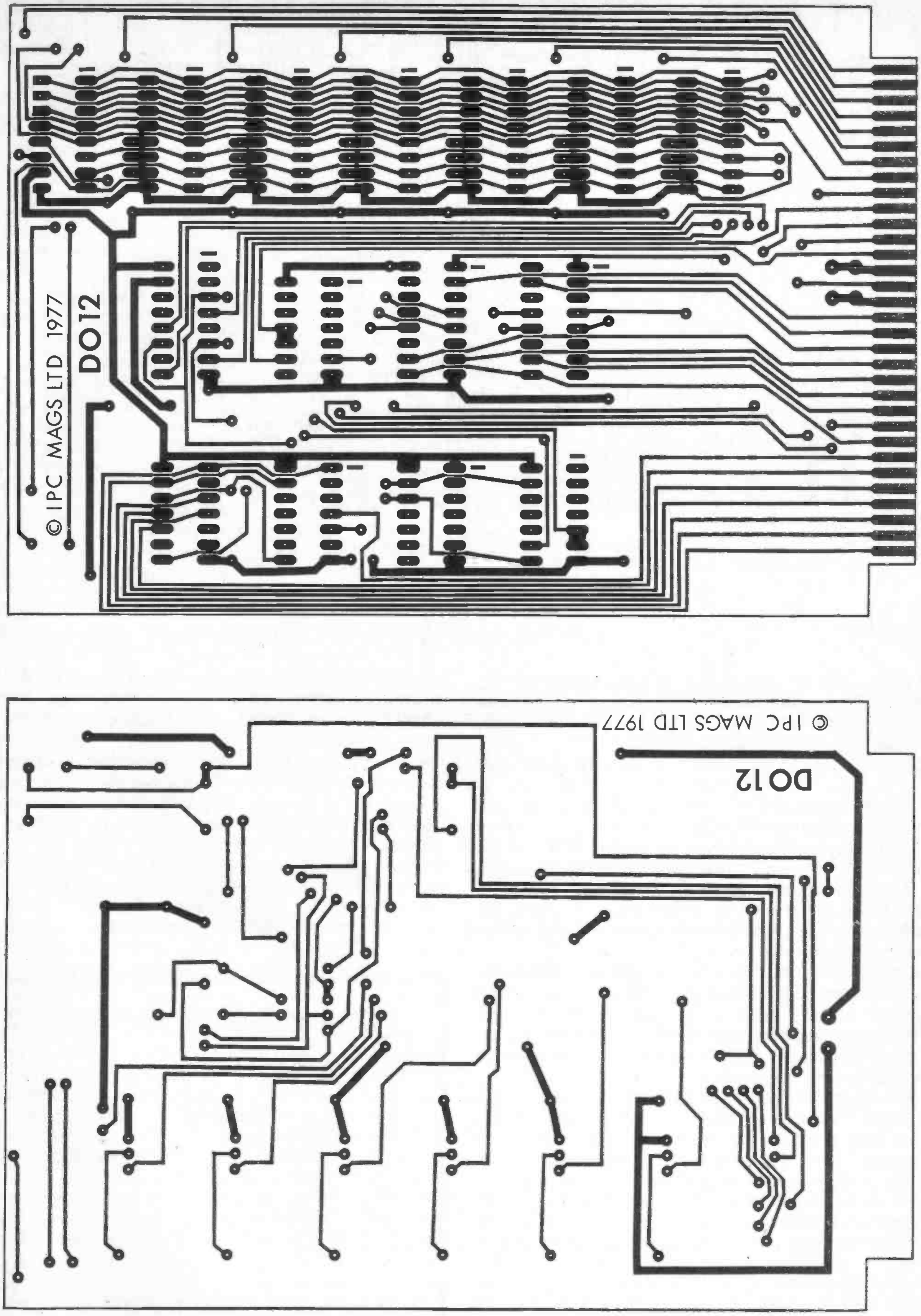
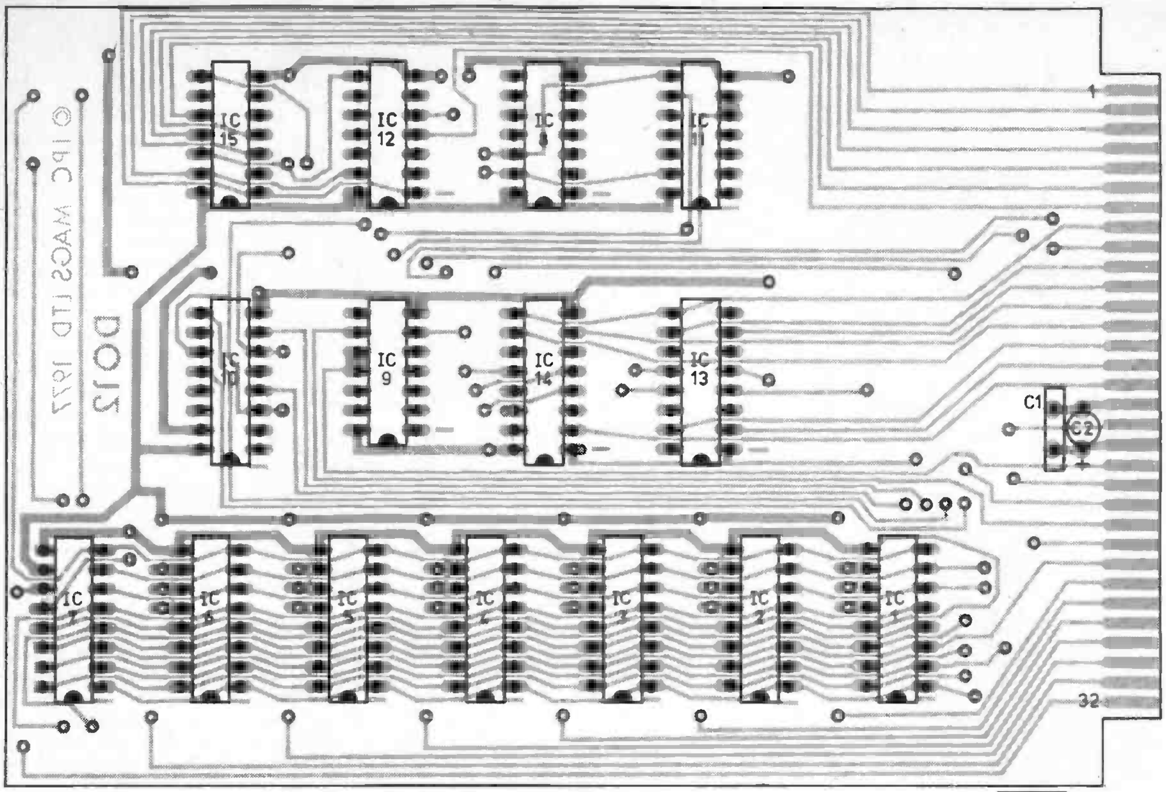


Fig. 4: Details of the printed circuit board. The top diagram shows the track on the underside.

2102 memories are MOS devices and although they have some anti-static protection built into them, it was thought desirable that they should be mounted in sockets to avoid any unnecessary handling. Of course the 2102s could, if desired, be soldered directly into the board. If this is done it is essential that a well earthed soldering iron be used and



O Denotes wire link through board TMB491

Fig. 5: Component location diagram for the memory board.

that precautions are taken to deal with any static electricity before the devices are handled. If sockets are used they can either be conventional 16 pin DIL types or, for economy, Soldercon sockets can be used.

The procedure for assembly is to start by inserting all the TTL logic i.c.s (74 series) into the board and to secure them temporarily by soldering just one pin on each device. Next check carefully that the devices are all in their correct positions and properly orientated. If all is well the soldered joints to the tops of the integrated circuits can be made. Finally the solder joints to the opposite side of the board can be completed taking care not to let solder run between the circuit pads where it might form solder bridges between adjacent pads.

Since this is a double sided board there are a number of wire links to be inserted through the board to connect the tracks on opposite sides of the board. These links are inserted using the same method as that described for the input board last month. There are a total of 93 through wire links to be inserted in this board.

Next, the sockets for the memory integrated circuits can be inserted. If Soldercon sockets are used they should be cut off into lengths of eight sockets before being soldered into the board. Leave the metal strap across the sockets in position at this stage. It is useful to solder only the end sockets of the strip of eight at first and then to adjust the positions of the strips at each side until a 16-pin i.c. fits easily into the socket. When adjusted the remaining pins of the strip can be soldered to fix it firmly in place.

Finally the two decoupling capacitors can be wired into position and the whole board should then be checked carefully for any missed joints or solder bridges between tracks or pads. If all is well the metal retaining straps across the tops of the Soldercon sockets can be removed, by carefully bending them to and fro with a small pair of pliers.

The memory board is now ready for testing but at this stage the 2102 memory chips should not be inserted into the board but should be left in their conductive foam or other antistatic packing. We shall deal with the testing of this card in a later article when the whole decoder is complete, since the memory card requires signals from both the input and display cards before it can be checked. Since there are no adjustments to be made the circuit should work with no trouble unless there are faulty devices or errors in the assembly of the board.

Next month we shall begin dealing with the third logic board which controls the generation of the display.

TO BE CONTINUED

Components list for Memory board

IC1	2102
IC2	2102
IC3	2102
IC4	2102
IC5	2102
IC6	2102
IC7	2102
IC8	74177
IC9	7400
IC10	74157
IC11	74177
IC12	74177
IC13	74175
IC14	74175
IC15	74177
C1	100n disc ceramic
C2	47μF 6·3V tantalum bead

Printed circuit board type D012
Soldercon sockets or 16-pin DIL sockets for 2102

Servicing the Baird 700 Chassis

E. Trundle

THE Baird 700 series appeared almost at the start of colour in the UK (in days of old, when men were bold, and i.c.s not invented . . .). They were like no other sets before or since. These large dual-standard receivers seem to owe something to American practice, with triode synchronous detectors and other miscellaneous oddities. There is no shortage of preset controls throughout the set, and any specimen one is likely to acquire will probably have been twiddled from black-level to breakfast time! These "adjustments" are commonly committed when the set develops a fault, whereupon a screwdriver is pressed into service rather than an oscilloscope or a test meter. One may find for example that the delay line matrix controls have been wound for maximum colour when the chroma level drops due to a fault elsewhere.

Although the sets look dated these days, with loving care they can be made to give a very good account of themselves, especially if treated to a new c.r.t. and a decoder overhaul. The chassis is quite reliable, and more to the point predictable, in that most faults encountered tend to fall into the "stock" category most of which, we hope, are described below. If we have missed any, no doubt our readers will fill us in!

Construction

The chassis is of peculiar shape, with four printed circuit panels mounted vertically in a metal frame on runners (à la Decca Bradford) which enable the chassis to be withdrawn. Accessibility is generally very good, with one or two notable exceptions. Some early hybrid receivers of other makes were notorious for the alarming deterioration of the printed circuit panels, which tended to carbonise and curl up until they resembled large black crisps: the 700 series fares quite well in this respect, but burn holes can and do occur, as will be described. The centre (decoder) panel can be swung out like a door, but the other panels must be dealt with in situ.

Tuners

The u.h.f. tuner is conventional and reliable from an electrical point of view. The mechanical arrangements often cause trouble however. The large rubber friction ring which drives the tuner shaft tends to perish and develop a permanent dent, causing loss of drive – this situation is often precipitated by cleaning the customer controls above with lubricant or switch cleaner, which percolates down into the works. The large plastic drive drum contains a pin – the anchor for the cord tensioning spring – and this often snaps off. Finally, the brass bush tends to undo its securing nut, whereupon the whole assembly falls to pieces – misery indeed. These troubles usually involve restringing the drive cord – no mean task – as shown in Fig. 1.

The valved v.h.f. tuner is not now used on v.h.f., so the tendency of the biscuits to warp will not be noticed. The feedthrough capacitors on the v.h.f. tuner can leak or go short to the discomfiture of R607, the h.t. feed resistor. This is 2·2kΩ (8W), mounted near the sound output transformer – it also feeds some of the PCL82 circuitry.

IF Strip

The i.f. strip is similar to that used on the monochrome 660 series. It is quite trouble-free so long as it hasn't been twiddled. Occasional cases of picture flutter can be resolved by reducing C144 in the a.g.c. circuit to 0·01μF (if not this value already). There is a tendency for components in the sound discriminator can L28-30 to touch the can itself, causing intermittent buzz and lack of sound. Replacement of C122 (10μF), D2 and D3 (OA90), followed by careful trimming of L28 and L30, will resolve most sound problems if the PCL82 and its pentode cathode bias components (560Ω plus 25μF) are in order.

Luminance

When servicing this set dismay may arise due to odd faults which are unconnected with the main complaint appearing. The answer usually lies with either the system switch, which can become half-cocked if it has not been secured, or wires becoming detached from the panels. The most common examples of the latter trouble are on the decoder panel, where the white video input lead to P8 can break or become disconnected, causing a blank raster, or the white lead from the c.r.t. base comes adrift from P13 on the panel. A disconnection at P13 robs the PFL200

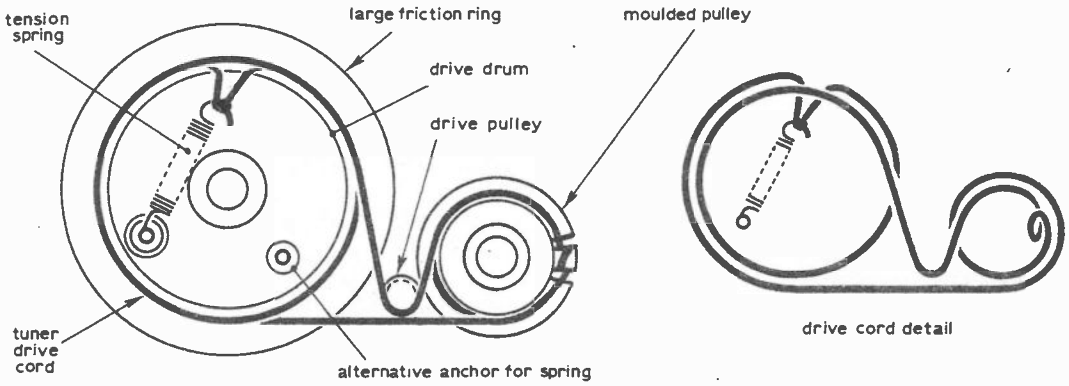


Fig. 1: The u.h.f. tuning drive cord system.

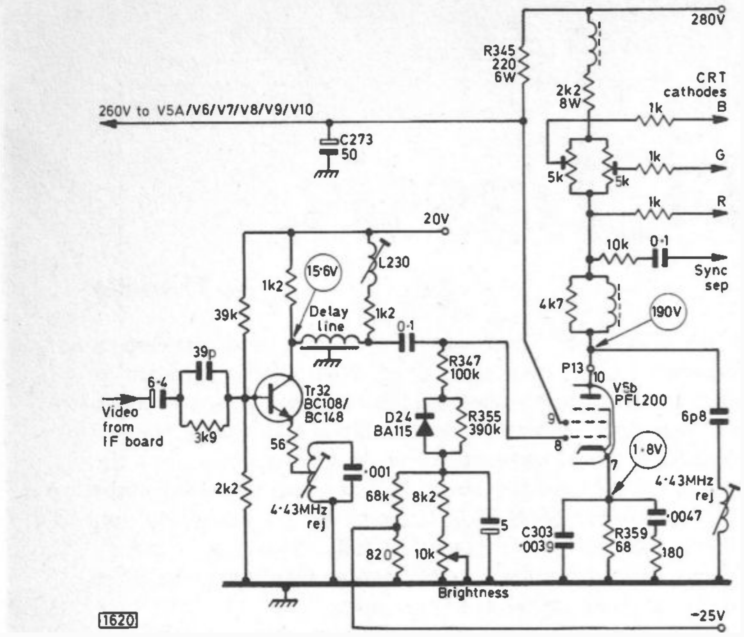


Fig. 2: The luminance channel circuit.

(luminance output section) of anode potential, and the brightly-glowing screen grid will destroy the valve after a very short time.

The PFL200 is the bête noir of this chassis, both halves contributing their quota of troubles. At this point we are concerned with the "b" (luminance) half of the valve, whose internal electrodes seem to have a magnetic attraction for each other. The first victim of this is usually the 68Ω cathode bias resistor R359 (see Fig. 2) which goes out in a blaze of glory, often followed by C303 developing a leak or short. R345 is next in line, and can almost disintegrate. The PFL200 is thus the instigator of burn holes in the printed circuit panel in the area of its associated resistors.

The d.c. restorer diode D24 is sometimes the cause of incorrect d.c. conditions in the luminance output stage, and the two associated resistors R355 and R347 are also worth checking. The effects of these faults are often masked by the repairer changing the setting of the d.c. restorer taps X, Y and Z (see Fig. 4), leading to brightness problems and the burn ups referred to earlier.

L230 is a wee rejector coil associated with the luminance delay line. It is physically fragile and often goes open-circuit, leaving the luminance delay line unterminated. The result is an over contrasted picture with reflections or ghosting.

Finally the luminance delay line driver transistor Tr32 tends to be unreliable. The symptoms of failure are weak or no luminance, or a "halo" effect and a higher voltage on the delay line than the usual 15·6V.

Decoder

There is only a single chrominance amplifier stage (Tr27) up to the chroma delay line, and a few faults are encountered here. A convenient killer over-ride switch will be found at the bottom of the decoder panel. In cases of no colour, operating this will usually confirm that the problem lies in the reference chain rather than the chroma amplifier. A block diagram of the decoder is shown in Fig. 3.

A change in saturation from left to right, accompanied by a change in background colour (magenta on the left fading to green on the right), should lead to a check of C232 (640μF), C312 (32μF) and C273 (50μF) which decouple the supplies within the decoder.

In the post-delay line circuitry the invertor transformers L214/5 and L217/8 often develop shorts between their lead-out wires. This leads to weak colour or imbalance between the B–Y and R–Y signal levels. The cure is obvious on inspection. After properly setting up the delay line circuit adjustments L213 and R275, any Hanover bars remaining are usually traceable to imbalance of the OA90 PAL switching diodes D26 and D27. Hanover bars due to this cause are easily distinguished by the fact that they are most noticeable on saturated reds.

Early sets had two 7·8kHz tuned circuits, L216A and L216B. In aligning these coils, L216A is set for maximum ident amplitude, followed by L216B for correct phasing of the PAL switching point – this receiver uses the ident signal to drive the PAL switch directly instead of via the usual (for those days) triggered bistable. Troubles are occasionally experienced in this department, with the emitter decoupling capacitors (both 25μF) drying up to give low ident signal amplitude. Later chassis used a modified circuit which omits L216B. In these versions L216A is adjusted for correct phasing of course, any error showing as a vertical band of incorrect colour on the right or left of the picture.

Reference Chain

The burst gate transistor Tr20 is not reliable, and can be responsible for unlocked colours (killer over-ridden) due to no gated burst being present, or erratic locking of the reference oscillator, the net result being intermittent colour due to colour-killer action. The same symptoms are often attributable to the OA90 gating pulse clipper D20, although if this is responsible the symptoms can usually be varied by altering the contrast control setting. The burst discriminator driver stage Tr21 is reliable in our experience, but the BA115 phase detector diodes are not. The usual effect here is inability to lock the subcarrier oscillator or get a sensible ident signal. The fault can be intermittent. We use 1N4148s in this position for replacement purposes.

If the reference oscillator (Tr23) stops, the picture background goes green, with no other colour of course. This is a useful clue, confirmed by the colour-killer switch having no effect on the fault. A stalled oscillator is sometimes caused by faulty polystyrene capacitors around Tr23, these being C221, C222, C223 or C219 (see Fig. 4). It is wise to replace the lot, especially where, as is often the case, the oscillator fails intermittently.

Synchronous Demodulator Driver

We now come to the villain of the piece, our old friend the PFL200. The "a" section takes the oscillator output and amplifies it to a level suitable for driving the cathodes of the triode synchronous detectors. Whenever reference drive problems are encountered and the oscillator is still running, the PFL200 should be checked by substitution. Interelectrode shorts tend to burn the screen grid feed resistor R238 and the control grid leak resistor R236. R239 (cathode) often succumbs too. In severe cases R345 in the h.t. line is also affected.

Turning now to the secondary windings on the subcarrier drive transformer L207/10, we find the earthy ends decoupled by a 25μF capacitor (C229). This component can be responsible for weak drive, imbalance of B–Y and R–Y, low G–Y and so on. In later modifications this troublesome component was removed altogether, the

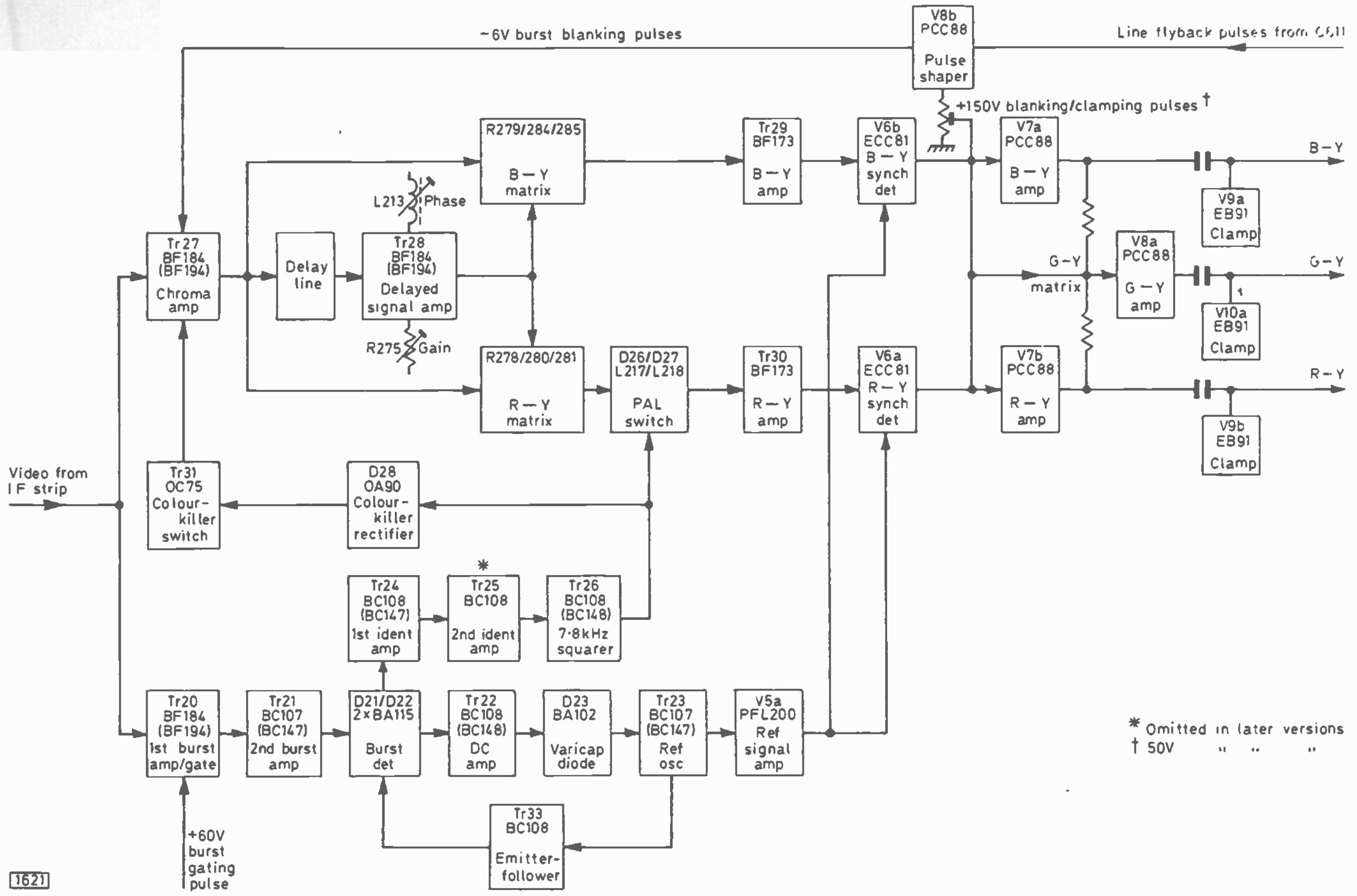


Fig. 3: Block diagram of the decoder. The luminance circuit components (Fig. 2) are also mounted on the decoder panel.

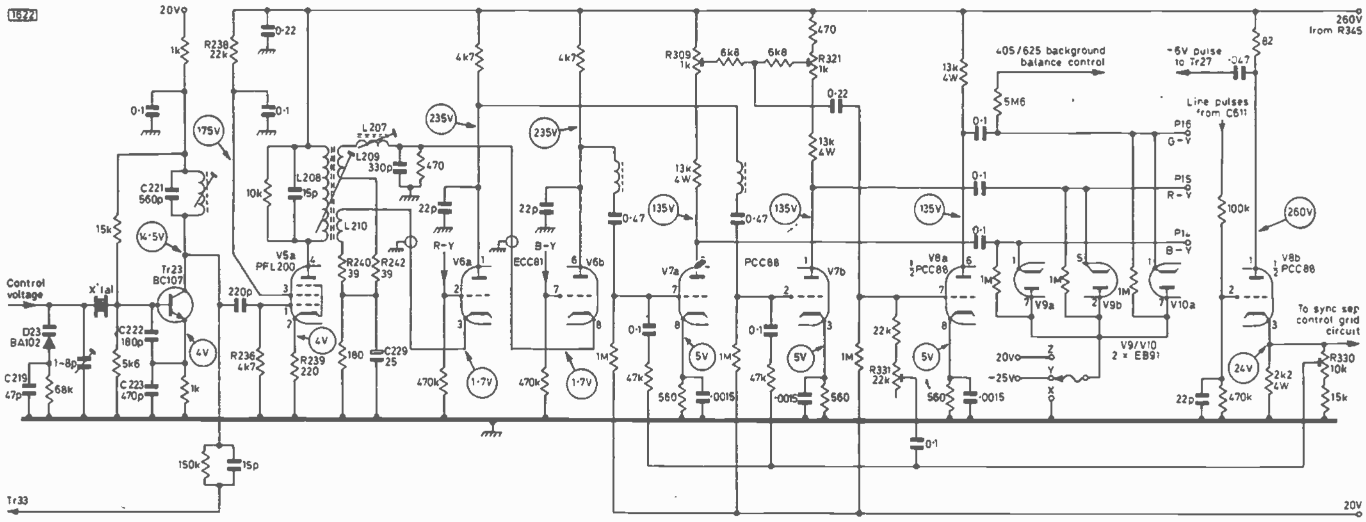


Fig. 4: Circuit of the reference oscillator, reference signal amplifier, synchronous demodulators, colour-difference amplifiers and colour-difference signal clamps. Circuit variations include a modified clamp circuit.

bottom ends of R240 and R242 being taken direct to chassis. If you come across a set with C229 fitted, remove it altogether and fit a shorting link, then realign L207/8/9. An unofficial alignment method which seems to give good results is to set the upper core L208/9 for maximum red on test card or bars, then adjust L207 (lower core) for maximum yellow.

Colour-Difference Amplifiers

The demodulated signals from the synchronous detector triodes are fed to the colour-difference amplifier triodes V7 and V8a. We are getting near the top of the panel now, and in these warmer latitudes the preset potentiometers R309 and R321 tend to split or curl up. This does little for the G–Y matrixing accuracy, although these controls are often found badly misadjusted anyway for various reasons, most commonly a faulty C229 as already mentioned.

Clamp Circuits

Line flyback blanking/clamp pulses are fed to the grids

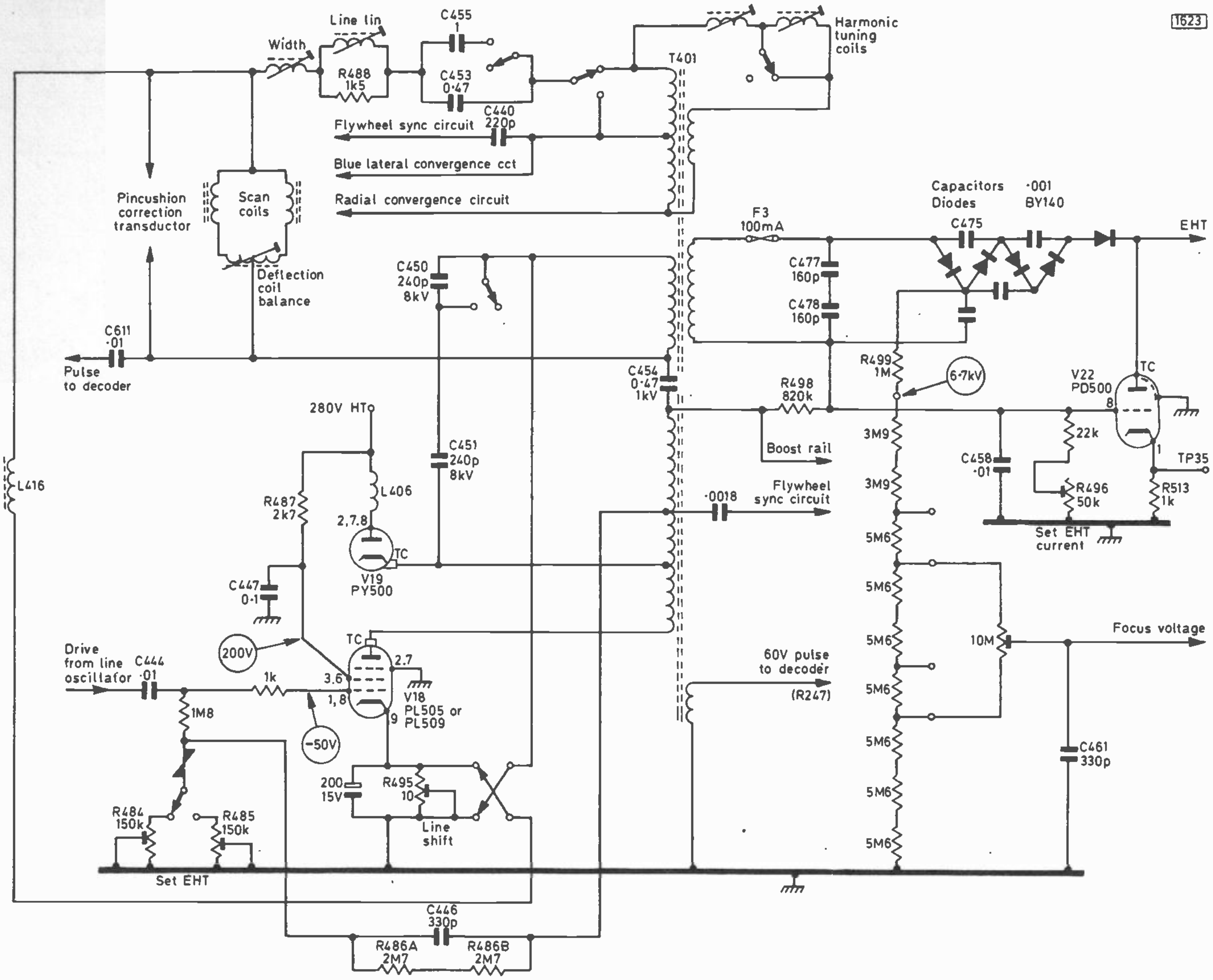


Fig. 5: Circuit of the line output stage.

of the colour-difference amplifier triodes from the slider of R330, which is squeezed in between the valveholders for V8 (PCC88) and V10 (EB91). The track very often parts company with the rest of the potentiometer, and commonly goes open-circuit into the bargain. This causes either insufficient or excessive brightness, depending on which side of the break the slider is. Replacement is difficult due to the limited space available, and if a respectable skeleton potentiometer is fitted it is necessary to brave the tangle of wires at the back of the panel and fit it there. Adjustment of this potentiometer is made for correct amplitude (100V) of the line blanking pulses on the B–Y feed to the c.r.t. at P14. Assuming that R331 is intact, adjustment of this for 100V blanking pulses on the G–Y feed at P16 completes adjustments in this area.

Before we leave the decoder panel, if you have invested in a new c.r.t. it's possible that flashover might damage one or more of the EB91 d.c. restorer diodes: the picture will then take on a coloured tint, depending on which diode has succumbed.

Field Timebase

The field timebase occupies the top section of the timebase panel. Field collapse accompanied by smoke from amidships is usually due to the h.t. supply resistor R606 touching the metal case of C607 on the bottom rear member of the chassis. Open the doorcoder and all will be revealed! Similar symptoms (but the smoke smells different) are caused by a short in C402 cooking R403 (see Fig. 6). These components decouple the boost feed to the field charging circuit and sit on the left side of the timebase panel. The cathode capacitor (C420, 500μF) for the PL508 output pentode lives on the convergence board. This component is often dry-jointed to its panel, leading to field jitter at the bottom of the picture. Jitter of the whole picture should lead to a check of the M3 sync filter diode D30. This can also be the cause of complete loss of field sync. The triode section of a PCF80 acts as field oscillator (with the PL508),. the pentode section of this valve being the sync separator.

Line Generator

The flywheel line sync discriminator uses a pair of BA144 diodes, D31/32. Any set encountered with OA81 diodes in this position should be fitted with BA144 or 1N4148 types regardless. Intermittent line sync problems can usually be resolved by replacing the diodes and checking R461 (12kΩ), part of the reference pulse integrating circuit. Much more often frequency drift, line pulling and difficulty in setting up the ECC82 multivibrator line oscillator is due to its anode load resistors R469 (18kΩ) and R475 (27kΩ) ageing. If the thing stops altogether, or sometimes fails to perk up from cold, the 680pF coupler C442 should be checked by substitution – as well as the above resistors.

Line Output Stage

Low width is a common trouble on this chassis and predictably the fault is generally due to the high-value resistors in the width stabilising circuit. R486A and R486B are each 2·7MΩ and tend to go high. Accessibility in the area of these components is poor, and we find it easier to remove the chassis from the cabinet for this and similar operations. The set e.h.t. potentiometer R484 sometimes curls up, making adjustment difficult. The line output stage circuit is shown in Fig. 5.

On the other side of the line output transformer, which itself is quite dependable, several weak spots exist. We'll kick off at the e.h.t. tripler, a strange device built up of separate rectifiers and capacitors. The 100mA e.h.t. feed fuse F3 will often be found open-circuit when problems develop in the tripler department, and the presence of this fuse probably accounts for the longevity of the transformer itself. Just out of sight under the paxolin lip of the tripler assembly lurk two tubular pulse capacitors, C477 and C478, both 160pF. These are wont to burn to a crisp, and are the most common cause of fuse failure. The value of these capacitors is quite critical for correct transformer tuning and width/e.h.t. ratio, and 160pF capacitors can be hard to come by. We suggest as a replacement 150pF and 180pF in series, both of the 12kV disc type.

The first capacitor of the tripler proper, C475 (0·001μF), is also prone to trouble, the snag here being that in spite of violent internal arcing and overheating it usually looks quite innocent! If F3 is blown and C477/478 are ok, most often this capacitor is responsible. When working on these high-voltage components, make the solder joints nicely rounded to avoid corona discharge.

The focus chain is fed from the first stage of the e.h.t. tripler, and these high-value resistors very commonly go high. In cases of poor focus check and replace them as necessary, using 2W types for reliability. Don't overlook R499 on the tripler as it is if anything more fault prone than its comrades on the convergence/focus panel. The focus control itself and its decoupler C461 occasionally fail, and when this removes the focus voltage from the c.r.t. altogether the misleading result is no raster.

C458 ties the grid of the PD500 shunt stabiliser valve to earth pulsewise, and has a habit of failing. This turns on the PD500, which then mops up most of the e.h.t., running very warm. This state of affairs is often accompanied by a "squegging" noise from the distressed timebase, and when this fault is first encountered one tends to suspect that the line oscillator has come unhinged! The other symptom of this fault is burning and arcing at the set e.h.t. current potentiometer R496, which can culminate in a burnt printed circuit panel if the set is left running long in the faulty state. Whenever C458 is replaced, the condition of R496, the PD500 valve, and the printed panel should be checked. A more rare cause of burnt components in the PD500 grid circuit is a soft valve. Inability to set up R496 correctly accompanied by poor e.h.t. regulation can be due to a change in the value of R513, the 1kΩ cathode resistor. When repairs have been made in the shunt stabiliser circuit, adjust the set e.h.t. current control R496 for 1·2V at TP35 (cathode of V22, PD500) with the c.r.t. screen blacked out.

The c.r.t. first anodes are fed from 2MΩ potentiometers which are connected between the boost and the h.t. lines (see Fig. 6). No picture (or sometimes a very dim one) is the

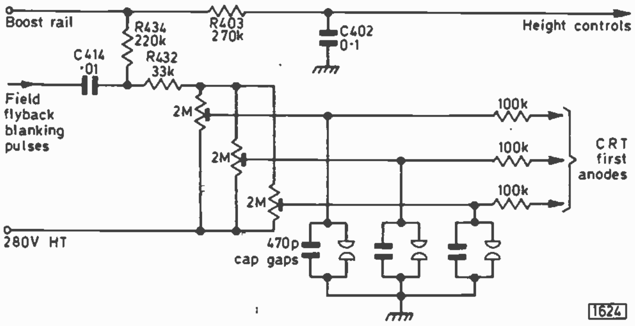


Fig. 6: The c.r.t. first anode circuit.

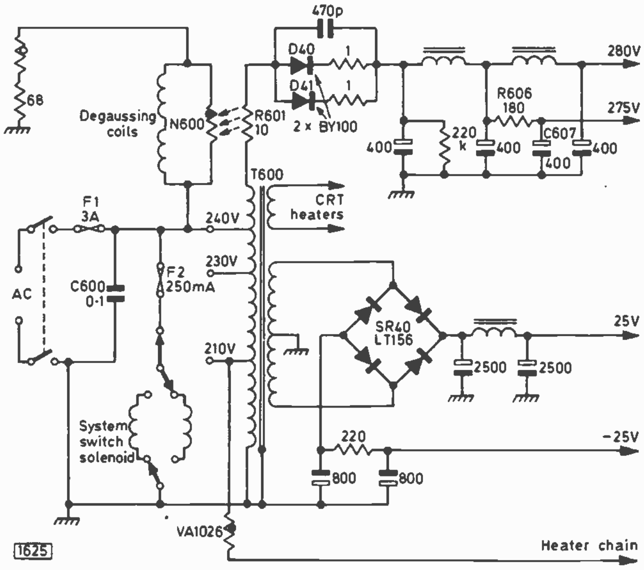


Fig. 7: The power supply circuit.

result when C414, which feeds field flyback blanking pulses to the A1 control network, goes leaky or short-circuit – R434 often burns as a result. In a few early receivers R432 was not present and a slight shading effect occurred, the left side of the screen being brighter than the right side.

The boost capacitor C454 sometimes shorts, overheating the PY500 boost diode and culminating in the mains fuse blowing. The same effect, but on an intermittent basis and with no overheating of V19, is often due to the suppressor choke L406 shorting to chassis beneath the boost diode valveholder.

In cases of a dead line output stage with the PL509 running cool, thrash round the base pins with a voltmeter. Zero on pins 3 and 6 means that R487 is open-circuit while full h.t. on pin 9 (cathode) is due to the line shift control R495 opening.

Convergence

The 700 series has the doubtful distinction of being probably the only set sold in the UK with the red and green convergence circuits not matrixed for vertical correction. This is no problem so long as the function and effect of each control is understood. Some early models had four OA10 diodes on the convergence panel in place of the more common clamp transistors. These diodes will be found wired in parallel pairs. Where problems are experienced, each pair of diodes can be replaced by an AC128 with its

– continued on page 427

LONG-DISTANCE TELEVISION

ROGER BUNNEY

IN addition to reporting each month on the prevailing conditions and on long-distance television reception generally, I attempt in this column to keep abreast of new developments and changes in the broadcasting field. Since taking over the column six years ago there have been radical changes in receiving equipment and in our aerial systems. On the programme side the networks radiate less test transmissions, calling for greater expertise when it comes to identifying stations. Possibly the next major advance will be further developments in satellite transmissions. We've already had experience here of the ATS-6 satellite transmissions to India, and in future we may well be directing our aerials skywards to receive signals at extremely high frequencies. This month I propose to take a look at some recent satellite transmission developments – unfortunately we can't, as yet, offer a source of 12GHz equipment!

Conditions during March

There were a few surprises with terrestrial reception during March, particularly a good tropospheric opening, mainly to the south with signals from France and Switzerland. The main activity was on the 6th, fading out on the 7th. Mike Allmark (Leeds) logged v.h.f. and u.h.f. stations in France, Belgium, Holland, West Germany and Switzerland, while Hugh Cocks (Devon) logged many French stations including weak TF1 625-line relay transmitters. Other loggings here at Romsey consist mainly of the usual meteor shower/scatter receptions, plus some early morning Sporadic E signals from Sweden on the 15th (ch. E2). Keith Hamer and Garry Smith (Derby) logged Czechoslovakia on ch. R1 for almost an hour at lunchtime this day, at very high levels.

From the 5th the aerial system here was for several days completely dismantled while I fitted new arrays, with the aim of reducing the interference from the nearby computer installation. The results were not exactly successful, and I hope to lift another revised system skywards shortly. An interesting point arose from my stacking two Antiference MH308 arrays: for the first time I used a US wideband combining transformer. Tests showed that the losses were low, averaging less than 0·5dB in Band I and rising to a maximum insertion loss of 1·1dB in Band III. I hope to be able to report on this device in greater detail, and also on a new aerial system, next month.

New EBU Listings

West Germany: Steinkimmen ch. E2 reduced to 50kW from 100kW e.r.p. (NDR-1).

Finland: Kajaani ch. E4 (15kW e.r.p.) is now closed. Another ch. E4 transmitter at Vuokatti (40kW e.r.p.) is now in operation (28E16 64N08).

Monaco: The ch. F2 transmitter is now officially closed, though it hasn't been operational for many years. In addition there are Monte Carlo ch. E30 500kW e.r.p. horizontal (atop the mountain behind the town) and ch. E35 40kW e.r.p. horizontal (TMC-2).

Switzerland: Saentis ch. E31 158kW e.r.p. (French), ch. E34 158kW e.r.p. (Italian), and ch. E7 (German) increased to 30kW e.r.p. All transmissions horizontally polarised.

USSR: I am still considering the best way to list over 700 new u.h.f. stations, most of 1000 or 600kW e.r.p. and on all channels between R21-R60!

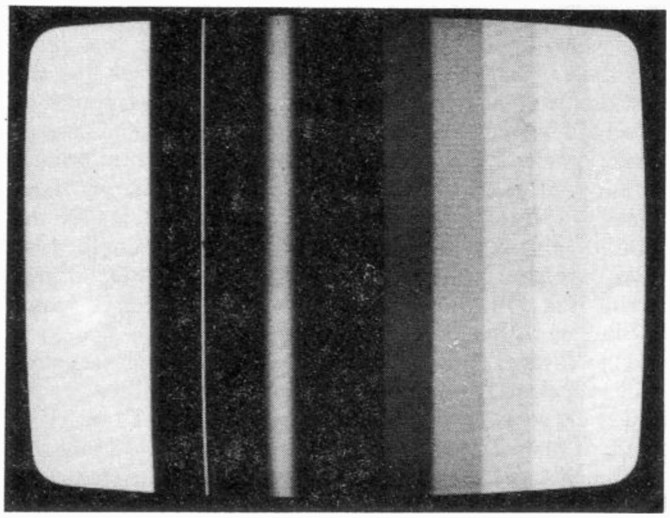
News Items

Afghanistan: Preparations are being made for the commencement of television from the capital, Kabul. Financial assistance is being given by Japan.

India: Yet more balloons! It seems that studies favour the use of 18 balloons moored at 10,000ft. to cover most of India with television signals. It seems that the cost would be less than a quarter of that for conventional land-based transmitters. No date has been given for start of work.

Pakistan: Both the Karachi and Lahore TV Centres are now producing colour programmes. The current price of colour receivers (about £1,000) is rather restricting enthusiasm!

Belgium: The system C transmissions at v.h.f. changed to system B from 26th April 1977. At the same time experimental BRT-2 and RTB-2 transmissions started.



Test Pattern used by RTVE (Spain).

BRT-2 will be on Tuesday and Friday evenings, RTB-2 on Wednesday and Thursday evenings. BRT-1 will go out on chs. E2, 10, 11, 43, 44, 49; BRT-2 on chs. E25, 46, 47, 48, 55, 62, with retention of system C on ch. E2 only.

From our Correspondents . . .

Brian Fitch (Scarborough) reports that Switzerland is to allow private radio/TV companies to establish programme networks and that ten such companies have applied for licences. Our congratulations to Bill Holt (Leeds) on his promotion to Service Manager. Bill has been an avid experimenter with Band I arrays: amongst these have been a wideband fanned dipole and more recently a corner reflector with dipole arranged in a reversed polarised system but connected in phase. I hope to be able to give more details of these in the near future.

Satellite Update

Following the successful Indian TV transmissions at 860MHz from the ATS-6 satellite a second successful experiment is taking place, this time to Canada and at 12GHz. The Canadian CTS (Communications Technology Satellite) is in synchronous orbit at 116°W over the Equator and incorporates a 200W travelling-wave tube amplifier – one of the most powerful transmitters to have been used in space. Its solar collectors extend to some 55ft. overall (see Fig. 1) and can provide 1330W – 1074W at 72V for the various experiments and 256W for "housekeeping". The uplink from earth is at 14GHz. Receiving stations for the 200W output are tuned to 12·038-12·123GHz and there is also a permanent 20W downlink to Ottawa at 11·843-11·928GHz. For reception, dish arrays of 32in., and three, seven and ten feet diameters are used – the smallest is reported to have a signal/noise figure of better than 40dB.

Japan is also to enter this field. Three satellites are to be launched by NASA into a 36,000km synchronous orbit at 110°E for the Japanese Space Development Agency. The TV transmissions will be at 100W in the 11·7-12·2GHz band and are expected to start before 1979. The Japanese broadcasting organisation (NKH) has produced a receiver adaptor for direct reception of these transmisssions. It uses a parabolic dish reflector (either of 60cm or 1m), with a planar s.h.f.-u.h.f. converter fitted within the waveguide. The converter is a metal sheet with "the appropriate pattern cut or etched into it". The i.f. output is at 360MHz±90MHz, with noise figures and conversion losses of 4·1dB and 3dB respectively. The 360MHz f.m. signal is then further converted to a conventional a.m. vestigial sideband TV signal within the normal v.h.f. channel allocations. The unit has already given good results with the Canadian experiment.

At the recent Geneva conference of the ITU, the UK was allocated five channels for TV broadcasting in the 12GHz band. As to when broadcasts will commence cannot at this stage even be guessed at. CBC in Canada comment that direct to home transmissions will not take place before 1985.

Although most systems at present make use of accurate parabolic dish arrays, the EBU has published details of a prototype 1m square array consisting of copper laminate board with extremely low loss dielectric properties. The surface is covered with a mass of etched dipoles, all connected in phase and to a common output point where the first conversion stage would be located. This would seem to be ideal for mass production.

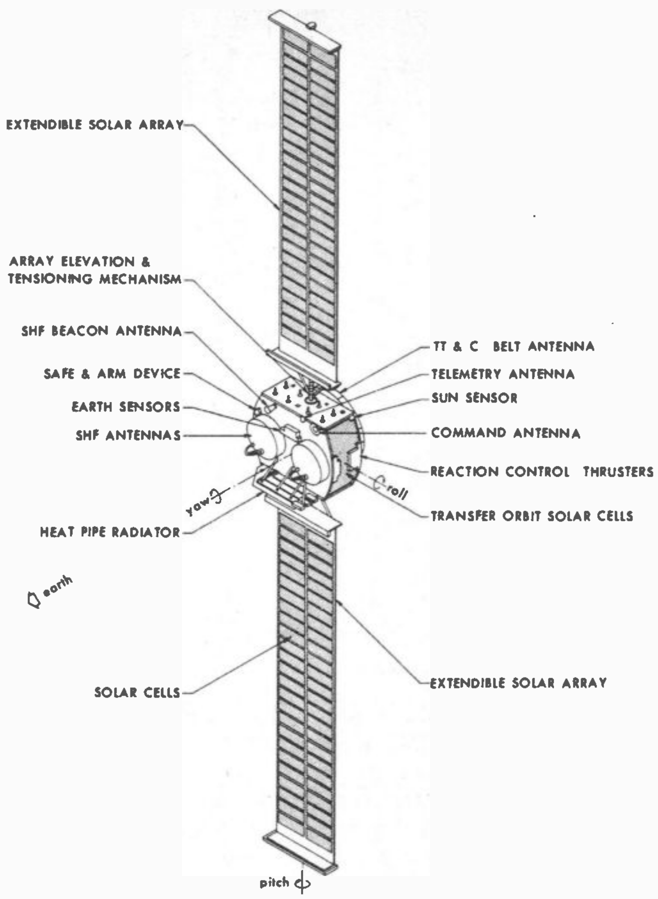


Fig. 1: Details of the Canadian CTS satellite.

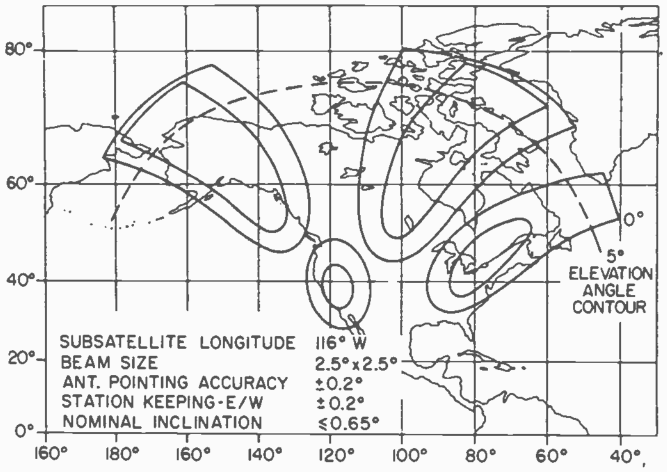


Fig. 2: Typical coverage areas of the CTS satellite at 12GHz: the outer lines indicate the – 3dB points.

Diagrams by courtesy of the Canadian Electrical Engineering Journal.

We hope to end this "satellite update" next month by including detailed information from Philips of equipment available for off-air satellite reception, both at 860MHz and 12GHz. Our thanks to Brian Fitch for obtaining information on the CTS satellite.

HOW TO DX – PART 2

Last month we discussed suitable types of aerial. The story doesn't end there however since it's necessary to mount the aerial(s) on a mast. Heights of up to 30ft. can usually be achieved quite easily at moderate cost, though depending on the means of support some physical effort will be required. For the affluent among us there are telescopic,

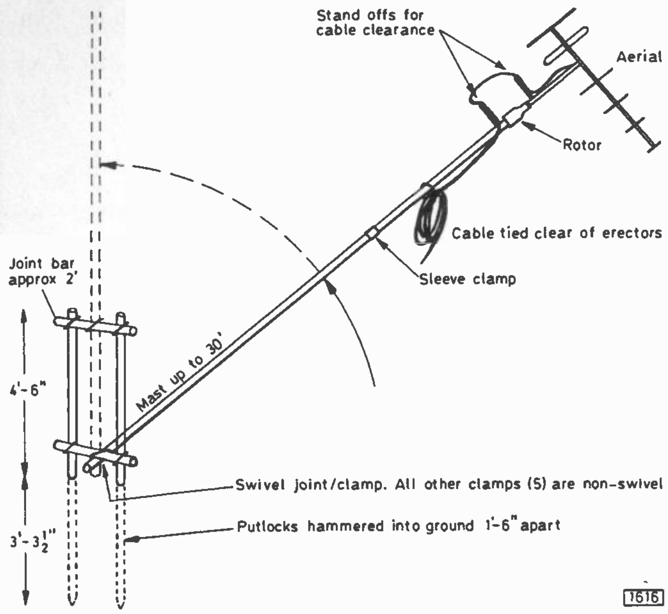


Fig. 3: Scaffold TV aerial mast. Putlocks can be obtained at any length to order.

tilt-over unguyed 80ft. lattice structures: the effort required here is mainly in digging a deep hole for the concrete – and writing out the cheque!

The easiest and possibly cheapest way of making a free-standing mast which can be tilted is to use a scaffold pole system. It's possible to construct a mast of up to 30ft. but I would suggest that you stop at 25ft. for the first one of this type you try. A mast system such as that shown in Fig. 3 can be pushed into the vertical position by two people and when vertical one person holds the mast whilst the other bolts it safely. Most large builders' merchants have a range of scaffolding, or indeed contacting a local scaffolding firm may bring forth an illustrated leaflet showing the clamps, sleeves and swivel joints available.

Typical Scaffold Installation

Fig. 3 shows a typical installation. Two putlocks (a length of steel scaffold flattened at one end) are hammered into the ground to the depths suggested – hopefully missing any underground pipes and mains cables. Space them some 18in. apart and parallel. Two jointing bars are then clamped as shown. The clamps are non-swivel types. The mast is clamped to the lower jointing bar via a swivel clamp, allowing the mast to be lifted without fear of the bottom moving. When pushed into the vertical position a non-swivel clamp is used to hold the mast against the top jointing bar. If both the upper non-swivel and the lower swivel are loosened slightly the mast will slip through and rest on the ground. Thus the putlock supports only keep the mast in the vertical plane, the weight load being taken straight to the ground. It's obviously wise to have a base plate or other metal plate for the mast base to rest on, to prevent the mast digging into the ground. The upper section of the mast is sleeved on via a steel scaffold sleeve clamp since scaffolding is usually 1⅞in. o.d. unlike the usual 2in. o.d. aerial mast tubing.

The putlock support structure should be of steel and the mast itself should be of alloy scaffold. When pushing the mast into the vertical position it will whip but cannot slip due to the swivel clamp. Lift it slowly. It's wise to tie up any coaxial feeders to avoid trampling over them whilst erecting: 8ft. from the top is usually sufficient. If a lightweight rotor is used, match it with a lightweight array to avoid damage. It should be possible to provide additional support for such a rotor with the usual thrust and alignment bearings.

Using Your House

Most of us live in conventional houses which can be used as an efficient support structure – the peak of the roof is often up to 28ft. Ideally one should live in a house with a side wall to the height of the peak roof level. Then, armed with a high ladder, wall brackets can be Rawlbolted to the uppermost brickwork and, with the addition of a 2in. o.d. alloy mast, we can be up to 35ft. at minimum cost. In such installations it is wise to clear the roof by at least 4ft. at Band I – this will allow one to scale the roof to examine the arrays at any time. The chimney can also be used, with a heavy duty lashing, but if it's used for solid fuel or as a gas flue outlet ensure that the arrays are clear of the outflow in the interests of reducing corrosion.

Whilst on the topic of roofs I would advise against using an attic array. True, excellent results are obtained during Sporadic E openings – but then I've locked noise-free Band I Spanish signals with just a small screwdriver in the aerial socket! The outside array with its freedom from screening and absorption comes into its own however when Jordan ch. E3 is struggling in – I've never received Jordan on a screwdriver!

Lattice Masts

The subject of lattice masts could fill a book. A lattice mast enables one to lift the aerials from 30ft. to perhaps in excess of 100ft. They can be climbed with ease and if correctly erected are much safer than a scaffold mast – bearing in mind that the height may be three times as much. Lattice masts are expensive – very expensive if purchased new. Fortunately it's possible to buy surplus masts, and a look through the RSGB publication *Radio Communication* will often reveal a reasonably priced one. An alternative source is a Government Auction. My first alloy mast came from a USAAF sealed bid sale – 26ft. at a cost of £4! P. Harris, Organford, Dorset usually have a number of masts available, often at reasonable prices. If one has no financial limit however a number of companies can supply a range of lattice structures. Again the RSGB publication should be consulted. It must again be pointed out that these products are expensive when new. My own mast in its original 30ft. form cost £52 some years ago: the same mast is currently advertised at £162! This illustrates the current high cost of masts and also how inflation has affected most aspects of our lives.

Rotating the Array

The next point requiring a decision is how the arrays are to be rotated (assuming we are not using an omnidirectional array). It's possible to rotate the whole mast by hand: the mast must be secured vertically but able to rotate within its support structure. The scaffold system could be used for this, or you could use several wall brackets mounted one above the other with the mast loosely clamped through the 'U' brackets. In both cases precautions such as greased mast grommets etc. must be taken to avoid wear between the brackets and the mast. To reduce friction use a large ball bearing at the base of the mast, with the mast resting on the ball and the ball in turn resting in a depression on a metal plate. Ball race bearings can also be used – these often have bolt holes allowing fixture to a wooden or metal baseboard.

Electrical Rotators

Electrical rotors are available from about £30 upwards. The light duty systems have a limited head loading and for anything more than a single array it's essential to use thrust bearings and matching alignment bearings. This removes the downward load bearing on to the motor housing and prevents excess sideways thrust due to wind. The larger rotor systems can take larger loadings without the need for support bearings, but where possible precautions should be taken against sideways thrust.

Power for the rotor is carried up the mast via three-, four- or five-core cable depending on the type of rotor in use. Control is via a control box calibrated with the points of the compass: it's normal to find rotation from North through to North (i.e. 360°) and impossible to exceed these settings. Earlier control boxes had a solenoid ratchet action that gave a loud clicking noise when in operation, but later types are silent. One advantage of the earlier types was that they gave an instant indication of the beam heading – a number of the later types give no indication of beam heading whilst in motion. The latter merely start and stop in the required direction with no direction indicated at intermediate points. I personally regard this as a disadvantage.

It's very important when cabling aerials via a rotor system to fit a stand-off arm above the rotor and another below on the fixed structure. This holds the cable clear of the motor and its projections, and prevents the cable rubbing or catching up. I have a separation of about 30in. between my two stand-offs.

Planning Permission

A final point on lattice structures with a permanent foundation. For large masts it may be necessary to obtain planning permission. Before erecting or even purchasing the mast, circularise your neighbours to tell them that you propose to put up a mast for distant TV signals. Tell them that it won't affect their signals, nor attract lightning or foreign interference. Then fill up the planning application forms (usually four or more) and call it a radio mast to carry fringe TV aerials. Do not call it a lattice tower. Add that all neighbours have been contacted and have no objections. It's helpful to state that the aerials are for reception and not for transmitting, and hence won't cause interference. To keep the form simple, compare the mast's height with that of your house (e.g. just high enough to clear the roof etc.). There should then be no problem.

Aerial Downlead

A simple rule is to use the best coaxial cable. The signal at the aerial is weak, and with a long cable run much of it can be lost. Antiference have two types of air-spaced (i.e. spaces in the dielectric) coaxial cable. The standard type has a loss per 100 metres of 9·2dB at 50MHz and 23·1dB at 500MHz. This compares with the low-loss type which has a loss per 100 metres of 5·5dB at 50MHz and 18·9dB at 500MHz. A signal voltage drop of 6dB along your feeder is half your signal!

THE BAIRD 700 CHASSIS

– continued from page 423

base and emitter strapped together. The transistor's collector then corresponds to the diodes' anode.

Junky convergence controls are not as common on this chassis as on most of its contemporaries, the only real offender being R524, the R/G line amplitude control. A suitable replacement will be found in R517, the corresponding 405-line control.

Intermittent horizontal convergence change is often the effect of a noisy system switch. This should be cleaned and firmly fixed in the 625 position, or soldered up once and for all.

Power Supply

The power supply circuitry (Fig. 7) is nothing if not robust – no Syclops nonsense here! No results and a shattered fuse is often due to a faulty mains buffer/filter capacitor C600 or, less commonly, a short-circuit h.t. rectifier diode D40 or D41. No results and an intact fuse usually means that the rotary mains on-off switch has failed. A picture which gradually decays away with defocussing and white clipping should lead to a check of the c.r.t. heater connections on the mains transformer, where dry-joints can occur.

The pincushion correction transductor is mounted on the power supply panel and can fail quite spectacularly with fireworks and a burnt board. A more subtle effect caused by a faulty transductor is ringing, which causes wrinkles or corrugations in the corners and edges of the picture. Check the associated damping resistor R442 (22kΩ) before condemning the transductor on this one. Some sets may be encountered on which the early type of transductor AT4041/03 was fitted. This can result in the top of the picture bending to the right: the device should be replaced by the later AT4041/05, and R442 fitted (across pins 5 and 6) if it is not already there. Transductors are easily identified by the type number stamped on the side.

Occasional purity problems, in which coloured patterns often drift gently over the screen for ten minutes or more after switch on, can usually be resolved by moving the VA1103 degaussing thermistor N600 nearer to R601 to increase its working temperature.

710 Series

The 710 series was an updated version of the earlier models, and many of the bugs we have described were ironed out in this later chassis. All the 19in models were of the 710 type and on the 19in sets the degaussing coils tend to develop short-circuit turns, leading to burning of the degauss control components or mains fuse blowing. Many models in the 710 range were fitted with a push-button tuner which eliminated the maladies associated with the rotary tuning system, but had mechanical problems of its own with the actuating bar becoming dislocated. The cure is obvious on inspection, and usually involves removing the tuner cover to check and lubricate the bearings. Modifications include the addition of a.f.c. – an RCA CA3034V1 i.c. is used for this purpose – and the use of a later type of tripler with the PD500 omitted and a v.d.r. type focus control. ■

Faults on the Bush TV125/Murphy V849 Series

N. Lyons

THESE sets, the Bush TV123, TV125 and TV128 and the Murphy V849, V873 and V879, are now some fourteen years old. Many still survive however and they are particularly prized as DX receivers. Their modification for DX use was described in the December 1973 issue, while stock faults and servicing were covered by Les Lawry-Johns in the June and July 1969 issues. The purpose of this short article is to cover various faults which could cause trouble to those with limited experience of this chassis, particularly those who have obtained one of these sets for DX use and find that they have problems with it before they can start on modifications for DX use. Being of bird's nest construction, the chassis can seem formidable at first sight.

UHF Tuner

To start with, it's best to regard the valve u.h.f. tuner as a dead loss: a cheap transistor replacement will be far more satisfactory, fed from the valve u.h.f. tuner's h.t. supply via a suitable dropper resistor. It's safe in these sets to short out the u.h.f. tuner heaters – this won't over-run the remaining heaters.

VHF Tuner

The original v.h.f. tuner, type A337, was fitted with a PCC89 and a PCF86 valve and suffered from various faults, not the least being breaking into oscillation in Band I. This will usually be found to be due to 1C11 (0·001μF) which decouples the a.g.c. line or 1C6 (15pF) which earths the secondary of the input tuned circuit going open-circuit. Cross-modulation and violent overloading are often caused by the mixer output coupling capacitor 1C20 (0·001μF) in the i.f. can on the tuner unit becoming leaky. This results in the application of a positive voltage to the control grid of the first i.f. amplifier valve (the EF85). In quite a number of these sets the v.h.f. tuner has been replaced by a type similar to that used in the later TV141 series, with a PC900 and a PCF801 valve. In our experience these tuners have never caused any trouble.

AGC Faults

Moving on to the main chassis assembly, problems can be experienced with the a.g.c. circuit. As shown in Fig. 1, this is relatively complex. The main a.g.c. circuit is shown at (a) and consists of a voltage doubler rectifier (2MR3) followed by the usual filters and a diode-connected triode clamp. A noisy picture may not be the tuner but the 10MΩ resistor 2R13 in series with the a.g.c. delay control going open-circuit. Unsatisfactory contrast control action and/or unstable sync and buzzing sound may be 2RV1 being set incorrectly or 2R13 changing value. Other culprits of odd a.g.c. action are 2C6, 2C15 and 2C19. On 625 lines there is a second a.g.c. line – see Fig. 1(b) – to prevent lock-out. This consists of a filter between the u.h.f. detector output and the control grid of the second i.f. stage. Poor hold on 625 lines may well be due to 2C30 in this circuit. Also check 2R51.

Vision Troubles

A slow deterioration in picture quality and possibly the sync performance as the set warms up on 405 lines is often due to the vision interference diode 2MR4 (OA81) going leaky – being a germanium type, it suffers badly as the temperature changes. It's not operative on 625 lines of course.

No vision at all with a rather disturbed raster and buzzing sound may well mean that the third i.f. amplifier valve's screen grid feed resistor 2R19 (1kΩ) has changed value – or the associated decoupler 2C20 (0·001μF) has died. The possibility of the 270Ω cathode bias resistor 2R23 in this stage increasing in value should not be overlooked.

Very weak signal can be due to the h.t. feed resistor to the anode of the first i.f. stage going open-circuit: this is 2R7 (22Ω) on 405 lines, 2R8 (33Ω) on 625 lines. A point to note here is that if a very strong signal comes along from the tuner the effect of this fault will be more akin to aircraft flutter.

Faced with a blank raster, check the 3·3pF i.f. filter capacitors 2C32 (405 lines) and 2C33 (625 lines) in the final i.f. can. They have been known to short together.

Returning to faults where there is at least a little video present, if it's negative check 2C31 which feeds the a.g.c. detector or even, on 405 lines, 2L22 which forms the inductive section of a 3·5MHz parallel tuned rejector circuit following the vision detector diode: if there is overloading as well as negative vision try the video cathode-follower's 15kΩ load resistor 2R35 and if necessary check 2L24 in the associated i.f. rejector circuit.

Brightness Increase

A large number of these sets suffer from increasing brightness. This can be due to the v.d.r. (3VDR3) in series with the brightness control going odd but is much more likely to be the result of the pentode video amplifier's 10kΩ anode load resistor 2R33 creeping in value.

Flywheel Sync Circuit

The line timebase is quite reliable, but there are frequent troubles, including timebase failure, due to the awful semiconductor diodes used in the flywheel line sync discriminator circuit. We have seen these replaced by

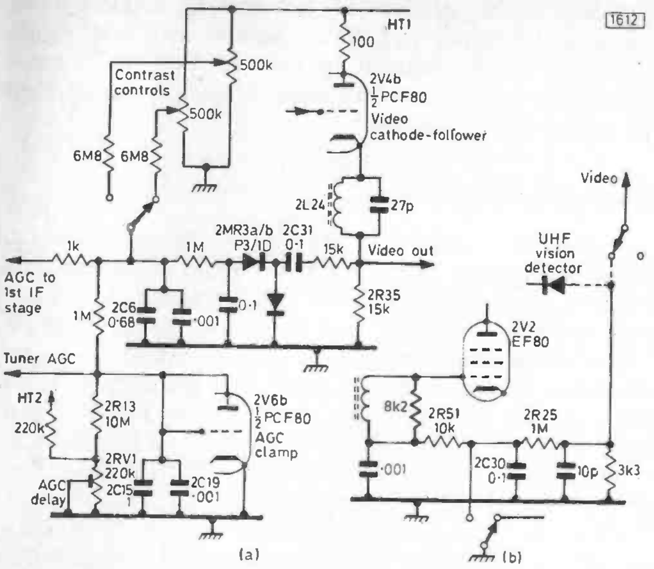


Fig. 1: The a.g.c. system. (a) Main a.g.c. circuit. (b) Additional circuit operative on 625 lines to prevent lock-out on sudden application of a strong signal.

various repairers by anything from OA81s to 1N4004s, the latter with more than a little cogging on the picture. Our experience is that OA85s serve best as replacements. In one case we encountered the symptoms were line whistle but no e.h.t.: the set would start from cold on 405 lines but on 625 lines it would start at the wrong speed and if then switched to 405 lines would continue at the wrong speed. The cause was dissimilar forward resistance of the discriminator diodes. Another fault, wondrous to behold, is when the line collapses on plugging in the aerial: the set produces a normal noisy raster with no signal but as soon as the discriminator diodes see sync pulses they cause hell and the line oscillator stops.

Line Generator Presets

There are four controls in the line generator circuit, the hold control 3RV5 (100kΩ), the 625-line preset hold control 3RV3 (500kΩ), the flywheel line sync discriminator balance control 3RV1 (2MΩ) and a trimmer 3TC1 (150-700pF) which enables the main hold control to be set for correct speed on 405 lines at the centre of its range. When not caused by the diodes, such faults as cogging, weak or non-existent line sync or even line collapse can be due to 3RV1 or 3TC1 being incorrectly set. 3RV1 can also have an intermittent track, causing line collapse, or can change value, causing S-shaped verticals.

Shorting Resistor

Finally, a fault which sounds unlikely but has caught us twice. The set works well for about half an hour, then in five minutes the width will reduce to about half the normal width, eating line output valves in the process. The h.t. drops to about 150V and the line output valve's screen grid voltage will be found to be the same. The cause is that the 2·2kΩ screen grid feed resistor 3R28 has gone short-circuit when hot. In both cases, by the time I had switched the set off and connected an Avo meter to the resistor to measure its resistance it had cooled down sufficiently to assume its correct resistance. ■

Frequency – Synthesised Tuning

Phosphor

In the USA, where there are rather more TV channels available to the viewer, tuners which respond to the channel number are being developed – the channel number is simply "dialled up" and the tuning system does the rest. There are various ways in which the designer can go about arranging this, but common to all is the digital frequency synthesiser – digital rather than analogue because l.s.i. chips enable complex logic circuits to be cheaply made, with no setting up required.

At the heart of the frequency synthesiser system is a phase-locked loop which of course operates on similar lines to the familiar flywheel line sync system. A voltage controlled oscillator – VCO, see Fig. 1 – feeds a phase detector which produces zero output only when the VCO is exactly in step with the reference oscillator. The output from the phase detector is amplified, filtered and fed back to the VCO in such polarity as to bring it back into step with the reference signal should it drift. With the flywheel line sync system the reference oscillator is at the transmitter while the VCO is the line timebase. In this case the VCO operates at exactly the same frequency as the line sync pulse repetition rate, the object of the exercise being to remove the effect of noisy jitter on the sync input.

Adding a Counter

Now suppose, as shown in Fig. 2, we place a counter between the VCO and the phase detector – for example the 7490 divide by ten integrated circuit. For the loop to lock, the VCO now has to run at ten times the reference frequency. The clever manufacturers of i.c.s now make programmable counters, which can be cascaded if required, and as a result any number we select, from one to theoretically no upper limit, can be counted. By using such i.c.s, any whole number multiple of the reference frequency can be generated – with a precision equal to that of the reference signal.

It helps to use a phase detector which gives one output polarity when the signal from the VCO is below the reference frequency and the opposite polarity output when the VCO signal is above the reference frequency – in effect a combined frequency and phase detector. It's easy to make such a detector with i.c. logic elements, ensuring that the VCO pulls in over its entire range without the need to get it "nearly right" as has to be done with the simple circuits used in flywheel sync systems (with these there has to be some slight error for the system to operate).

The v.h.f. and u.h.f. channels in the USA are separated by 6MHz. It would seem therefore that 6MHz would be the choice for the crystal reference oscillator, and that the divider would be programmed by whatever number is appropriate to get the channel we want. Unfortunately life is not that simple. For one thing it's not the channel frequency that has to be synthesised but the appropriate local oscillator frequency, which is higher than the signal frequency by the amount of the i.f. Also the channel frequencies are not exact multiples of 6MHz, though they are spaced by this amount.

Operating at UHF

A further problem is that clever though the i.c. manufacturers are they cannot yet make programmable counters which operate at u.h.f. Considerable ingenuity has been used to overcome this limitation. A very simple solution is to divide the VCO and the reference signals by the same fixed amount and then feed the divided VCO output to the programmable counter – see Fig. 3. Fixed counters can be made to divide by amounts up to more than 1GHz, powers of two being preferred to multiples of ten. Thus if we can get a programmable counter to work at 10MHz, the range can be extended to 500MHz by dividing the VCO output by 50. The reference oscillator should then operate at 6MHz/50 = 120kHz.

There is another approach however which keeps the basic channel spacing frequency for the reference signal. This is easier to filter and as we shall see the technique is preferable to prescaling.

Although a programmable divider cannot at present be made to operate at 500MHz it's possible to make a "variable modulus" counter which can count by either of two adjacent whole numbers on command. Once again it's easier to understand the technique when described in decimal form. Fig. 4 shows the arrangement, with a variable modulus divider dividing by either 10 or 11. The variable modulus counter is followed by a programmable counter operating at M, which must be ten or more: in addition there is an auxiliary counter A operating at 0-9. At the start of the cycle the variable modulus counter divides by 11 – until told to change. After 11A pulses, the auxiliary counter will have counted down to zero. At this point it tells the variable modulus counter to change to dividing by 10: it must itself then stop counting until reset. The programmable counter's output is also reduced by A, and thus now contains M – A. It will require 10(M – A) input pulses therefore before it too reaches zero. Complete reset then happens, which is where we came in, the counters being

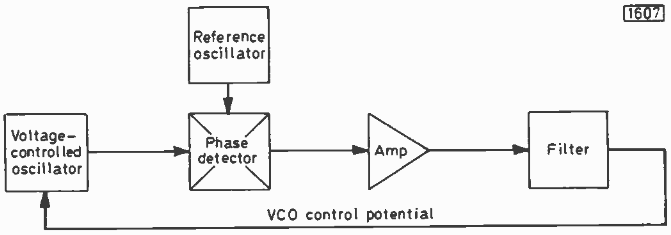


Fig. 1: Basic phase-locked loop. The phase detector pulls the voltage-controlled oscillator into synchronism with the reference oscillator.

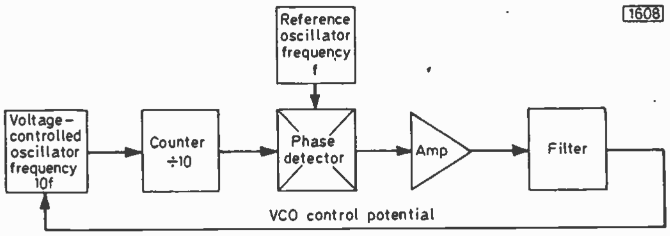


Fig. 2: Adding a counter. The voltage-controlled oscillator now operates at ten times the reference oscillator frequency.

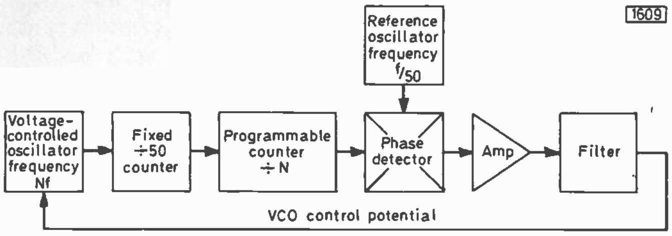


Fig. 3: Using a programmable counter and a prescaler to extend the range. The programmable counter makes it possible to alter the frequency of the voltage-controlled oscillator while still maintaining a locked loop. By suitable programming channel selection can be achieved.

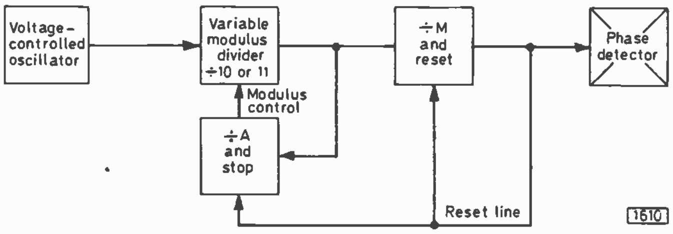


Fig. 4: Another way of overcoming the frequency limitations of programmable counters is to use a variable modulus divider.

reset to M and A respectively. A total of 11A + 10(M – A) pulses has to be supplied to the input each cycle, working out at 10M + A. M can be made the hundreds and tens digits and A the units digit therefore of a high speed decimal counter which can divide by any whole number from 100 to 999. To divide by 517 for example M would be set to 51 and A to 7. TV channels are not decimally spaced of course, but the principle is still valid for other operating moduli.

Channel Selection

While the u.h.f. counting problem can be solved more cheaply by using digital techniques than by heterodyning to reduce the u.h.f. to a region where the normal programmable counter can work, there is still the problem of converting the channel number to a counter programme. Once more the i.c. manufacturer provides the solution, in the form of a read only memory (ROM) device. This stores the counter programme corresponding to the channel number. The ROM is controlled by a keyboard similar to that of a pocket calculator, and a read out, similar again to a pocket calculator, shows the viewer which channel he has selected.

The system selects the local oscillator frequency at the precision of the crystal used in the reference oscillator circuit. Thus no manual fine tuning or a.f.c. should be required, the transmitter being probably several orders more stable than is strictly necessary even for colour.

Fine tuning may be required however, for example to avoid interference. One way of doing this is to pull the reference oscillator in the same way as is done with colour decoder reference oscillators. Another way is to use a much lower reference frequency and a much higher count, effectively reducing the channel spacing to a few tens of kHz. The count can be altered by a few numbers either way from the correct one, providing mistuning in steps, and by suitable choice of numbers the ROM can be greatly simplified, using a reference which is a small fraction of the channel spacing. This is the reason for preferring the variable modulus counter to the prescaler. The latter would require a further reduction of the reference to a value so low that there would be problems with the filtering in the loop. As it is, channel change can be so quick that no sound muting is necessary during the change.

UK Implications

The system outlined above is only one approach and is particularly suitable in the USA with the much wider choice of channels, the v.h.f. and u.h.f. standards being the same and within the capability of the synthesiser. Whether it would be worth using the technique in the UK is questionable, though it's certainly applicable to Band II f.m. receivers and multi-channel two-way radio systems from h.f. upwards, giving considerable reduction in cost and increased versatility. ■

Letter

BECOMING A SERVICE SPECIALIST

THE comments on my short article on becoming a Service Specialist (February) made by Barry Pamplin (April letters) are so much the opposite to the experiences of myself and several colleagues who have followed a similar course that I'd like to make the following points in reply.

First, local press advertisements are inexpensive and give a job return at a fraction of the £2 suggested as a commission to the "small and medium sized TV shops within a ten mile radius of your house". Note the number of tradesmen regularly advertising in the classified columns of local papers.

Secondly, to be in business small and medium sized TV shops must have their own service engineers. On what basis does Barry Pamplin suggest that these shops deal with the free-lance serviceman? Does the free-lance represent the firm, in which case complaints, payment etc., must be made back at the shop, or does the shop owner tell his customer "sorry, I'm not able to service your receiver but can arrange for a free-lance to call"? In the first case the free-lance has little to gain apart from his £2, but much to lose. In the latter case the shop is put in a bad light – and bad news travels fast.

Quite apart from the "consumer protection" angle, the free-lance service engineer who gives competent, fair priced service in the home can quickly become the dealer of tomorrow. Only outright Electricians are likely to give TV service work to a free-lance on a commission basis.

Some TV shops may employ a free-lance service engineer on a part time or per job basis – but only in their own workshop, not dealing direct with customers and probably taking their custom away.

I think we all know what makes good customer relations – but "just chatting for fifteen minutes on each occasion" isn't what the customer called you for. I'd further say that this time, plus the time and expense involved in travelling to customers over a ten mile radius in any direction at £2 a call, isn't a practical business proposition.

Finally, I didn't advise renovating "old bangers"! Selling or renting good reconditioned sets can be the foundation of a good business – take a look at the windows of highly successful and profitable national rental companies! – **G. R. Wilding** *(Paignton, Devon).*

The Decca 80 Chassis

Part 3

Barry F. Pamplin

IN this final part in the series we'll be taking a look at the timebase circuitry used in the 80 series chassis and then briefly glance at the newer 100 series chassis which employs the Philips/Mullard 20AX c.r.t.

The Timebase Panel

The circuit of the timebase panel is shown in Fig. 10. It contains the components associated with the sync separator, line oscillator, line driver, the entire field timebase circuit, the c.r.t. first anode controls, part of the audio output i.c. shunt regulator, the pincushion distortion correction circuitry and such dynamic convergence circuitry as there is (almost none!).

Sync and Line Generator Circuits

The well known Mullard TBA920 i.c. is used as the sync separator and line generator (IC300). Composite video is applied to pin 8 and 12V d.c. at pin 1. The pulses which drive the line driver transistor Tr300 appear at pin 2. The 12V supply line is derived from the 37V supply produced in the line output stage. The components concerned are R326, D302, C316 and the 12V zener diode D301. This arrangement presents the problem of how to get the supply from the line output stage going when the line oscillator is itself fed from that supply. R324 is included for this purpose, providing a bleed current via the 165V h.t. line to get things started. You don't need me to tell you what the symptoms are when it goes open-circuit!

The cluster of capacitors around this i.c. are mute evidence to the apparently insurmountable difficulties of building circuits with long time-constants into silicon chips. Fortunately they rarely go wrong, since tracking down the faulty one could be a long job.

The only adjustment in the circuit is the line hold control VR321, which is set to give a floating picture with the test points connected to R306 linked across.

Diode D300 is connected to the tuner selector (on some models) where its cathode is earthed when the set is operated with a VTR. This short-circuits C304/R305, providing the short time-constant sync conditions required for VTR operation.

Most faults in this section of the receiver are due to the i.c. itself, and this should be checked by substitution before other tests are made – remembering to check the pin voltages (see Fig. 9). Other components which have been known to fail are the driver transistor Tr300 (same type as the video output transistors) and the line start resistor R324. On early chassis this resistor was 6·8kΩ – on later production it was reduced to 5·1kΩ to overcome intermittent failure to start.

The Field Timebase

Turning now to the field circuits, you will see that the whole operation is performed by IC301, an SGS TDA1170. Sync pulses from the collector of the field sync pulse integrator transistor Tr301 are fed to pin 8 of the i.c., and the output to drive the scan coils appears at pin 4. The frequency of operation is controlled by the time-constant R349/VR350/C331.

The 23V supply for this i.c. is derived from the 37V line via the series regulator transistor Tr302.

For some reason which is not immediately apparent it is the field timebase i.c. rather than any other one that takes a beating when the c.r.t. flashes over. The Decca modification to prevent this is the addition of a strap between the earthy end of C331 and the earth tag on the i.c.'s heatsink. Apart from this the circuit is reliable.

As in every part of this set, when trouble occurs it is more often than not the i.c. itself which is faulty. Amongst the symptoms recorded and found to be due to a defective i.c. are field collapse, half the scan missing, foldover at either the top or bottom, general linearity troubles, and compression in the centre of the scan. Whatever one's sentiments about the trend to pack everything into i.c.s, there can be little doubt that servicing a circuit like this is a hundred times easier than those horrors with six or eight transistors all coupled together in mysterious ways which defy any logical approach to fault location.

A1 and Convergence Circuits

The only other circuits on the panel are the c.r.t. first anode controls, which occasionally suffer with open-circuit tracks or local burn ups, causing the grey scale to assume a cast, and the pincushion correction transducer and dynamic convergence controls. To date we have had no trouble from these circuits. The only dynamic correction required by the SSI tube (apart from the line balance coil L705 which is on the tube neck assembly) is that concerned with the correct overlay of vertical lines at the side of the scan. To obtain the necessary correction currents a 70V line flyback pulse is integrated by L300 to give a sawtooth current in the convergence coils L701/L702. Resistors R345, VR347 and capacitor C325 add a parabolic component to the current,

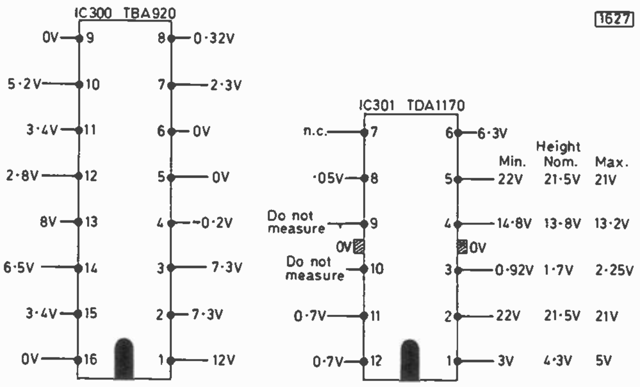


Fig. 9: Timebase panel i.c. voltages, measured with an Avo Model 8 (20kΩ/V).

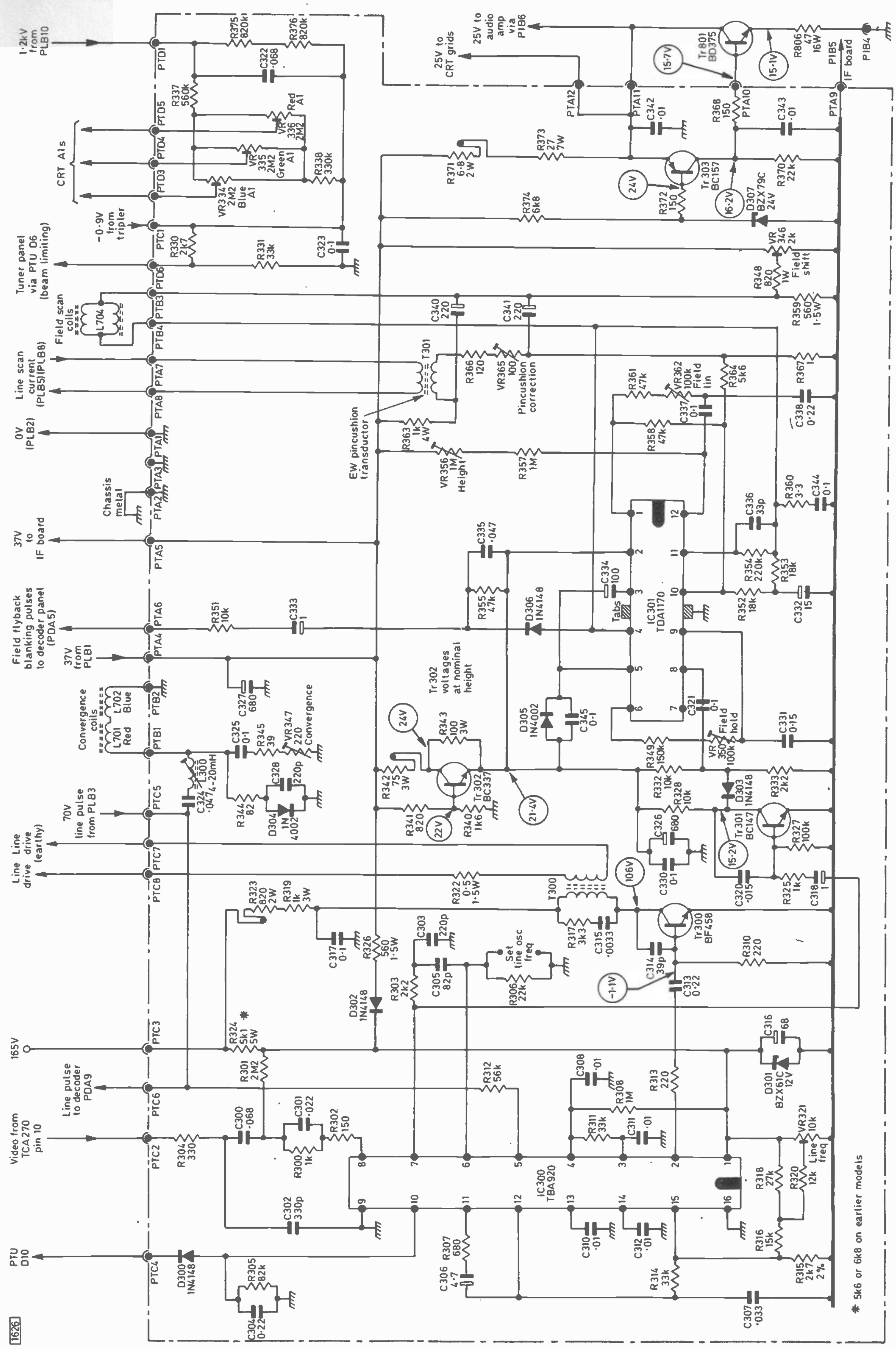


Fig. 10: The timebase panel circuit, which includes the minimal dynamic convergence circuitry required by the Toshiba SSI tube. The shunt regulator which supplies the audio i.c. is also shown.

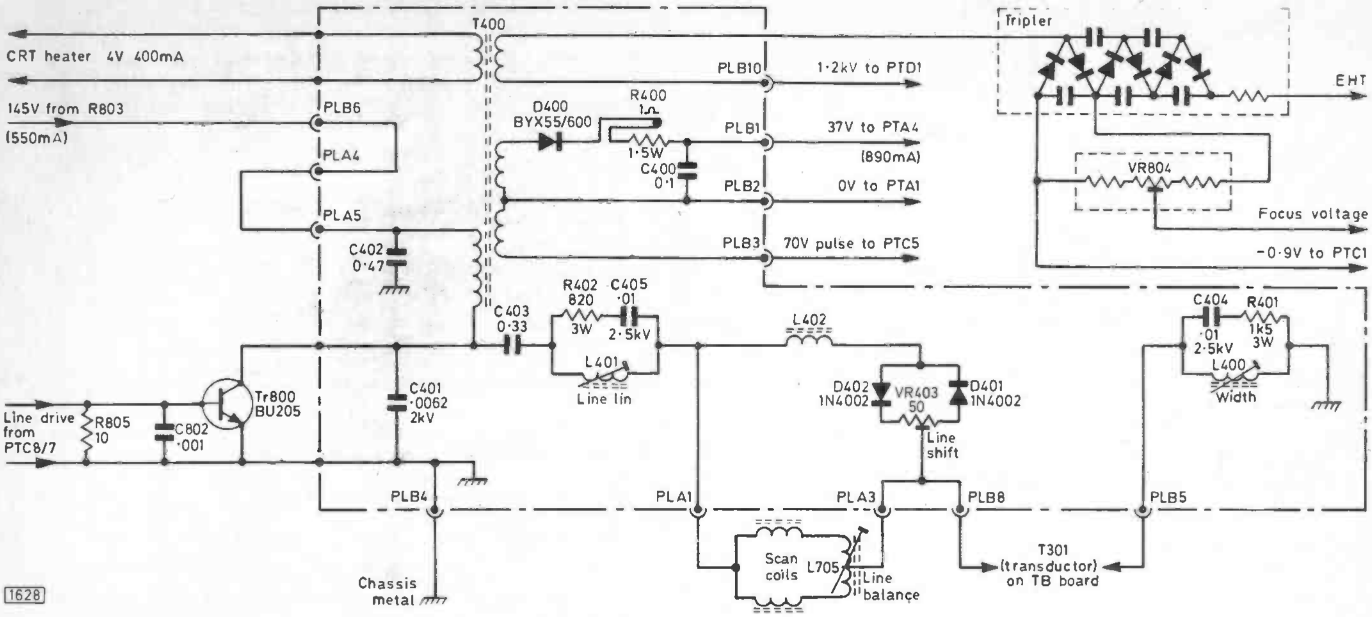


Fig. 11: The transistor line output stage is classically simple. East-West pincushion distortion correction is provided by a transductor mounted on the timebase panel: the line scan current flows through one section of this.

and diode D304 minimises static convergence shift during the operation of adjusting the dynamic convergence controls.

The Line Output Stage

The circuit of the line output stage (Fig. 11) is surely a joy to behold after dealing with sets from some other manufacturers – it is so simple that it looks like one of those idealised circuits so beloved by text book authors. Indeed it would be an insult to my readers to start explaining how it works. Not only is it simple but it's also, as these things go, reliable. Sometimes the transistor goes short-circuit and actuates the trip on the power supply. Sometimes the tripler goes with the same effect. Occasionally the tripler develops a fault which results in the trip blowing the mains fuse half way through Coronation Street each week, much to the annoyance of the viewer and the chagrin of the poor engineer who after replacing the fuse three times on the trot begins to tear his (or her – if any of you out there are of the gentle sex) hair out.

On many of these energy recovery output stages the tuning capacitor across the transistor (C401) gives a fair amount of trouble. So far on the 80 series we have not come across this fault, but it's a fair bet that sooner or later we will.

Servicing Precaution

When fault finding in the line output stage it's a good idea to add about 200Ω of extra resistance in series with the h.t. line feed dropper R803. This prevents faults in the stage automatically killing off the BU205 as soon as you switch on.

Low-voltage Supply

One feature of the line output stage is that it feeds every other part of the set via the 37V supply obtained from the transformer secondary via D400 and R400/C327. The latter is on the timebase panel. R400 is a fusible link resistor which is obviously intended to open in the event of a short on the 37V line. In practice is doesn't seem to work like that. Any overload operates the crowbar trip before R400 has a chance to get hot enough to open.

Overloaded 37V Line

When dealing with a set that keeps operating its crowbar as a result of overloading of the 37V line it saves time to bear in mind the various feeds from that supply. The system used by the author is as follows.

(1) Deactivate the crowbar and insert an indicator lamp as described in the section dealing with power supplies.

(2) Switch on the set and check the voltage at the following points. A lower voltage than that shown indicates a fault in the section mentioned.

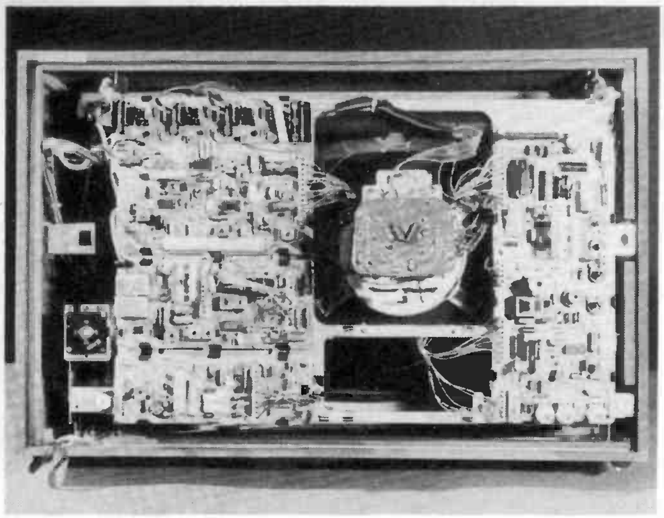
Tr302 emitter	23V	Field fault.
TL213 on decoder	25V	Decoder fault.

Sound output stage faults which drag down the 37V line are masked by the effect of the shunt regulator, but such faults are easily recognised by the effect they have on the audio produced by the set.

The 100 Series Chassis

The Decca 100 series chassis is similar in many respects to the 80 series. It uses a Mullard 20AX 110° tube, and is currently available in 22 and 26in. versions. The 20AX tube has in-line guns, vertical phosphor stripes, preconvergence and, to counterbalance all these good points, a certain amount of East-West pincushion distortion.

The convergence circuitry is different from that used on the 80 series, there being six so called "convergence tolerance controls", though in later chassis not all six are actually fitted. The main framework is the same as the 80 series, as are the power supply board, the i.f. and sound board and the decoder board. The timebase board and line output board differ to cater for the different scanning



Rear view of the chassis, showing the neat layout.

requirements of the 110° tube, and there is an additional board for the convergence tolerance circuitry. A BU208A line output transistor is used, and a discrete component field timebase with an output stage similar to those used in the Thorn 9000 and RRI Z718 chassis.

Two other minor differences concern the h.t. dropper resistors, which are horizontally mounted at the top of the framework on the 80 series but are vertically mounted on the left-hand side on the 100 series, and the line output transistor which is mounted on the main framework on the 80 series but on the 100 series merits a nice heatsink with all mod cons attached to the line output board.

The line section of the timebase board remains as in the 80 chassis. The 100 series timebase board is considerably larger than the 80 series board, partly because it contains the circuitry which drives the E-W diode modulator in the line output stage – it's a high-level modulator incidentally. N-S distortion on the 20AX tube is small and is not corrected on the 100 series chassis – at least not on those sold on the home market!

Because the 100 series chassis has been in production for only a short time there is no hard data on stock faults. As it uses the same power supply board as the 80 series it will presumably be heir to such troubles as we previously mentioned in this department: the same goes for the i.f., sound and decoder circuits.

Summary

To summarise then. As a successor to the Bradford chassis the Decca 80 and 100 series seem to have hit the right balance between sticking to established technology and using some up-to-the-minute design concepts. From a servicing point of view the design is a dream. It is easy to get at, runs cool, and for seven out of ten service calls all you need is a set of i.c.s and a penny to get the back off. At last – colour servicing on a push-bike!

Corrections

On the Mk 1 decoder there is no link between PDA2 and PDA10: this link must be added if a Mk 1 decoder is used to replace a Mk 2 decoder (the earthing paths differ).

In Fig. 4 (power supply circuit) the voltage at the junction of D617/R643 was shown as 29V. This is incorrect. The voltage at the junction R617/R618 is 29V: the manufacturers do not quote any voltage figure at the junction D617/R643. ■

Constant-current Sources

S. George

STABILISED h.t. and l.t. supplies which provide a constant voltage output are familiar enough to us nowadays. Circuits which provide a constant current output on the other hand are quite rare in TV practice, though they are used in some recent solid-state colour receivers.

The first constant current source was the barretter, which was included in the heater circuit of some early valve sets to maintain the heater current at the correct 300mA despite mains voltage variations. It consisted of a thin iron wire suspended in an inert gas. The resistance of the wire increased as the voltage across it rose, which is not surprising since it was operated in a semi-glowing condition and as we all know the hotter you make a conductor the greater its resistance. It was a fragile device however and soon fell into disuse.

Pentode and Transistor Output Characteristics

The pentode or beam tetrode valve is a simple and quite close approximation to a constant current source, simply because once its anode voltage has reached a certain point further increase results in negligible increase in anode current. The typical pentode output characteristics shown in Fig. 1(a) bring this out: above about 50V the anode voltage/anode current curves for different control grid voltages are almost horizontal. This implies another characteristic of the pentode and beam tetrode valve: its output resistance is high. We are talking about a.c. resistance here – change in anode voltage over the resulting change in anode current (Ohm's law). If you consider the valve simply as a type of conductor its apparent anode-cathode resistance, given by Va/Ia (not *change* in voltage and current), is vastly different.

Thus supposing we have 200V at the anode, 170V at the screen grid and a negative control grid bias of −10V. The anode current – see Fig. 1(a) again – would be about 150mA and the anode-cathode d.c. resistance about 1·3kΩ. A pentode or beam tetrode valve is not an ordinary conductor or resistor however: on measuring its true output impedance the change in anode current as a result of reducing the anode voltage from say 200V to 150V is so small to be negligible. The high output impedance of multi-grid valves is due to there being at least one screening grid between the control grid and the anode, and also to the physical construction, with the anode in particular being well spaced from the control grid.

A transistor operated in the common-emitter mode has a similar output characteristic, as Fig. 1(b) shows. The curves are quite linear above a certain collector-emitter voltage, but are not parallel with one another: the greater the base current, the more the curves tend to spread.

Thus if this transistor is biased to a particular working point within its operating limits, say 20μA base current for example, an a.c. input signal which swings the base current equally between the extremes of say 10μA and 30μA will not be equally amplified – the positive half cycles will be amplified to a greater extent than the negative half cycles, a point we tend to overlook. This means that there must be distortion, and in fact if second harmonic distortion is not to exceed 5% the ratio of one half cycle to the other must not exceed 1·22. This is rather straying from the point however.

The transistor's collector-emitter output characteristics show that it has a medium to high output impedance. Thus with a base current of 30μA for example, changing the collector-emitter voltage from 8V to10V produces too small a change in collector current to be read with any degree of accuracy, implying a high output impedance. As with the pentode valve however if the transistor is regarded as a type of conductor its apparent resistance is quite low.

To sum up then, if a transistor with a fixed bias is in series with a varying supply voltage, its collector current will not vary to any great extent.

Differential Amplifiers

This feature is important when a transistor is used as the current source for a differential amplifier (long-tailed pair). This particular arrangement is rarely found in discrete TV circuitry but is widely used in TV i.c.s.

Let's take the basic differential amplifier circuit first – see Fig. 2. Here two transistors of the same type operate in the common-emitter mode with a shared emitter resistor and identical value collector load resistors. They can amplify from d.c. to v.h.f., require no decouplers, and can be cascaded in a multitude of ways. The input is normally applied between the two bases so that, assuming identical transistor characteristics and loads, as the current through one transistor increases so the current through the other one decreases to exactly the same extent, maintaining a constant current through and a constant voltage across the common emitter resistor. The output can be taken from between the collectors or between one collector and chassis,

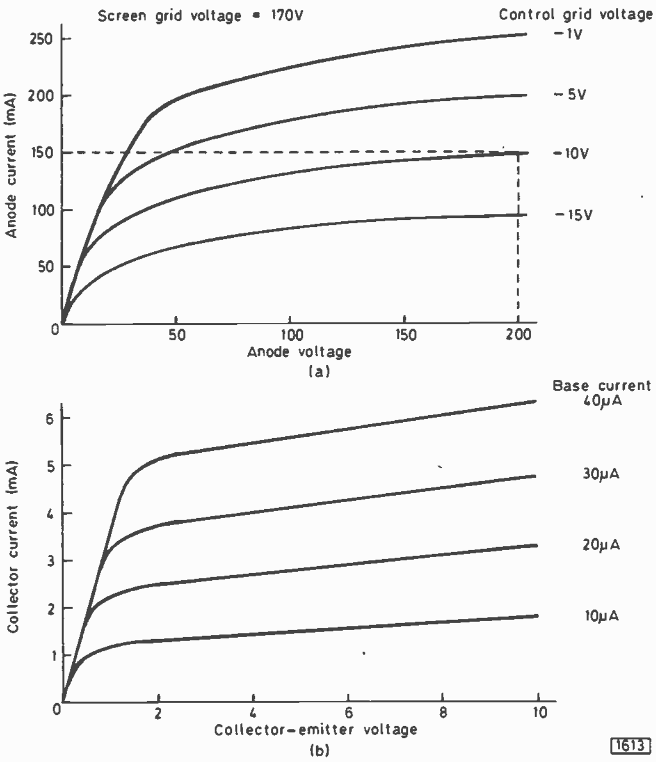
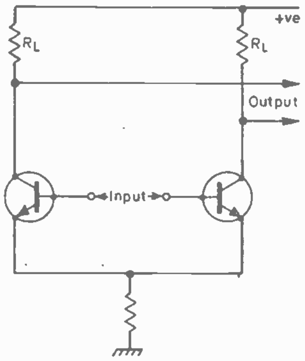


Fig. 1: Typical output characteristics of a beam tetrode valve (a) and a small-signal common-emitter transistor (b). In both cases once a low anode or collector voltage has been exceeded the current flowing through the device varies very little with further increase in anode or collector voltage.



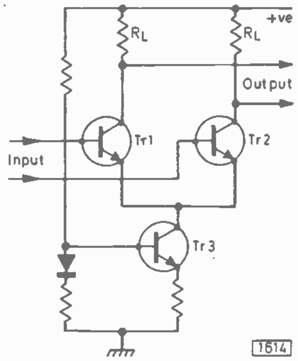


Fig. 2: (left): Basic transistor differential amplifier (long-tailed pair).
Fig. 3: (right): Improved circuit in which the common emitter resistor is replaced by a transistor (Tr3) with fixed bias to provide a constant current source for the differential pair Tr1/2, thereby minimising the response to in-phase signals appearing at the two bases (common-mode inputs).

depending on the requirements of the following stage.

The two transistors in a differential amplifier circuit respond therefore to the signal difference applied between the two bases. They will also respond to in-phase signals appearing between their bases and chassis. If the transistor characteristics and load resistor values are identical however the collector voltages will shift by the same amount. Thus providing the output is taken from between the two collectors there will be zero signal output.

Some imbalance must exist however, and in consequence similar inputs between both bases and chassis will result in some response between the two collectors. This is called the "common-mode" response and is clearly not wanted, especially in i.c.s, since it can lead to instability. With a common-mode response, the collector currents of the two transistors increase or decrease together (though not to the same extent) instead of differentially: thus if the current supply to the two transistors could be set at a predetermined fixed figure there would be a maximum common-mode rejection, the amplifier responding almost exclusively to differential input signals.

A high value emitter resistor would help in this respect, but would involve an excessive voltage drop. The answer, particularly in i.c.s where another transistor on the chip is of no great moment, is to replace the emitter resistor with a fixed biased transistor – see Fig. 3. Although there is only a small collector-emitter voltage developed across the transistor (Tr3), its high output impedance holds the total current flowing through the differential amplifier pair reasonably constant, largely eliminating common-mode responses.

The constant current source transistor Tr3 can be provided with fixed forward bias from a resistive potential divider chain, with a diode incorporated to give enhanced stability with temperature change, or the bias can be provided by a string of diodes or of course a zener diode. The dissipation of a constant current transistor used in this way will be a fraction of that of a resistor with comparable effectiveness – this is vital in i.c.s – and the transistor will involve only a small voltage drop.

In an i.c. one might well find Tr1 and Tr2 replaced by Darlington pairs where high current gain is required. Making the forward bias to Tr3 adjustable gives control over the gain of the circuit.

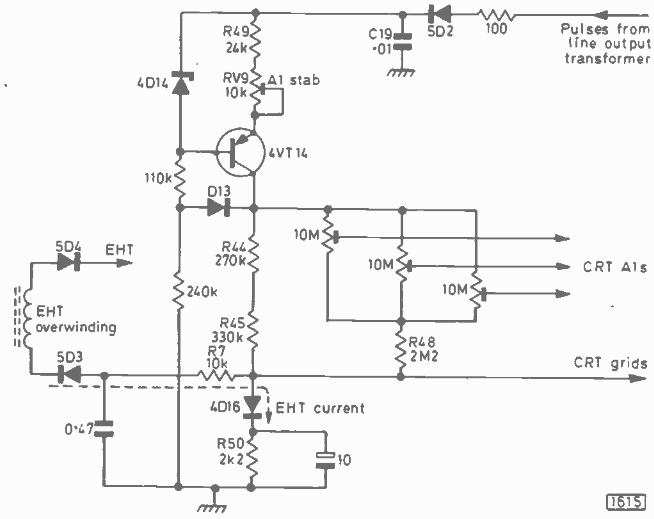


Fig. 4: The constant-current c.r.t. first anode voltage stabiliser used in the Rank Z718 colour chassis. The 30V zener diode 4D14 provides a fixed forward bias for the constant-current transistor 4VT14 whose constant collector current provides a stable voltage across the resistors in its collector circuit. since the first anode preset controls are included in this resistive network the first anode voltages are held constant and are also constant with respect to the grids which are taken to the junction R45/R48/4D16. 4D16 provides beam limiting. In later versions of the circuit the preset controls are 2·2MΩ, R44 is 510kΩ, R45 560kΩ and R48 430kΩ. There have also been minor modifications in the beam limiter circuit.

Constant-current First Anode Supply

An interesting example of the use of a fixed-biased transistor to provide a constant current supply is found in the current RRI Z718 chassis. The circuit is shown in Fig. 4 and is used to stabilise the c.r.t. first anode voltages.

Positive-going line flyback pulses are rectified by diode 5D2 to provide 700V across its reservoir capacitor C19. This supply is fed via R49 and RV9 to the emitter of the constant current source transistor 4VT14 whose base is forward biased by zener diode 4D14. The collector of this transistor is taken to chassis via R44, R45, 4D16 and R50, the c.r.t. first anode presets, in series with R48, being connected in parallel with R44 and R45. The c.r.t. grids are connected to the junction of 4D16/R45/R48, and in this way the voltage between the c.r.t.'s first anodes and grids is held constant. This gives a very stable brightness level.

Beam limiting is also carried out in this circuit. 4D16 is normally forward biased, carrying 4VT14's collector current. It also carries the e.h.t. current however, which flows via the tube, the e.h.t. rectifier 5D4, the e.h.t. overwinding on the line output transformer, 5D3, R7, 4D16 and R50 to chassis. 4VT14's collector current and the e.h.t. current flow through 4D16 in opposite directions, and so long as the former exceeds the latter 4D16 remains forward biased. If the e.h.t. current is excessive – if it equals 4VT14's collector current – 4D16 cuts off and its anode voltage moves negatively. The bias on the c.r.t. grids is thus increased, pulling back the beam current.

This use of currents flowing in opposite directions through a single diode is widely employed for beam limiting in solid-state receivers, both because of its simplicity and because the threshold level is maintained automatically without the need for preset adjustments. With preset beam limiter controls it's often found that they have been over advanced. This imposes excessive loading on the e.h.t. rectifier, overheats the shadowmask and degrades picture quality. ■

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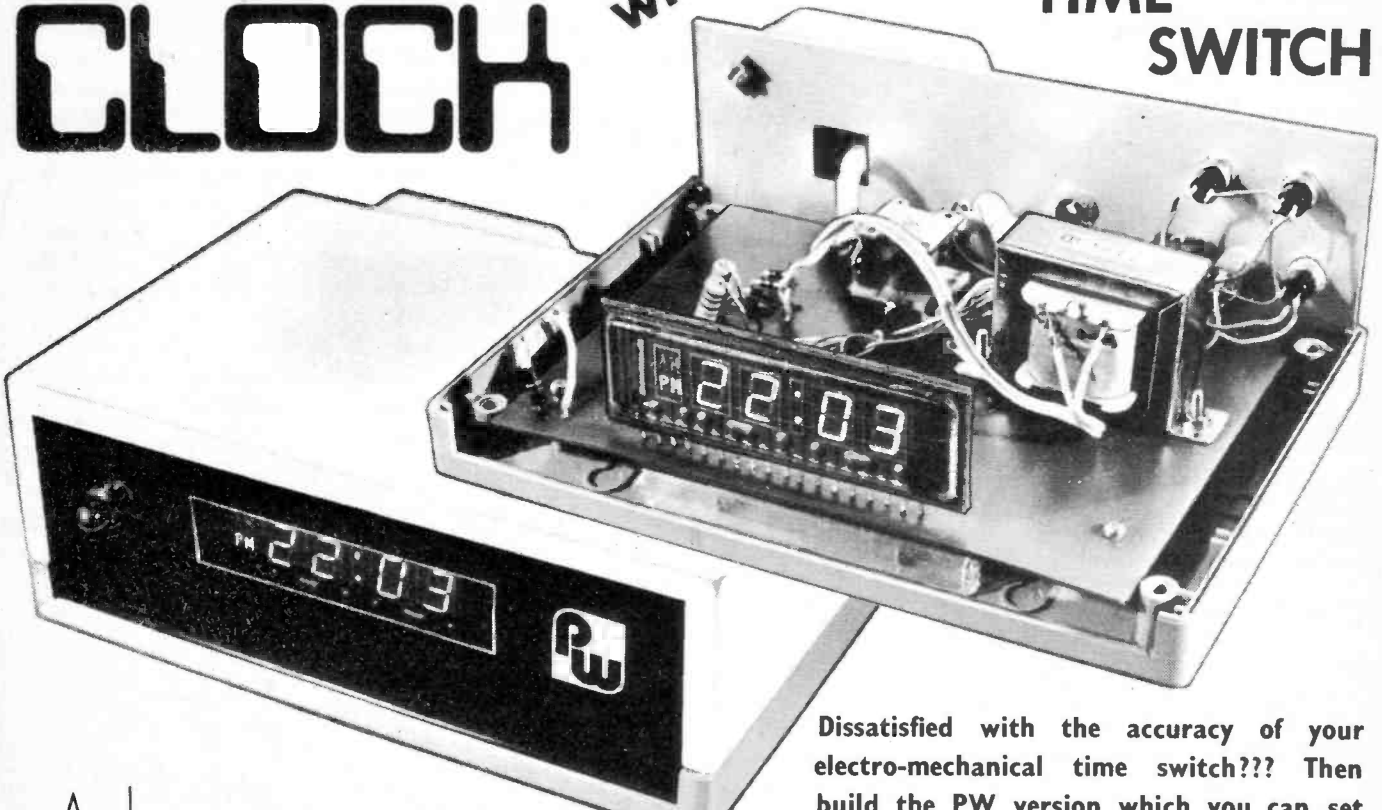

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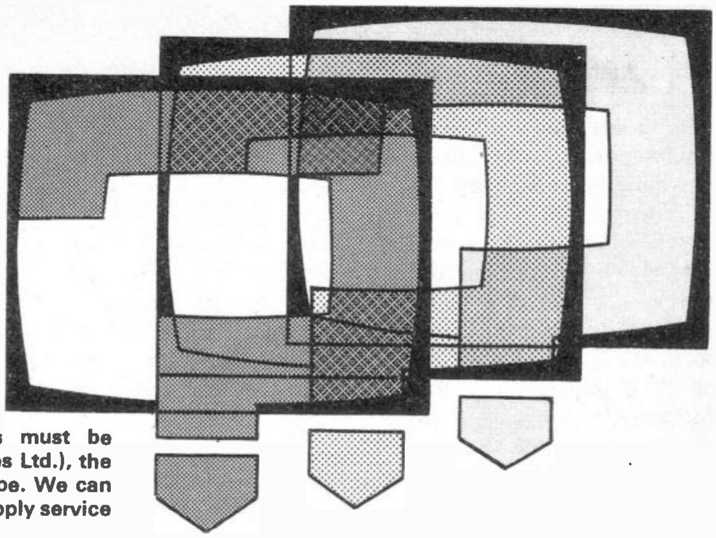

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THORN 3500 CHASSIS

The fault is displaced lines, fading to a ripple – similar to the cogwheel effect. It clears up when the set has been on for a quarter to half an hour. While the fault is present there is a whistle from the chopper choke L603. Also, the picture intermittently goes green. The h.t. reservoir/smoothing block C602/C603/C606 has been changed – it had blown and leaked.

The most likely cause of the trouble is that C619 (140µF) which smooths the chopper output is defective. Use a 220µF replacement. If necessary check C631 (0·01µF) in the driver transistor's collector circuit. For the green picture start at pin 6 on the c.r.t. base, where the voltage should be 160V, and check back through the green channel. The transistors, preset green drive control and the diode and electrolytic (W207 and C227) in the clamp circuit are all possible causes of the trouble.

FERGUSON 3816

The screen is very bright with just the ghost of a picture showing through. The brightness and contrast controls have no effect and the rail voltages are down.

We suggest you start checking in the video output stage, where the transistor itself (VT9) is the chief suspect. Check the voltage across its collector load resistor R51. There should be 45V at the collector with about 4V at the emitter. The excessive c.r.t. drive seems to be overloading the circuits to pull down the rail voltage. A BF337 is a suitable replacement for the video output transistor. (Thorn 1590 chassis.)

DECCA SERIES 10 CHASSIS

This set gives a good picture except for one slight fault which cannot be detected on most scenes. When the background is red however there is a vertical band of green down the right-hand edge of the screen, while on a green background there is a red band.

The ident signal is used directly to operate the PAL switch in this chassis, i.e. there is no bistable circuit. The switching is operating too early due to the ident signal being incorrectly phased. To clear the fault, find the ident coil L207 – the large coil beside the chroma delay line – and adjust it carefully to eliminate the effect.

PHILIPS G8 CHASSIS

The trouble is that horizontal orange lines appear on the screen when the set has been on for about two hours. They are stationary, wide at the bottom and closer to each other at the top. They will disappear by themselves but then reappear. They can also be cleared by switching the set off and on again, but reappear after a short time. This set uses the BA14 decoder panel.

Locate the area of the panel occupied by the reference oscillator transistor T173 and its adjacent crystal X167. If the application of a hair dryer at full heat to this section causes colour drop out preceded by orange or green stripes screw the core of the coil (L008) down about one turn. If this doesn't cure the fault you will have to check the components in this area.

GEC SERIES 2 CHASSIS

There is a field hold fault on this single-standard monochrome set. The field can be locked with the control about midway, but after a few seconds the picture drifts slowly up or down. The field charging capacitor C238 was found to have an improperly connected lead (inside) but replacement has made no difference. A new PCL805 field timebase valve has also been tried.

Check that the voltage at the screen grid of the sync separator section of the PFL200 valve is about 60V. If not, check the feed resistor R141 (47kΩ). Check C131 (4µF) which decouples the screen grid of the video section of the PFL200, the field sync pulse coupling capacitor C206 (300pF), and try a new PFL200 if necessary.

PYE 697 CHASSIS

This set gave perfect reception until recently when the colour started to come on only after the set had been off for a considerable time. The "cooling down" period required gradually increased, until the colour ceased to appear at all.

We suggest you try adjusting the reference oscillator a.p.c. loop bias preset RV10, on the back of the decoder to the left of the chroma delay line. When it is correctly adjusted the voltage at TP5 nearby (collector of the d.c. amplifier VT15) should be about 5V. Adjust the control for good colour, and check its range by repeatedly changing channel and tuning it for the most rapid colour pull-in.

PHILIPS G6 SINGLE-STANDARD

The trouble is severe buzz which varies on the different channels, being quite intolerable on BBC-1, less so on BBC-2 and least on ITV. Adjustment of the a.m. rejector potentiometer in the f.m. detector circuit has been tried and the component changed, but with no improvement.

It seems that there is quite a lot of signal in your area. Try adjusting the a.g.c. present control (R2092) as follows. Connect a voltmeter across the emitter resistor (R2086) of the first i.f. transistor and short-circuit the a.g.c. detector's reservoir capacitor C2041. With no signal, adjust R2092 for a reading of 2·4V. Connect the aerial and remove the short. If the buzz persists, see if you can minimise it by further adjustment of R2092. If not, return the control to the previous position. Check C1021 (100μF) which smooths the HT8 rail feeding the sound i.f. strip and the a.g.c. circuit – it may be drying up or have internal leakage. It may be necessary to fit an aerial attenuator.

GRUNDIG 5010

About six months ago the cutout blew and the scan thyristor was found to be the cause. The set worked for about a month then the cutout blew again. This time the flyback thyristor was faulty. On replacing it the set worked for ten minutes when the cutout again blew. Replacing the 0·15μF capacitor C515 which feeds the gate of the scan thyristor cured the trouble for a while but ever since the situation has been as follows. Upon switching on there is perfect picture and sound but after ten minutes either the cutout will blow immediately or the raster will become small, bright and heavily folded with the cutout operating after a second or two. If the set is left switched off for an hour or two and the cutout reset the picture will be o.k. for ten minutes after which there will be a click and off it goes again.

The capacitor and resistor (C515 and R515) in the scan thyristor's gate circuit are suspects but much more common are dry-joints on the panel in the line timebase department, especially around the commutating/input transformer 9245-834·21. Check the print connections carefully, also the transformer's internal connections. The mica washer under the flyback thyristor can also cause these symptoms.

BAIRD 600 SERIES

The boost voltage on this set is low at about 450V. All other voltages seem to be o.k. however and the line output stage valves, the boost capacitor and the line output transformer have all been replaced. None of the valves overheats so I presume that line drive is present. The width control has also been replaced. The DY86 e.h.t. rectifier does not light up.

If the output stage valves are cool check the PL504's screen grid circuit components R76 (1·5kΩ, 5W) and C77 (0·22μF). The trouble is more likely to be a changed value resistor in the width circuit however: check R77 (3·9MΩ) and R75 (1·8MΩ). Also check the value of the focus control R79 (2·2MΩ) which is connected from the boost filter circuit to chassis. Did you fit the correct line output transformer? – check the number on the back of the old one.

PHILIPS T-VETTE 11TG190AT

The fault here seems to be in the video section. On 405 lines the picture disappears suddenly five to ten minutes after switching on, leaving a blank raster but normal sound. Switching from one standard to the other restores the picture to normal for a further five-ten minutes. The situation is the same on 625 lines except that the picture fades off gradually. The video bias and a.g.c. presets have been adjusted in accordance with the manual and this seems to have cleared the fault – but on 405 lines only. The picture sometimes darkens a little a few minutes after switching on. This can be corrected by resetting the brightness control. Most of the resistors in the brightness control circuit have been changed since the originals had all increased in value.

It seems unlikely that the problem is due to an a.g.c. fault. We suggest you check the video driver and output transistors T2019 (BF115) and T1220 (BF177), also the 625-line video coupling capacitor C2077 (0·64μF electrolytic). No doubt you have cleaned the system switch and checked its operation. An oscilloscope would be invaluable in dealing with a fault of this type.

THORN 1590 CHASSIS

The first problem with this 12in. portable was wavy verticals which could not be removed by adjusting the line hold control. Subsequently the field collapsed to a horizontal white line. The voltages in the field output stage all seem normal however.

The field scan waveform is fed to the coils via C78 (1,000μF) which tends to go open-circuit to cause field collapse. If this is in order, check the oscillator stage voltages. The wavy verticals are likely to be due to the reservoir/smoothing capacitors C85 (4,700μF) and C87 (1,000μF). If these are in order check C86 (220μF) which decouples the slider of the set h.t. volts control.

BUSH CTV25 SERIES

Monochrome reception is perfect but as soon as the decoder is enabled by the presence of a colour burst on the signal the picture takes on a slight overall greeny-yellow tint which is especially noticeable in darker areas of the picture. The severity of the tint alters as the saturation control is varied, but is unfortunately noticeably bad at the correct setting. The decoder and the set as a whole has been set up correctly in accordance with the manual and new colour-difference output valves have been fitted. If the colour killer is over-ridden on monochrome the tinting immediately appears. I know of someone else who is experiencing exactly the same trouble on this model incidentally.

The tinting is due to stray pickup of the subcarrier oscillator signal in the early stages of the chroma amplifier and is unfortunately inherent. You might be able to improve matters by extra decoupling of the 15V line in the regions of the reference oscillator transistor 6VT3 and the first two chroma amplifier stages 5VT9 and 5VT1. Experimentation with earth paths, using heavy braiding, might also help.

PHILIPS G6 CHASSIS

There is a brightness/contrast fault on this dual-standard colour set – which is used on 625 lines. To obtain a picture the brightness control has to be at minimum and the contrast control increased carefully until the picture has just acceptable contrast. Turning the contrast control farther results in a dark picture with field slip and rasping on sound. At the optimum setting of the contrast control a washed-out picture is maintained if the brightness control is turned up fully. When programme transmission has ended there is a low brightness raster with poor interlacing at the top – this is made worse if the contrast control is turned either way from the optimum position.

It seems that the d.c. working level of the PFL200 luminance output valve is being determined by the collector voltage of the preceding phase splitter transistor T2144 (BC108). This should not occur since there is a coupling capacitor, C2045 (0·15μF), between the two stages. The capacitor is probably leaky.

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

A KB Model CK500 colour receiver was suffering from colour drift. Directly after switching on the colour performance was reasonably satisfactory, but after the receiver had been on for a while the background would take on a yellow tinge. Yellow, it will be recalled, is a complementary colour of red and green, so the drift appeared to signify that the tube was operating with reduced blue gun beam current.

It was decided first to check on the background white and run through the exercise of setting up the grey-scale. During this procedure it was noticed that the blue drive preset was almost fully advanced and that further correction of the yellow tint was impossible because of the small range of adjustment left.

The chassis used in this KB set is the ITT CVC5, which uses primary-colour drive to the red, green and blue cathodes of the picture tube. The demodulated B–Y signal is fed to the base of a matrixing transistor which adds the Y and B–Y signals to obtain the B signal. This is capacitively coupled to a pair of d.c. coupled transistors – the blue driver and output stages. Because of the a.c. coupling at the input, a diode clamp driven by line pulses is used. The blue drive control is in the output transistor's collector circuit. This area was fully investigated, including the two transistors, the clamp diode and the associated components, but no change in d.c. level could be detected.

It was then thought that perhaps the picture tube might be responsible, the blue gun emission falling for some reason. Before delving into this possibility, which could have meant a tube change, further attention was given to the signal carrying circuits in the blue channel. Oscilloscope tests and bridging of suspect components soon revealed the cause of the trouble, which was cleared by replacing one component.

Have you any idea of which component this might have been? See next month's Television *for the answer and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 173
Page 386 last month

The mini-explosion had certainly occurred within the Decca colour set, and after removing the back cover and ventilating the house it was soon discovered that the e.h.t. tripler at the bottom right-hand side of the cabinet had fractured and blown part of its shell on to the decoder board – fortunately with little damage to the electronics there.

The tripler in the early Decca single-standard chassis is physically larger than the latest species and appears to have a harder and probably slightly thicker encapsulation. The original symptoms were obviously caused by overheating of some of the selenium rectifier elements within the encapsulation, the pressure building up after the receiver was switched off and removed from the mains supply. This was certainly a very unusual fault. Its timely occurrence avoided returning the receiver to the workshop however!

Tripler replacement and readjustment of the focus and first anode presets put the performance back to normal and no further malfunction has been reported.

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TELEVISION JUNE 1977

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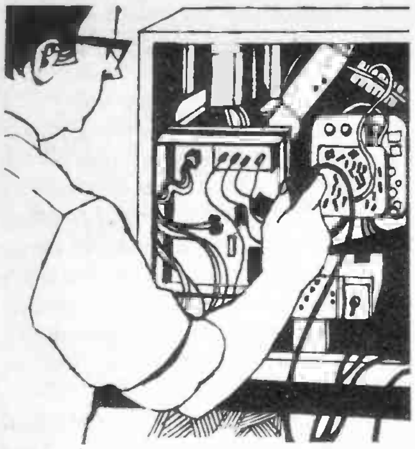

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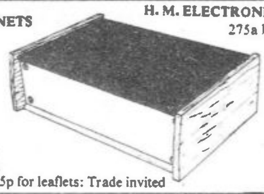

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