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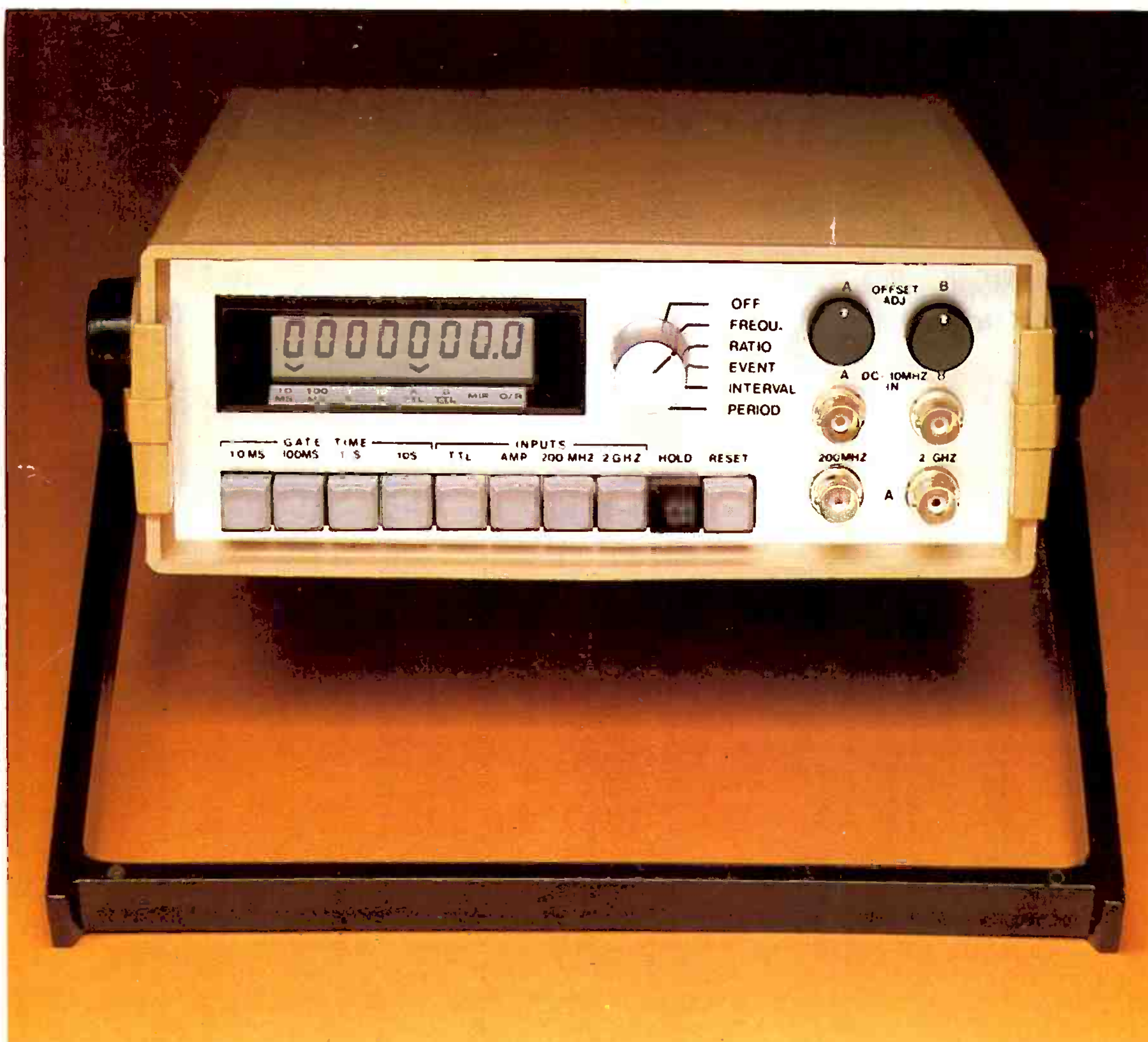

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TV FAULT REPORT • VCR CLINIC

TELEVISION

April 1983

Vol. 33, No. 6
Issue 390

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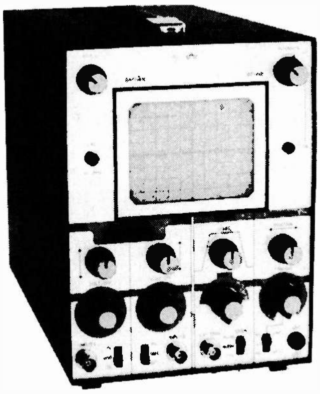

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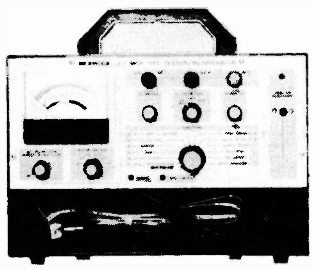

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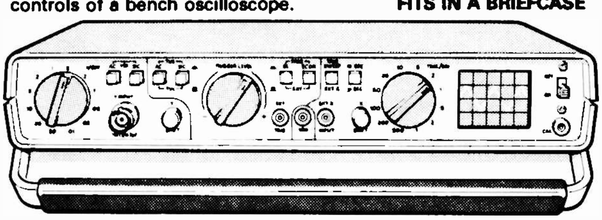

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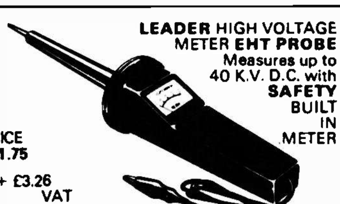

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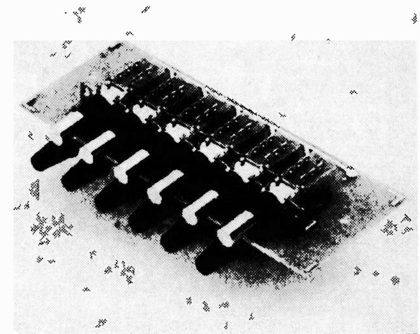

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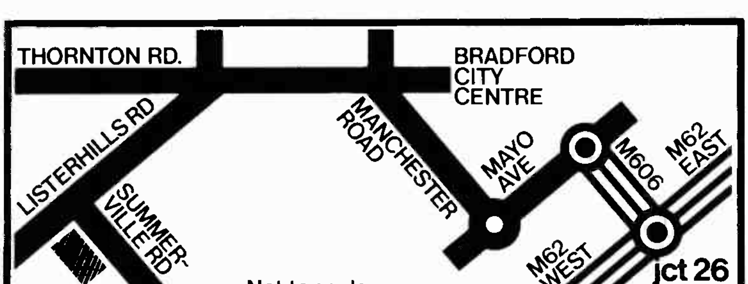

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TELEVISION

A Touch of the British Disease?

Quite recently I was reading an article that commented on a certain country's failure to innovate, lack of investment and excessive reliance on declining industries. The UK? You might well think so – the story has an all too familiar ring about it. But no, it was W. Germany. Not only that, but the main subject of the article was the W. German electronics industry. A day later (really!) I was reading an article on the failure of businessmen in another country to take the initiative in developing and going after new markets: they relied excessively on ageing products in declining markets. Ah now, it must be the UK this time, surely? Not so. The subject was the economic situation in the USA. To cap it all, very shortly after that I was reading about another country where the economy has gone ex-growth, production is stagnating, the government faces budgetary problems and there's concern over increased delinquency amongst school children. The latter subject brought in familiar sounding phrases like latch-key kids. This time it was Japan! Are we to conclude that the whole world is at last succumbing to the dreaded British disease?

Perhaps it's more that common weaknesses are being shown up by the present world wide adverse economic conditions. The main underlying causes of the situation appear to be the end, some years ago now, of the post-war boom; a lack of new technical developments to stimulate markets and production; and the consequences of excessive movements one way and another in the prices of commodities, oil in particular. The latter have led to quite irrational moves in exchange rates, further compounding the world's economic difficulties.

One could say that it's a case of world mismanagement, though no one's charged with that particular duty of course. Perhaps more to the point one could say that free market mechanisms have failed to work effectively in the economic conditions of the last decade. The problem here is that managed markets don't work any better, as the evidence from E. Europe shows.

A return to economic expansion is what's generally hoped for, and the electronics industry, which is by definition innovative, is in a better position than most other industries to provide at least part of the required stimulus. Many things are talked about: the next generation of computers, information technology, ever larger scale integration and so on, with various buzz words like satellites and cable being bandied about to add apparent zest to the prospects. Whether it will all happen is another matter. Large sums are being devoted to computer development – the so-called fifth generation of computers – but will a further massive increase in computer power be necessary, any more than supersonic air travel which seems to have been quietly buried? There is after all a limit to all things: at what point does number crunching become an end in itself? Once you get to this point you leave the world of practical products that can be sold profitably and enter the realm of grandiose schemes – white elephants. The things that have made the biggest everyday impact have been relatively down-market items such as electronic calculators, digital watches and VCRs.

VCRs, yes, and this brings us to the curious agreement (see overpage) reached between Japan and the EEC to limit the export of Japanese VCRs to EEC countries over the next three years and to increase the "floor price". The *Financial Times* didn't like the look of this one bit – a drift towards managed trade it complained. Why should cartels be set up so that the consumer ends up paying more than he need do for what he buys? Quite so.

The agreement is a curious affair, the first to be reached between Japan and the EEC (previous "voluntary" trade restriction agreements have been with individual countries). How it's to be put into effect has been left so vague that the whole thing looks like some sort of bluff. The idea is to help correct the present massive trade imbalance and give the European V2000 system a chance to survive. A production rate of 1·2 million units a year is expected to ensure economic manufacture of V2000 machines, and the hope is that sales will reach the same level. But this cannot be guaranteed of course. The V2000 system has the advantage of some further development capability in comparison to the VHS and Betamax systems, but it came along too late, and whether more sophisticated features and capability will mean much to prospective purchasers is open to question. The continentals have always been prone to over design consumer electronics equipment (think of the Philips K70 and K80 chassis, the extraordinary remote control system used in the Saba H chassis, and the more recent Grundig chassis bristling with sealed modules). One can't help but feel that it might have been wiser for Philips to have entered into a manufacturing agreement with a Japanese concern in the way that Thorn did.

Meanwhile the Japanese electronics industry seems to be set on moving up market, to the evident concern of the US industry. Considerable successes have already been achieved in the semiconductor field, and the world of large computers is clearly the next aim. What then?

The fact is that many lines of development in electronics are reaching their natural limits. The microprocessor for example is the culmination of a technology now some twenty years old. Bubble memories have been proposed and worked on but got nowhere, while some of the proposals now being talked about, for example the use of superconductivity to increase computing speed, would be horrendously expensive. It's possible that the electronics world could catch another British disease – the one that produces symptoms like the R101, the Bristol Brabazon and Concorde.

HELD OVER

The next instalment in our VCR Servicing series has had to be deferred while Mike Phelan took time off to write about conversion of the Philips N1700 series machines for half speed operation.

Due to shortage of space we have been unable to include the usual Readers' PCB Service box this month. The service continues in operation and the details given last month (see page 265) still apply.

Teletopics

JAPANESE-EEC VCR AGREEMENT

After four weeks of negotiations in Tokyo an EEC Commission delegation and representatives of the Japanese Ministry of International Trade and Industry (MITI), lead by the minister Sadanori Yamanaka, have reached an agreement to limit the export of Japanese VCRs and nine other categories of "sensitive" goods, including colour tubes, to Europe. The agreement has been endorsed by the EEC trade ministers.

Under the terms of the agreement, Japanese VCR exports to Europe are to be restricted to a total of 4·55 million machines this year, including 600,000 kits for assembly in Europe. The agreement is to last for three years, with export ceilings being negotiated yearly. In 1982 Japan exported 4·95 million VCRs to Europe – the figure for 1981 was 2·85 million. Japanese VCR exports world wide rose from 7·35 million in 1981 to 10·65 million in 1982.

The agreement between the EEC and Japan will "align" the prices of Japanese VCRs with those of European producers and "guarantee" European manufacturers sales of 1·2 million units this year (sales in 1982 amounted to 800,000). Quite how the alignment is to be carried out, considering the wide variety of different types of VCRs of varying degrees of sophistication, is not clear. Neither is it clear how European manufacturers can be guaranteed sales if the public should decide not to buy their products. It nevertheless seems that Philips and Grundig feel they have been given a breathing space to get production of V2000 type machines established at an economic level, and in consequence they are expected to withdraw the anti-dumping complaint they had lodged with the European Commission.

Control of prices and export totals at the Japanese end is to be put into effect by the formation of a MITI controlled cartel. Philips and Grundig have been under great pressure on the VCR front in Europe: both companies have been operating their production lines at well below capacity, and it's said that Grundig have been making a loss of over £50 on every machine sold.

SATELLITE TV COLLOQUIUM

The IEE is to hold a full day (9·15 a.m.-4·45 p.m.) colloquium on Unisat-1, the UK's first TV broadcasting and business communications satellite, on Tuesday May 17th. Non IEE members will be welcome at the meeting, which is being held at the IEE's Savoy Place, London WC2 headquarters. The satellite is to be launched in 1986 and is being privately funded by British Telecom, British Aerospace and GEC. It will provide for domestic DBS TV reception throughout the UK using dish aerials of less than 90 cm diameter, with regional beams covering the USA and Europe suitable for transatlantic business use and TV links.

VIDEO DISC LATEST

W.H. Smith have started to stock LaserVision software. The news follows a successful test operation at four of the group's stores. A wide selection of discs is now being stocked by 26 of the company's outlets in Scotland and England – the discs retail at £16-£18. It seems that Philips had hoped to sell some 10,000 players in the UK in 1982. No official sales figures have been released, but guesses in the trade suggest that the figure was between two and three thousand. The LaserVision system has also now been launched on the W. German market.

Things are all of a sudden livening up in the disc field. Following several postponements, JVC have now announced the launch of their VHD system – on the Japanese home market at the end of the month (April). It seems that Matsushita may launch a rival system at around the same time. In the UK, the RCA disc system has again been on show to the trade. An autumn launch is possible, with the players selling at around £200.

BIB's RE-RECORD TAB

VHS cassettes have a safety tab which can be snapped out to avoid further recordings being made – a useful feature for preventing accidental erasure. The tab is positioned at the rear of the cassette. What happens if you nevertheless want to reuse the tape? To overcome the problem, Bib have introduced a re-record tab which snaps into the position occupied by the original tab. The Bib re-record tab is reusable and can be easily removed using a small screwdriver or similar instrument. The tabs come in packs of twenty, the recommended retail price being £1·47 per pack including VAT. Detailed instructions are given on the attached display card.

TRADE SCENE

For the first time since the fifties, more TV sets are being sold outright in the UK than rented. Rental accounts for a much higher proportion of the large-screen colour and teletext receiver market however. The peak year for rental was 1972, when 73 per cent of sets made in the UK went out on rental.

According to a recent Mintel intelligence report (available from Mintel, 7 Arundel Street, London WC2R at £45), over 95 per cent of monochrome portables and 80 per cent of small screen colour sets are now being bought, which in view of the competitive pricing policies of retail outlets and the greater reliability of the current generation of sets is not surprising. Thorn remain the largest UK setmaker, with production running at some 700,000 sets a year to supply 25 per cent of the colour market and 14 per cent of the monochrome portable market. Philips also have 25 per cent of the colour market, and around 16 per cent of the monochrome portable market (the portables are mainly imported). Sony, Hitachi and Toshiba all have a share of some ten per cent of the colour set market.

A joint statement from Thorn EMI and JVC reports that negotiations for Thorn to manufacture TV sets for JVC are at an advanced stage. This seems to be a logical development in the growing collaboration between the two companies. The plan is to supply JVC with models in the 20-26in. range from Thorn's Enfield and Gosport plants. JVC at present import only small screen colour sets and observe a voluntary restraint agreement that provides an import allocation of 10,000 sets a year. The output from Thorn's Newhaven joint-venture VCR plant now goes 60-40 per cent to Ferguson (Model 3V31) and JVC (Model HR7650) respectively. Most of the rest of the Ferguson and JVC VCRs supplied to the European market now come from the joint-venture plant in W. Berlin.

The latest financial report from Tatung reveals that the losses made at the Decca Bridgnorth TV plant have been reduced by two thirds, while Decca's share of the UK colour TV market has doubled to four per cent. Tatung (UK) Ltd. hope for a further doubling of their market share and a return to profitability in the current year.

Production of Körting colour TV sets is being transferred to the parent company's (Gorenje) plant in Yugoslavia. Research, development and pilot production will remain in Grassau, Bavaria.

VDU FILTER

To reduce VDU operator eye strain, The Power Equipment Co. Ltd., Kingsbury Works, Kingsbury Road, London NW9 8UU is marketing a Swedish made anti-glare filter. The filters fit over the screen and are priced at £35 each plus VAT. In use the filter largely eliminates reflections and improves the display's contrast ratio.

SONY'S "SERVICE MATTERS"

Sony is the latest firm to produce a service bulletin, entitled "Service Matters", for the servicing trade. The bulletin will be issued quarterly by Sony (UK), Technical Publications, Ascot Road, Feltham, Middx. Other firms that publish bulletins for the servicing trade include Philips, Thorn and Hitachi.

NEW VCRs

JVC have now launched their VHS-C format portable VCR, Model HRC3, on the UK market. The HRC3 comes complete with an EC30 cassette which has a playing time of thirty minutes, a remote control unit, a thirty minute rechargeable NiCad battery, battery charger and carrying case. The compact cassette can be played in a standard VHS machine via adaptor type CP2U which is also supplied with the machine. There are various optional extras including tuner connection cables, a heavy duty battery and a mains adaptor.

The HRC3 can assemble edit two pieces of recorded material by backspacing approximately thirty frames between camera takes, creating clean edits. Other features include a built-in r.f. converter; record lock switch to save power between camera takes; automatic quick review; automatic rewind; a power save switch; r.f., video, audio and headphone outputs; microphone and camera inputs; and an LCD tape counter with memory function, also doubling as an accurate tape remaining indicator in minutes and seconds.

A new lightweight camera, the GX78, has been launched to complement the HRC3. It weighs just 1·38kg, can record well-defined pictures at light levels down to 50 lux (aperture f1·3), and has a two-speed X6 power zoom lens with macro position for close-up shots. The GX78 can also record stereo sound.

Panasonic have added the NV200, a portable using the VHS-C compact format, to their range of VCRs.

WILLOW VALE TRADE SHOW

The next Willow Vale Electronics trade show will be held at the Tay Motel, Perth, from 11 a.m. to 8·30 p.m. on Wednesday, May 4th. Admission is by invitation which is obtainable on request by telephoning 0734 884444.

RADIO RENTALS' TV MUSEUM

Radio Rentals have opened the Baird Museum of Television at their Swindon headquarters. Amongst those present at the opening were John Logie Baird's widow Margaret Baird, who made the trip from her home in S. Africa, and Leslie Mitchell, who announced the start of BBC TV test transmissions from Alexandra Palace in 1936. The museum brings the story of TV to life, with working models, pictures and sound recordings from Radio Rentals' archives. Amongst the exhibits are two sets constructed by Baird himself and a Fultograph machine dating from the twenties. The latter was used for sending still pictures by wire. Groups wishing to visit the museum should apply to Christine Reid, Radio Rentals, Relay House, Swindon, Wilts SN2 2BB.

SATELLITE TV NEWS

The magazine *Satellite TV News*, which was started as a quarterly publication in August 1981, is now appearing monthly. Though initially aimed at the consumer, the policy has more recently been to provide full coverage of the industry. Details can be obtained from HRC Editorial Services, 41-47 Derby Road, Heanor, Derbyshire DE7 7QH.

PRESTEL MAKE OR BREAK

The Prestel service has cost some £40 million and still has only 22,400 subscribers, 95 per cent of whom are business users. Recent efforts to increase Prestel use have included Club 403 (see Teletopics last month) and the Micronet system for home computer users (see Teletopics, December) which has now come into operation. There are at least 600,000 home computer users in the UK, so the system could well give Prestel a much needed boost. British Telecom state that they hope Prestel will be in profit by 1984/5 when, incidentally, the computers are due to be replaced (only six are actually in use, the other sixteen being redundant). If Prestel doesn't begin to show a profit by then the whole system could be scrapped.

NEW BOOKS

"Tomorrow's Television Today" by Michael J. Stone has been published by the author and is available at £9·85 plus 65p post and packing from 47 Filton Avenue, Horfield, Bristol BS7 0AQ. The subtitle is "a handbook on satellite television reception", which is just what it is. There's been a great need for a book such as this, which discusses the technicalities of satellite reception in a practical manner. There's no circuitry, but much information is provided on aerials and receiver systems, with details of the satellites visible from the UK, plus a computer (Commodore PGT) programme and a Cassio programmable calculator programme for satellite location.

The latest, sixth edition of *"Beginner's Guide to Television"* has been revised and brought up to date by Eugene Trundle, who should need no introduction to readers of these pages. An excellent introduction to the subject.

The RETRA 1983 *"Year Book and Directory"*, published to coincide with the Association's fortieth anniversary, has been greatly expanded in comparison to previous editions and now runs to 376 pages. Up to date lists of addresses and suppliers are always useful to have, but this directory includes much else besides. Available to non-members of the Association at £10·50 including post and packing from RETRA, 57-61 Newington Causeway, London SE1 6BE.

"Basic Colour Television" Part 1 has been published by Technical Press, Freeland, Oxford OX7 2AP at £4·95 net. Parts 2 and 3 will complete the coverage of the subject and are due for publication this month. The work is described as a "basic training manual" and forms part of the "Common Core" series. It treats the subject in an admirably down to earth manner.

Fault Report

Notes on TV faults from Nick Lyons, Richard Roscoe and Mick Dutton

Battle with a G8

After a few years of TV servicing I think most of us acquire prejudices against certain models and a respect, even fondness, for others. Which models fit into which category varies as widely as the engineers whose opinions I've sought. My own favourites are probably no better than anyone else's – it's perhaps just that certain designs accord better than others with my jumbled brain pattern. Anyway, a chassis I favour is the Philips G8: a power supply panel that anyone can understand, the chassis at mains neutral, the tube heaters powered from a mains transformer and so on. The trivial needs and common tasks are well established – line output transformer and thyristor rectifier/regulator replacement and, as in the set in question, the BU105 line output transistors.

The set was an early one and had simply "gone off" after about a quarter of an hour's use. With the back removed we soon established that the power supply was working. Check the 800mA h.t. fuse on the line scan panel: it had blown catastrophically, so I decided to replace it and see what happened. This time it held, but on measuring the h.t. line the voltage was found to have fallen from 205V to around 150V. The line output stage made not the slightest noise whilst in this condition – no sparking or straining noises from the output transformer – and on removing plug PC1 which connects the h.t. to pin 11 of the line output transformer the voltage returned to 205V. So I assumed that the line output transistors were short-circuit, quite rightly as it happened. In went a couple of BU208s, my standard cure-alls, and after disconnecting the tripler I switched on. We now had nothing: fuses intact, 205V line correct.

A bit of fruitless stabbing about occurred at this point. I even brought in the scope to check waveforms (since retiring the Cossor scope in favour of a modern transistor job I've had a greater tendency to do this). By now at any rate I'd alighted on the right area: given that virtually no current was being drawn and the 205V supply was present, something in the lower half of the line output stage was clearly amiss. The meter was dabbed across the lower transistor's emitter resistor, which was proved to be intact. More fruitless stabbing and headscratching, then I decided to confirm the resistance reading again – this time from the transistor's emitter pin to deck instead of across the resistor itself. The reading was about 100Ω instead of 1·8Ω.

Well, the wiring on the top line drive board had become extremely scabby, brittle and dry-jointed to the board – in a manner more akin to what you'd expect of a hybrid set. In one of those I'd have suspected something like this to start with, but I find it difficult to credit such frying in a solid-state set and don't go for it quite so readily.

Having taken the line drive board out to unsolder the transistors, I'd obviously aggravated the problem. So the most thermally stressed wires were replaced, and after running the iron over all the lands on the board and retinning them I refitted the board. Fire up, and joy at last. There you are then: even in a favoured set you can't always proceed by logic alone, and fundamental suspicions should not be overlooked just because "fried dry-joints are not common" on the particular model.

The new transistors should in theory have been balanced, though I must confess that I don't usually bother unless there are obvious problems. This is because: (1) They probably aren't far out anyway. (2) The coil is probably fried and the core jammed, or will jam when you move it, usually at a worse point than initially. And such mucking about with an old coil always ends in tears! (3) BU208s, which are what I always fit, are much more robust than the original BU105s and tend to withstand a bit of disproportionate loading with better grace. **N.L.**

Decca 100 Chassis

Why oh why do the triplers fail so often in the Decca 100 chassis? Nearly every one of those in my patch has had a new tripler at some time. In fact whenever I see a blown mains fuse in one of these sets I disconnect the tripler and replace the fuse without making any further checks. On switching the set on everything else returns to normal – well nearly always, anyway. On this particular set the fuse blew persistently, and violently at that.

Now if there's one bit of gear worth its weight in gold it's my trusty variac. I find it essential with all these chopper and thyristor power supplies around. Well, on winding the variac up slowly the set worked. Why, knowing my dislike of thyristors and anything to do with them, I had to prove beyond doubt that every other relevant component was o.k. I don't know. What I should have done was to suspect the thyristor of some perverse problem and replace the damn thing. After all, they're not expensive.

What I did however was to prove that the thyristor would short again when connected to the mains supply directly. I connected the wretched thing to the AVO, provided a dummy load, forgot to remove the crowbar, switched on and bang, another fuse gone. The crowbar had tripped and the thyristor didn't like having rectified national grid supply fed to it directly at switch on. So I finally replaced the device, as I should have done to start with. I also replace the crowbar thyristor on such occasions in case the heavy current it's passed on tripping, especially after repeated tripping, has damaged it. This done we had another bang at switch on. The poor old bridge, by now sick of all this heavy pulse work, had succumbed. After this was dealt with everything was back to normal, the tripler being innocent all the time. **N.L.**

This Plug Business . . .

So I'm not the only one who's irritated by this plug removing business – LLJ complained about the same thing some time back. I bet over half the sets I get from domestic customers have had the plug removed before the set's brought in. I can't help challenging the odd customer about this. A common excuse is "I didn't know whether you had square pins or round, so I took it off just in case." That's a two-edged snub for a start, implying that I'm so archaic I still have 5A sockets and that I'm incapable of making up an adaptor lead.

Another popular excuse is "the set's in the hi-fi cabinet and I have to take the plug off to thread the lead through the hole in the back". Well, it's better than the last one, but try following it up with "oh, so you've brought the plug with you then" whilst holding out your hand. A modification to this is the "I've a long extension lead and didn't think you'd want it trailing around" brigade. The reply that really gets me however is simply "well, they're so expensive now, aren't they?" The chap with the ancient G8 runs a removal business and tells me they get similar trouble with castors and the like . . . **N.L.**

Monitors

Monitors, or at least those built as such instead of being adaptions of a standard chassis, are a breed apart. They don't have that mass produced look about them – in fact some have a distinctly cottage industry look, being hand wired on a short production run. This all too frequently means that they seem to have been assembled from the centre outwards, all hand wired of course, the faulty bit inevitably being at the centre.

Having suffered two power supply faults in the first year of its life, plus associated potentiometer trouble, the set in question had earnt itself a less than sparkling reputation. After a further six weeks of faultless service yet another problem arose – intermittent smoking with no observable effect on the picture. When we removed it from the case it refused to smoke, so we left it on. No smoke was seen during that or the next couple of days, but we didn't put it back into service since on the strength of its previous efforts, or lack of them, it wouldn't have lasted long.

Sure enough it went faulty a few days later, but true to form the symptoms were different. A picture about half the normal size and of exceptional brightness was being displayed: a crackling akin to that of frying bacon accompanied this spectacle. I then did something I'll not forget. I approached the odious object with an e.h.t. meter (30kV full scale), with the aim of checking at the e.h.t. connector. When the probe was brought within about half an inch of the connector's outer cover however a spark of almost unprecedented violence came from beneath. A loud crack accompanied this, the meter shot off the scale, I jumped a mile and dropped the probe. After that I switched the thing off and refused to touch it again.

It stood neglected for a month or so, then a colleague decided to have a go. By this time the voltage had started to track from the cavity to the tube 'dag and to the front case member at random. He switched off, did no further tests but rebuilt half the line output stage and most of the power supply. Switching on gave normal service. A costly and time consuming repair. The moral is not to bemoan mass production and look back nostalgically to the days of "hand-crafted" sets: the modern technology does not lend itself to that approach – electronics probably never did. It was just that the basic simplicity of an earlier generation of sets enabled them to work despite cottage construction methods. **N.L.**

Rank T20A Chassis

A Co-op 6348 (Rank T20A chassis) came in for service recently. Won't come on the card said, and indeed it wouldn't. The mains fuse was intact however, and the switch-mode power supply was producing a healthy 200V output. Now in normal operation the line oscillator receives its 12V feed from the 36V supply produced in the line output stage, via a regulator, so a start-up circuit is required. This consists of 4C19, 4R49, 4D13 and 4D14 (see Fig. 1). Once the line timebase gets going, the oscillator chip is fed via 4R48 and 4D11. So failure of the set to start could be due to a fault anywhere in the line timebase or in the start-up circuit, which is quite a lot of territory to cover. Experience has taught us to check a few likely suspects first however – 4C19 for example, the state of the soldering around the pins of plug 5Z1 on the line output panel, and the line output transistor's base current limiting resistor 5R8 (1Ω). Sure enough, 5R8 was open circuit. Great! Switch off, fit a replacement, then try again. Nothing!

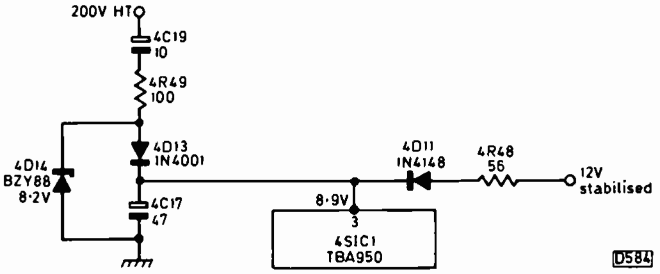


Fig. 1: Line oscillator start-up circuit used in the Rank T20A chassis.

We switched off gloomily and decided to make some tea. Then the phone rang, and after various interruptions half an hour had gone before we returned to the 6348. Switch on and it burst into life. Good picture and sound, no sign of anything amiss. Tap around the various panels to check for possible dry-joints, but everything seemed solid enough. Maybe the mains plug was not connecting properly? Nothing happened when we jiggled it about, so we pulled it out and then pushed it firmly home. The set went off – but didn't come on again!

We decided to connect a 9V battery across 4C17 in place of the start-up arrangement. The set then came on, so the start-up circuit was clearly at fault. But the fault occurred only when the set was switched on shortly after it was switched off. When left for half an hour it had worked perfectly. A glimmering of an idea began to form. We switched off and checked the negative side of 4C19. A large *negative* voltage was present! So 4C19 was not discharging immediately after switching off. As a result 4D13 was reverse biased and the start-up action was blocked until the charge on 4C19 leaked away. The cause of all the trouble was the zener diode 4D14. It's purpose is to limit the start-up pulse to a safe value for the i.c., and to provide a discharge path for 4C19 at switch off.

In fact 4D14 could have been faulty for a long time, since a set is not normally switched on and off rapidly in the home. A new 8·2V zener diode restored reliable start-up action every time, and the only problem left was how to justify the size of the bill – most of the time had been spent tracing a fault that no one knew was present. **R.R.**

Grundig 1510

The complaint with a Grundig Model 1510 was that it would go dead intermittently. In fact the line timebase was shutting down intermittently due to a crack in the print adjacent to pin 4 of the e.h.t control module. **M.D.**

Decca 80 Chassis

The complaint with a Decca set fitted with the 80 series chassis was that it wouldn't change from Channel 4 to

BBC-1 without having to press ITV first. The set is tuned to the Sutton Coldfield transmitter, and would change channels in any combination between BBC-1, BBC-2 and ITV, but when changing from Channel 4 to BBC-1 the a.f.c. would lock out. The problem was that C3 (0·1μF) which decouples the tuning voltage line had gone open-circuit. **M.D.**

Philips G8 Chassis

It's not often that I get an unusual fault on a Philips G8 colour set nowadays, but just recently I've had three in a row. The problem with the first set was that the line hold would shoot off frequency. All likely capacitors and the two zener diodes – one on the timebase panel, the other on the signals panel – were tried, also the line oscillator coil. The problem was eventually tracked down to R521 (15Ω) going high in value intermittently. This resistor is in the emitter circuit of the reactance transistor.

The second problem was an annoying ticking noise on the sound. Removing the plug to the volume control stopped the noise, and when the plug was replaced we discovered that the voltages in the audio output stage jumped in sympathy with the ticking. The fault was traced to the audio coupling electrolytics C2204 and C2201 (both 1·6μF) being leaky when voltages were applied across them.

With the third set the problem was an intermittent crackle on the sound – it was a later set (550 series) with the combined i.f./chroma signals panel and rear convergence panel. Tapping the convergence panel would make the crackle come and go, but tapping anywhere else in the set had no effect. The problem was traced to the plug/socket connecting one of the wires to the blue lateral convergence assembly not making contact – there was no noticeable effect on the screen. **M.D.**

N1700 Speed Conversion

Mike Phelan

THOUGH they are no longer in production, the Philips N1700-N1702 series VCRs are well known for their excellent picture quality. Many are now available on the secondhand market for under £100, and represent a good purchase provided you don't need to view prerecorded films. On the debit side, the tapes are expensive and give up to only three hours' playing time. Halving the tape speed will double this with very little sacrifice of picture quality. With the earlier Philips machines (N1500 and N1501) it was necessary to reduce the diameter of the motor pulley to achieve this. The N1700 has d.c. motors however, so we can vary the speed electronically. Doing it this way also has the advantage that the machine can be made to run at the original speed at the flick of a switch. The cost of the components required for the modification is minimal – about £1.

The N1700's Servos

To see how the job can be done, it's useful to consider the operation of the machine's servos. Fig. 1 shows the arrangement in block diagram form. Most of the circuitry is contained in five plug-in modules – to simplify matters the U228 digital lock-in module has been omitted.

In the record mode, field sync pulses are fed to the U236 module to provide a reference. They are divided by two and then converted into 25Hz ramps which are fed to sample gates. The pickup heads below the head drum and capstan flywheel provide feedback sample pulses. These are fed to monostable multivibrators which produce trigger pulses to operate the gates. As a result, the gates produce pulses whose amplitudes depend on the sampling time, i.e. the relative timing of the ramps and the feedback pulses. These output pulses are stored in the drum and capstan servo modules U219 and U230, the stores being triggered from the same multivibrators that trigger the gates. In the record mode 25Hz pulses are also passed to the control head via sync module U237 for recording on the tape's control track.

The drum servo works in exactly the same manner on playback, except that this time the reference is the 50Hz mains a.c. divided by two. The capstan servo also uses this reference on playback, but the sample pulses are obtained from the tape via the control head. They are routed via transistor TS203 and a monostable multivibrator in module U237, which also includes the playback tracking system.

The tape speed depends on the d.c. conditions in the capstan servo loop: i.e. when, on playback, the off-tape control pulses are arriving at exactly 25Hz the servo output voltage is such that the capstan motor is driving the tape at the correct speed.

Halving the Tape Speed

To see how we can halve the speed, consider what would happen if we already had a tape which had been recorded at half speed. If we play it back at the standard speed, the off-tape control pulses will arrive at too high a frequency. The servo will try to slow the motor down, but even if it managed to slow the motor sufficiently to reduce the pulse rate to say 35Hz the motor voltage would still be too high. So the required correction can't be obtained without altering the d.c. conditions in the U230 capstan servo module.

The circuitry involved is shown in Fig. 2. In addition to the sample/store arrangement which sets the correct phase conditions, there's a speed detector which counts the pulses from the capstan flywheel pickup head and in conjunction with a frequency-to-voltage converter establishes an approximately correct speed. The phase control system then takes over.

The operation of the speed control circuit is as follows. The incoming pulses are first amplified by transistor TS6, whose output goes to the gate of the f.e.t. TS8 and to the base of TS7. This latter transistor and its associated components form a ramp generator: the slope of the ramp is fixed irrespective of frequency. This ramp is applied to the drain of TS8, which switches on to sample the ramp amplitude whenever a pulse arrives at its gate. The output is stored by the 0·1μF capacitor at TS8's source. We thus have at one of the inputs to the following operational

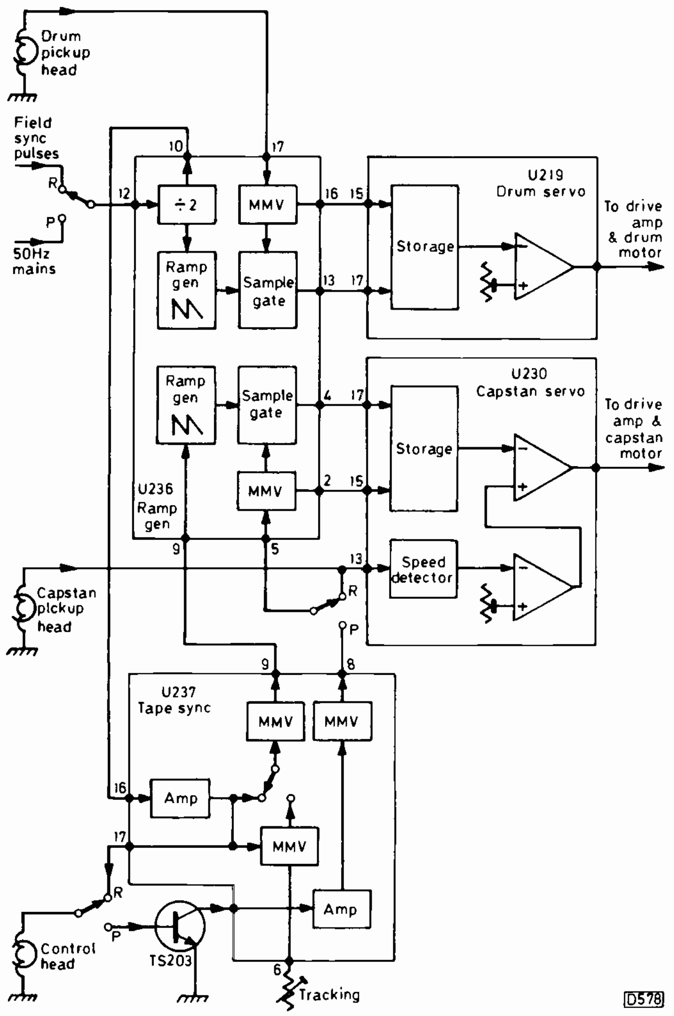


Fig. 1: Simplified block diagram of the N1700's drum and capstan servo system.

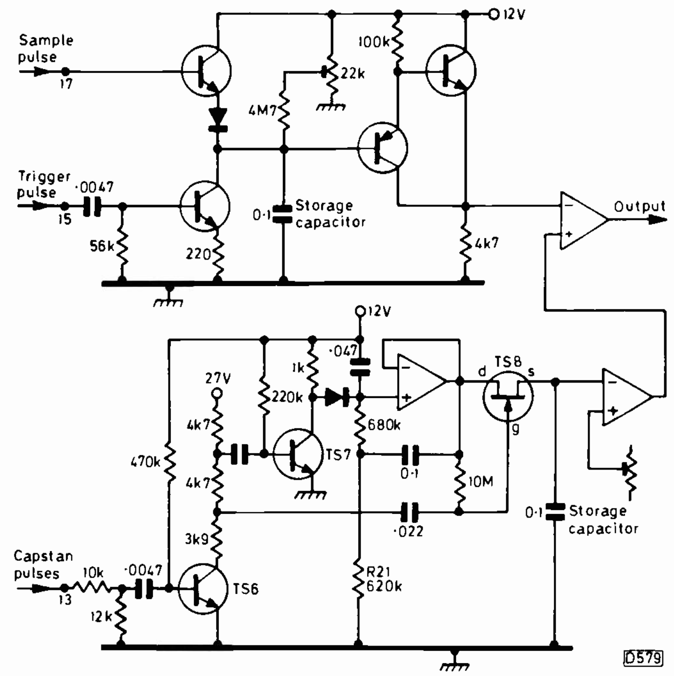


Fig. 2: The part of the capstan servo circuit (in module U230) that requires modification for speed conversion.

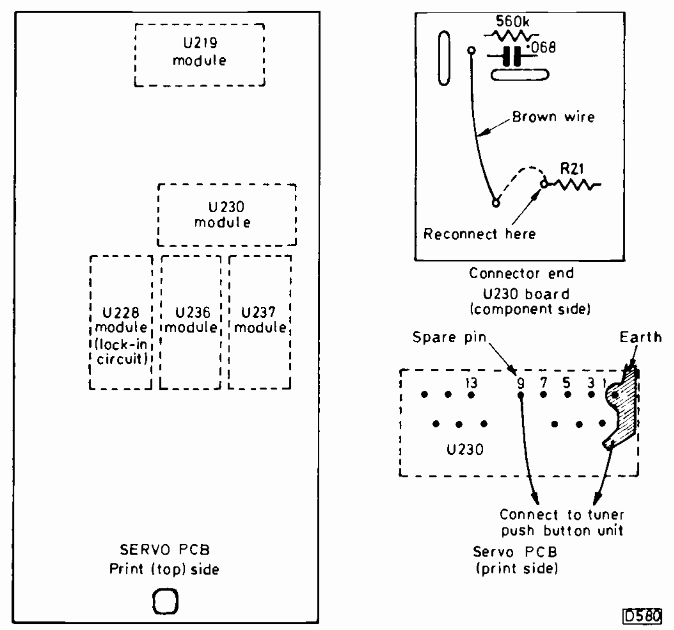


Fig. 3: Modifications to the U230 module.

amplifier a voltage that's proportional to the incoming pulse frequency.

We can vary the d.c. conditions by altering the value of R21. Increasing it will lower the speed, so a value of 1·2MΩ will halve the speed. The phase control circuit will do the rest.

This takes care of playback, but what about record? On record the speed control circuit tries to maintain the reduced speed provided by R21's altered value, but the sample pulses applied to the phase control circuit from the capstan pickup head will be at the "wrong" rate, so the servo won't lock. All is not lost however: we don't really need phase control of the capstan on record – Philips do it for convenience, to minimise switching. If we connect pin 17 of the U230 module to about 6V, i.e. the same as the centre of a 12V ramp, the capstan will run evenly at half speed in the record mode, and it's not necessary to switch the circuit back to the original condition for standard speed operation.

To sum up the modification then, to get half speed operation we switch the value of R21 in module U230 from 620kΩ to 1·2MΩ, which we can do by using the spare set of contacts on channel selector no. 8. We also need to break the connection to pin 17 of module U230 on record and connect it to 6V. This can be done with a simple electronic switch (see later). Finally, but only on the N1702, the clock can be made to display five hours maximum of timed recording length – this cannot be done on the N1700 unless an N1702 clock module is fitted, but is no great disadvantage because if the switch is not left in the "lock up" position the tape will run to its end.

Practical Details

To carry out the modification, the first job is to remove the cassette lift by depressing the pin on the left-hand side. Next slacken the two screws that retain the top cover – they are at the back. Then remove the cover – this can be a bit of a struggle.

The servo board will be seen on top of the tape deck. Locate module U230 and remove it (see Fig. 3). The module plugs in – don't unsolder it. Find R21 and remove but don't discard it, then unsolder the brown wire and reconnect it as shown – in the hole where the left-hand end of R21 was. This brings the connection for R21 out to an unused pin (9) on the edge connector. Connect a length

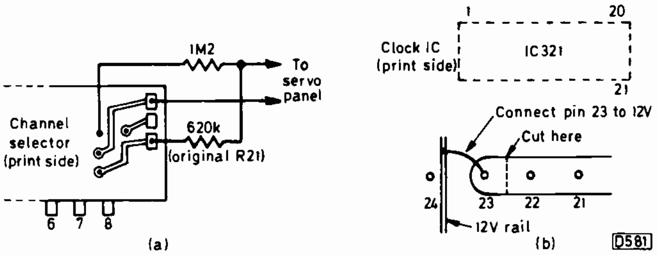


Fig. 4: (a) Speed change connections to the channel selector unit. (b) Clock conversion (N1702 only).

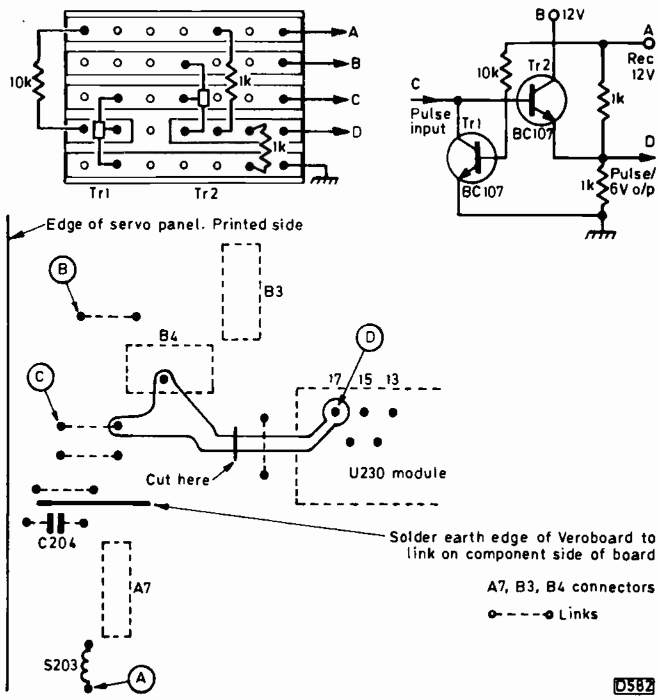


Fig. 5: Electronic switch to control the input applied to pin 17 of module U230.

of fine twin cable to pin 9 of the edge connector and to chassis as shown, and route it through the wiring so that the servo board can still be hinged up. The cable should emerge near the tuning buttons. The two resistors are fitted on the spare switch on button no. 8 (it's possible to press two buttons in at once when recording).

Next, remove the cabinet top half. The four screws in the corners are obvious, but there's a fifth one accessible only when the record key is depressed. The print behind the push buttons will now be visible (see Fig. 4). Fit the new 1·2MΩ, ¼W resistor and the original 620kΩ one as shown, and connect the twin cable from the servo board. While the cabinet is off you might as well modify the clock (N1702 only) to display five hours instead of three (see Fig. 4). Cut the print with a Stanley knife and connect pin 23 to the line of print that runs between pins 23 and 24. Then reassemble the cabinet half.

The final job is to make up the electronic switch, which is easy to do on Veroboard (Fig. 5). In the record mode terminal D provides a 6V output: Tr1 is saturated by its base bias, shorting the base of Tr2 which is thus switched off. On playback the record 12V supply is inoperative and Tr2 passes the pulse input to terminal D. Solder the board on and link it up as shown, keeping the leads short.

All that now remains is to reassemble and test. With the connections as shown, the machine runs at half speed with button 8 pressed in. It will of course benefit from cleaning and lubrication as per the manual, and if a scope is available setting up the servo adjustments (but don't touch these if you don't have the necessary knowledge and equipment).

Letters

EARLY TVs WANTED

For the purpose of research towards a book on early television I'm eager to obtain any pre-war television receivers, in particular those manufactured by Pye, also brochures and literature. Those who visited the Science Museum history of television exhibition in 1980 may recall that I was involved with this and edited the exhibition supplement. My book *"The Story of Pye Wireless"* was published by Pye in 1979 and was reviewed in your September issue that year.

Gordon Bussey,
64 Pampisford Rd., Purely, Surrey.
Telephone (evenings) 01-660-2240.

MAINS FEED PROBLEMS

With reference to David Lisle's letter (February page 200) on mains supply problems, particularly in connection with the Philips G11 chassis, I'd like to say that in 90 per cent of cases where I've found mains rectifier, line output transistor or field timebase i.c. faults in this chassis the cause has been a defective adaptor or mains plug. When the G11 first came on the market six years ago I attended a technical seminar on the chassis: even then the Philips technical chaps commented that these sets should not be operated via a mains adaptor, and that only an MK plug should be used. The chassis is very reliable when these points are observed. It should be noted that transients due to faulty plugs/adaptors can reach 1-1·2kV for a few milliseconds. Hence the need for care with the mains supply.

Jim Rainey,
Bangor, N. Ireland.

PHILIPS G11 CHASSIS

I fully endorse David Lisle's comments regarding the importance of a sound mains supply in connection with receiver reliability. It's been my experience too that BU208A and/or TDA2600 field timebase i.c. failure in the G11 chassis is sometimes the result of mains supply arcing or interruption.

The other common cause of such failures in the G11 chassis is the h.t. reservoir capacitor C4029 going open-circuit intermittently. Monitoring the 153V h.t. rail in a suspect set will reveal the very occasional presence of a positive voltage transition which can result in destructive timebase problems. A defect in C4029 is often visually evident when it's removed from the panel: careful examination of the negative tag may reveal signs of darkening around the rivet head, indicating that it's not to be relied upon. A general rule of thumb is to fit a replacement in all sets employing the red-bodied "Pye" type: the blue type sometimes fitted seems to be far more reliable.

Incidentally the glow switch overvoltage circuit in this chassis is incorporated to provide protection against the effects of long-term excessive h.t. levels (greater than 195-205V) and is unresponsive to short-term transients.

In difficult cases, intermittent failure of C4029 may be so occasional that a critical combination of voltage surge and temperature conditions is required to being about a timebase fault. Thus timebase failure in the G11 chassis is more likely in a set fitted with a suspect type of h.t. reservoir capacitor and operated from a defective supply.

Peter H. Dolman,
Dolman Audio Video, Melksham, Wilts.

Editor's note: We've received several letters on this subject. Many thanks to all who wrote. C4029 problems have been mentioned before – see S. Simon's article on the G11 chassis in the September 1982 issue and Teletopics May 1982. Philips recommend the use of a DALY/ITT type (Philips Service code no. 124-47056).

CORRECTION

As a recent reader of *Television,* may I say that I find it most informative? There was an error in the February issue however. The Thorn 1500 chassis is fitted with a PCL82 audio valve (page 191), not a PCL86.

B.C. Smith,
Weybridge, Surrey.

Editor's comment: Yes indeed! Sorry.

12HG7 SUBSTITUTE

Some while ago (June 1982) Eugene Trundle wrote on substitutes for the obsolete 12HG7 luminance output valve used in hybrid Bang and Olufsen colour sets. He mentioned that he'd not tried the solid-state PL802 but considered it should work satisfactorily. I've used a PL802T in a 2600 chassis whose 12HG7 had an intermittent short-circuit – a genuine replacement 12HG7 would have been expensive indeed! The procedure is as follows:

(1) Remove the 47Ω wirewound heater dropper resistor from the PL802T – the 12HG7's heater is fed from a transformer secondary winding instead of being in a series chain.
(2) Remove the i.f./tuner/control panel from the set.
(3) Remove and isolate the −120V lead from the brightness control.
(4) Swap the 56kΩ resistor from one end of the brightness control to the other.
(5) Connect a 22kΩ, ½W resistor between the vacant end of the brightness control and the 30V supply.
(6) After refitting the panel all should be well!

The modified set has been working for many months now and the results have been very good.

P.R. Dowding, Dowding and Son,
Malmesbury, Wilts.

PORTABLE LIGHTING UNIT

Lighting problems should be negligible in the workshop. When doing outside work however you never know what lighting conditions you're going to find, so it's desirable to have some sort of portable spotlight to illuminate particular areas. The use of a battery powered torch is not the answer, whilst hooking up a 60W lamp with guard etc. will be rather clumsy. The solution I've devised is a

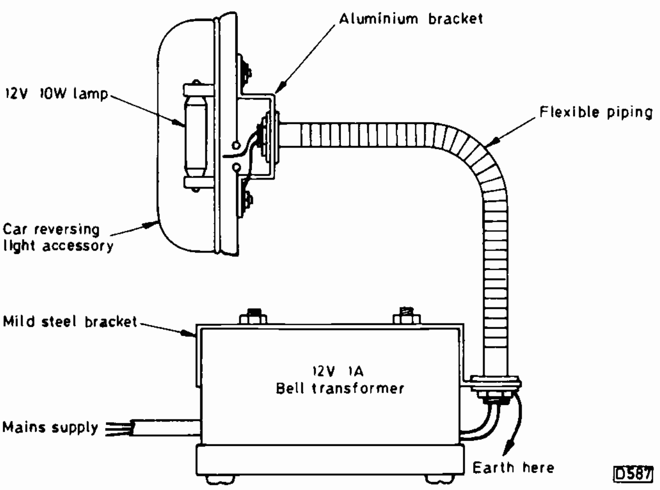


Fig. 1: Victor Rizzo's portable lighting unit.

compact, stable, safe and efficient transformer-powered portable lighting unit which can be easily constructed at moderate cost.

The device is shown in Fig. 1, from which it will be seen that the power pack consists of a bell transformer rated at 12V, 1A. The light itself is a car reversing accessory. The one I used is made by Sparto, measures roughly 11 × 5 × 3cm. and weighs a mere 80g. The 12V, 10W bulb gives a reasonable light output. A 30cm. long, 1cm. diameter flexible pipe was salvaged from a scrap stand light – if narrower piping can be found so much the better, but the flexible piping used for plumbing is not suitable.

One end of the piping is connected to a bracket made from reasonably thick aluminium sheeting. The lighting unit is fixed to this bracket by means of two bolts and nuts. The other end of the tubing is fixed to a fairly thick mild steel plate at least 3cm. wide, bent as shown. Three holes were drilled in this bracket, one to take the piping and the other two for fixing to the transformer. Such transformers normally have only one of the lamination tightening bolts protruding at the top, so the shorter one should be removed and replaced with a longer one. As is common practice with car lighting accessories, one of the lamp terminals is earthed: it's as well to earth the whole thing, the earth connection being taken straight to the flexible piping. Finally four rubber pads were fixed to the bottom of the transformer to stop the unit slipping about.

Victor Rizzo,
Msida, Malta.

BIONIC PYES

Some years ago I fitted many solid-state colour-difference amplifier panels to sets fitted with the Pye 697 chassis. These have worked very well, but a fault on the panels can cause concern. This is when the resistor that feeds the luminance output transistor goes faulty. The result can be a severely overrun c.r.t. – in one case the tube was ruined. I therefore replace this resistor with a higher wattage type whenever I get any of these sets in for repair.

When this resistor is faulty the beam limiter can become inoperative, with a whole series of misleading symptoms such as smeary pictures, bad focus, the tube neck glowing blue when the brightness is increased etc. On the occasions I've had this trouble the resistor has been virtually open-circuit.

P. Smith,
Hathersage.

Routine TV Receiver Tests: Thorn 8000 Series Chassis

S. Simon

LAST month we dealt with the original 8000 chassis. In due course this was superseded by the 8000A, which has a different power supply panel and an extended "mains dropper". These items still occupy the same positions, with the dropper on the left-hand side, mounted vertically, and the power supply panel under the centre section. The important thing to bear in mind is that the power supply panels cannot be interchanged, because the dropper used in the 8000A has two sections which replace two of the wirewound resistors mounted on the original panel, R727 and R729.

There are several other component changes, so it's essential to recognise the chassis being dealt with. Apart from the A on top of the steady bracket and on the rear cover, the type of dropper used and its connections will provide immediate identification. The original dropper had only three sections: an 8000 may be fitted with an 8000A type dropper, but in this case the upper sections will not be in use.

The 8500 Chassis

Several major differences were introduced with the 8500 chassis, to enable it to accommodate a larger tube. The line output transformer is of a different type and feeds a different e.h.t. rectifier. This contains a 150MΩ resistor which supplies a different type of focus control unit. The latter supplies some 4·5kV to the c.r.t. base. Another important difference is the line output transistor, which is a BDX32. There are changes in the circuitry around this transistor.

The power supply panel is over on the left-hand side, in a more accessible position, while the mains dropper is horizontally mounted just in board of the left-side chassis frame. The 12Ω surge limiting resistor R721 is replaced with a choke (lower left). The bottom centre section of the chassis has a much less cluttered look.

The mains fuse is 3·15AT and is mounted on a panel with other items immediately above the power supply panel. Amongst these items is the 800mA l.t. fuse and the mains filter capacitor, which may be a single one with a value of 0·22μF or two of 0·1μF each. The mains filter capacitor(s) are suspect if they are rated at 600V d.c. (300v a.c.) – they could well be the cause of a shattered mains fuse, also the mains plug fuse if this is rated at only 5A.

Later versions have a thermistor in series with and mounted on the mains input choke. You may well find it with one leg detached (as in the Rank A823 chassis). If the thyristor rectifier is type BT116 or C122N instead of type BRC4443, the series diode may be replaced with a wire link. If the diode is fitted you may well find it decomposed, as mentioned last month: if it's short-circuit, the thyristor should also be viewed with suspicion.

The power supply panel is prone to dry-joints, especially around the wirewound resistors, and a general visual check can be rewarding. If capacitor C710 (0·22μF) is fitted as part of the network across the thyristor it should be removed in the interests of thyristor reliability – it was deleted in later production.

Apart from the trouble spots already mentioned, the main problems concern the line output and e.h.t. sections of the receiver. A faulty e.h.t. unit can kill the line output transistor. Less seriously, it may affect the focusing. Thus a picture that's out of focus may require a new e.h.t. unit to restore normal focus control action although the picture is otherwise unimpaired. This is because the 150MΩ resistor in the e.h.t. unit has deteriorated. Before suspecting the e.h.t. unit however it's wise to check on the presence of a 100kΩ resistor (R609) in series with the focus pin on the c.r.t. base panel. If fitted it could be faulty. In later models it was deleted: so if you find that it's open-circuit, it's quite in order to short it out or replace it with a lower value resistor if this is more convenient. All this is not to say that the focus unit can't be at fault, in fact it often is. In our experience however the e.h.t. unit is more likely to be the culprit.

The 8800 Chassis

When the 8500 chassis was modified to operate a 22in. tube it became known as the 8800 chassis. The main difference this time is a redesigned convergence panel which is fitted in brackets at the top of the cabinet. Pincushion correction is added, and necessitates an extra buffer transistor (an f.e.t.) on the timebase panel to prevent the line pulses interfering with the field oscillator. Other than this it can for most practical purposes be regarded as an 8500 chassis. The first anode presets are still mounted on the c.r.t. base panel, and still give the occasional trouble when one of them goes open-circuit to remove the relevant colour or alternatively result in too much of that colour if the break is at the low-voltage end of the track.

Later Signals Arrangements

Later models have a varicap tuner. So the front press buttons are voltage selectors. The voltages applied to the tuning line are determined by the setting of the rear vertical strip of controls above the aerial socket. These are part of a panel which is easy to remove and which contains

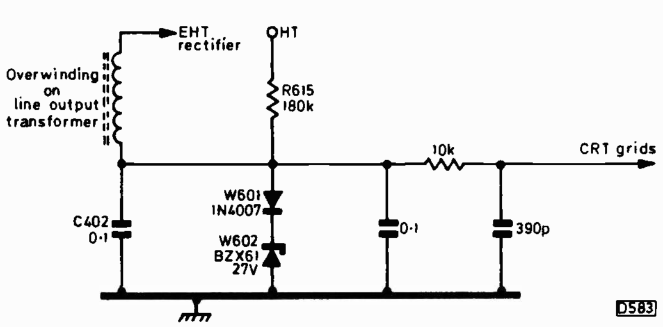


Fig. 1: The c.r.t. grid bias/beam limiter arrangement used in the Thorn 8000 series chassis.

the tuner and its supply components – or most of them.

The 33V tuning supply is obtained from the h.t. line via a 12kΩ resistor (R20) which is behind the mains dropper and a 10kΩ resistor (R15) which is mounted on the tuner panel. These supply the 33V stabiliser i.c. W2 (TAA550 or equivalent) which is decoupled by C3 (0.0022μF). A fault in any of these components can result in complete loss of signals. The drill is to check the voltage at W2 and if this is absent feel resistor R15. If it's hot, W2 or C3 is short-circuit: if it's cold, the resistor is either open-circuit, in which case there will be a high voltage at its h.t. end, or if there's no voltage here R20 is faulty.

The panel can also suffer from dry-joints, but by and large if the voltages are right (including the a.g.c. supply at pin 2 of the tuner and the 12V supply at pins 4 and 8), with a variable tuning voltage reaching pin 5, then the tuner itself is suspect (type ELC1043/05). This assumes that there is plenty of noise on the screen to show that the i.f. stages are working, and that the i.f. input plug is properly connected to the lower left of the signals panel.

The design of the signals panel changed drastically over the years, the panel used in the 8800 chassis having little resemblance to that used in the original 8000 chassis. Many of the transistors were replaced by i.c.s.

Apart from the points mentioned last month, a frequent cause of loss of colour is incorrect voltages at the pins of the i.c.s, particularly at pin 2 of IC5, where the correct 8·8V may not be present due to leakage in the 6·8μF tantalum smoothing capacitor C186. Remember also the likelihood of the crystal being at fault in this range of chassis. The i.c.s themselves are also suspect, but will often respond to warming or cooling in order to identify the faulty one.

If the appearance of the colour is delayed after changing channels, a slight adjustment of the lower right oscillator frequency preset R210 may be required – particularly if the associated i.c. (IC5) has been changed.

Tube Matters

A point we didn't mention last month concerns the bias applied to the tube's grids. The relevant bit of circuitry is shown in Fig. 1. W601 and the zener diode W602 are biased into conduction via R615, so the voltage at the grids should be about 27V. In the event of excessive e.h.t. current, the voltage at the junction of R615/C402 will swing negatively to provide the beam limiting action. The problem that arises is when R615 goes high in value. A negative voltage then appears at the c.r.t. grids and the result is a blacked out tube.

A frequent tube fault is a heater-cathode short in one of the guns. This is not necessarily the end of the tube. If the fault shows up as flashing or continuous bright illumination in one colour, the condition remaining when the relevant drive plug has been removed from the top of the signals board, relief can often be obtained by removing the 10kΩ resistor R607 from the tube base panel and wiring a resistor of about 47kΩ from one of the heater pins (1 or 14) to the affected cathode, i.e. pin 2 for red, 6 for green or 11 for blue. If the result is smearing of that colour, proving that the short is permanent, this is because of the capacitance of the transformer windings. It's perfectly acceptable to install a c.r.t. heater isolating transformer with low capacitance windings to operate the tube independently of the mains transformer, thus saving the cost of a regunned tube. Such transformers are still available from RS Components – stock no. 196-224.

VCR Clinic

Reports from Steve Beeching, T.Eng. (C.E.I.), Richard Roscoe, Derek Snelling and Mike Phelan

JVC HR7700

Several JVC HR7700s (Ferguson 3V23) came into the workshop just before Christmas, all wanted back fast. The problem with the first one was no audio recording via the line input socket — there was also a distinct absence of any audio in the record monitoring mode. This was an easy one, traced to a fault in the 4066 audio input switching i.c. on the junction panel. A 4016 proved to be a suitable replacement.

Another HR7700 had a more thought provoking fault. The customer complained that it wouldn't run properly in slow motion, which it didn't. After only a few seconds the speed would accelerate until tape damage occurred. Checking around the capstan servo showed that off-tape control pulses were initially present. They then disappeared as the tape speed increased. The problem was due to misalignment of the pinch roller, as a result of which the tape moved upwards. The control head would then miss the pulses and there would be loss of slow-motion control, the capstan motor running free at a speed close to the forward search speed.

I got rather upset with this machine when it severed my MH2 test tape whilst ejecting it. There's no real solution to the problem of tape slack at the end of rewind with the HR7700/3V23 and earlier models, though some measures can be taken to alleviate it. With later microcomputer controlled machines an extra, very short fast-forward pulse occurs after rewind has stopped in order to take up any excess tape. **S.B.**

JVC HR2200

An HR2200 portable machine wouldn't rewind — or for that matter review either. In fact there were no reverse motor functions at all. Checks were made up to and around the microcomputer, and it was found that information was being received but not acted upon. In fact it ignored any attempt at a reverse function, with not even a flicker from a LED. So it seemed that the micro was at fault, and I was cheered by my foresight in having a spare one in stock. This was short lived when I discovered that the type number suffixes differed. A quick call to JVC confirmed that the type had been changed, so I had to send for one.

Two weeks later I fitted the replacement. Still no rewind! So I bashed my head against the wall to clear my mind. This must have worked as I had one of my ideas. Perhaps the micro thinks that the tape is at start, as if rewind had just been completed? The answer was yes, due to a short-circuit start sensor phototransistor. **S.B.**

Intermittent Fuse Blowing

There have been more than just a few instances of intermittent mains fuse blowing in various machines for no apparent reason. The VCRs concerned are the Sanyo VTC5300 and VTC5000 and the Toshiba V9600, while the fuses are of the 500mA quick-blow type. Fitting anti-surge fuses is not the cure, and I cannot advocate the use of higher fuse ratings, though this will provide an answer. The reason for the fuse blowing is power supply surges, or more to the point transient spikes. These have more effect when the machine is in stand-by, since the extra current drain when the machine is running damps any transients.

I have it on good authority from Sanyo that the cure is to replace the 0.1μF mains filter capacitor with one of 0·0047μF. A 350V a.c. type is required and the RS Components type 114-569 is suitable. The modification also works with my Toshiba V9600s. **S.B.**

Sanyo VTC9300

Andy usually checks out VCRs before I get my hands on them. Just in case the fault is very simple, like Andy! In this case it was a Sanyo VTC9300, the note with it reading "servo unstable, has tendency to burst into flames." It was the usual story of power supply failure, but this time the 12V regulator transistor had been hot enough to melt its nylon insulating bush. The machine had previously been misrepaired during its guarantee period by a high street chainstore group, and now the customer was going to have to pay for it. Because of insufficient heatsinking, the transistor had overheated and destroyed the driver as well.

You may know that the Japanese series regulator transistor can be replaced with a TIP41 — provided it's of the same mounting package and not of the giant sort marketed by RS Components. I recommend smearing RS Components heatsink compound on all the contacting surfaces — transistor, mica insulator and aluminium. After doing all this and setting up the 12V supply playback was fine. But recordings seemed to be in mime and no sound could be monitored in the E-to-E mode. Attention was directed to the sound i.f. panel, where the 12V supply was absent from the detector chip which had a hole in its side. As well as the demise of the AN240 i.c. its power supply filter coil was open-circuit. **S.B.**

Hitachi VT9300

An Hitachi VT9300 had some very peculiar symptoms. In the E-to-E mode the sound was normal but the raster was completely blank. With a prerecorded tape the sound was again normal but instead of a blank raster there were some coloured streaks — as though the chrominance but not the luminance information was present. Scope checks in the E-to-E mode brought us to pin 2 of IC202: the video signal went in but didn't come out at pin 24 as it should. On playback the luminance signal went in at pin 1 but the composite video didn't reappear at pin 24. We decided to replace the chip (voltage checks had been inconclusive), but having ordered, received and fitted it the fault was still present. Since the voltage readings in our manual are clearly incorrect, we spent some time making comparative checks with a known good machine. This left us just as puzzled: the voltages on many pins were quite different and the sync waveform at pin 27 was inverted — negative-going in the faulty machine.

We thought the replacement chip might be defective, so we decided to consult Hitachi. A nice man listened to our tale of woe and then said "change CP206, the *LC* delay module." Apparently components in this can leak and distort the video. This affects the a.g.c. and results in various problems — anything from excessive gain to no video at all. He also gave us a tip which we happily pass on: if you have problems and suspect CP206 or its associated filter module CP205, remove it and bridge across with wire. If you then get a good picture, the module is at fault. Be careful however — the pins are small and fragile. **R.R.**

Sanyo VTC9300

The problem with a Sanyo Model VTC9300 was a ripple effect on the picture — the verticals were zigzag and wobbly, similar to line tearing and due to timing errors in the rotation of the video head assembly. These timing errors consist of very small drum speed changes as it rotates. The picture was stable initially, but as the machine warmed up the fault became evident. As the servo was found to be stable, the fault had to be due to either the drum assembly or the motor. The symptoms went after changing the motor, but I was not too happy as this could have been a coincidence. Sanyo were consulted and commented that there could still be problems with loose drum bearings — they can be tightened, but not without a torque gauge, as overtightening will result in bearing failure.

I've lately been informed by the customer that the machine is fine until it's been running for about five hours. The problem continues . . . **S.B.**

Toshiba V8600

The problem with a Toshiba V8600 was no colour during cue and review and still frame. In these modes there's a delay line to compensate for colour phase errors. The path to this was obviously open-circuit somewhere, and investigation revealed a capacitor which consisted of two bits of wire sticking up from the print — the body was elsewhere. As the component is mounted beneath a flywheel it seems that the customer didn't sit the machine on its feet and put pressure from beneath, with the result that the main PCB bent and the flywheel beheaded the capacitor. **S.B.**

Sony Rewind Problems

Most Sony dealers will know about rewind difficulties with ageing machines — C7s suffer the most, but C5s have their share of problems. A cheap way of curing the problem is to fit a new rewind pulley wheel: a more positive approach is to fit the Retro Rewind kit part no. A-6706-348-A. This consists of a rewind pulley wheel, a metal main drive wheel and a take-up spool turntable. **S.B.**

Mitsubishi HS303B

A Mitsubishi HS303B, brand new and still in the showroom, suddenly refused to respond to the rewind button, while when reverse fast search was selected the machine just switched off. The trouble turned out to be that the tape start sensor phototransistor Q578 (type PN202SR) had become leaky. Fortunately you can check by just unplugging it: if the fault clears, Q578 is the culprit. Incidentally this machine, like many of the newer ones, uses an infra-red emitter for end of tape sensing — so don't be fooled into thinking that the cassette lamp has failed.

The machine was put back on display, but two hours later it developed an audio fault. During record the audio through the TV set became low and distorted, and on playback it was clear that the distorted audio had been recorded. The audio in the E-to-E mode and from prerecorded tapes was o.k. however. On checking the symptoms more carefully we noticed that the distortion during record began a few seconds *after* the tape had started, and didn't occur if pause was selected. From this we deduced that the trouble lay at the point where the system control and the audio signals came together.

So we checked around IC3F1, one of the ubiquitous 4066B CMOS analogue switch i.c.s. This performs various audio switching functions under the control of the system logic. Sure enough when the delayed record (del. rec.) signal appeared at pin 12 it appeared at pins 10 and 11 as well. In went a new 4066 and back went the machine. Yesterday we sold it. We're keeping our fingers crossed. **R.R.**

Hitachi VT11

An Hitachi VT11 wouldn't record, i.e. when record and play were pressed nothing happened, though all the other functions appeared to be o.k. The first thing to do in a case like this is to check that the safety tab is in the cassette and that the safety tab switch is operating correctly. In this case the latter proved to be at fault. On this machine the switch is operated by a plastic lever which is clipped on to a nylon shaft. It had obviously not been pushed fully home on assembly, as it had risen up the shaft and was no longer making contact with the microswitch. **D.S.**

Hitachi VT9700

A problem we've noticed with some Hitachi VT9700 machines is patterning in the E-to-E mode when record is selected. The patterning takes the form of faint horizontal bars and disappears when pause is pressed. It appeares to be some sort of beat patterning between the i.f. and the audio boards (possibly the bias oscillator, as adjustment of this affects the patterning but doesn't eliminate it). If Hitachi come up with anything I'll let you know. Alternatively if anyone else has noticed the problem I'd be interested to hear from them. **D.S.**

Hitachi VT9500

"Loud noise on sound" was the complaint with an Hitachi VT9500. It worked all right in the E-to-E mode, but as soon as play was selected the sound was replaced with a loud feedback buzz. By tapping the audio board (the long thin one underneath) the fault could be made to come and go. Resoldering the joints in the sensitive area made the fault more intermittent but didn't clear it. Relay RL401 turned out to have intermittent contacts and had to be replaced. **D.S.**

Ferguson 3V01

A tracking problem with a Ferguson portable, Model 3V01, turned out to be due to the tension arm not operating correctly. The spring had come off. **D.S.**

Hitachi VT8500

An Hitachi VT8500 had a severe tracking fault, and as the paint seal on one of the guide poles was broken I thought that the customer had been twiddling and estimated for a complete tape path alignment. This was accepted, but alignment didn't cure the problem. After trying a head, lower drum assembly (not easy) and a couple of panels to no avail a colleague took a look at it. After a few moments he pointed out that one of the loading arms seemed to be rather close to the head, and sure enough comparison with another machine showed that the guide pole was bent. A replacement pole cured the problem. What the customer had done to bend it I don't know, but luckily the pole was inexpensive and no alteration to the estimate was required. **D.S.**

Ferguson 3V29

A Ferguson 3V29 would occasionally switch off, after which it might or might not start again if the play button was pressed. I decided to connect the scope to monitor the take-up reel and head drum pulses, and sure enough when the fault appeared the drum pulses disappeared. Unfortunately the machine then decided to work correctly for a couple of days. When it eventually failed again I found that there were no pulses at the drum pick-up head unless this was unplugged from the board. Obviously something on the board was damping the head.

Capacitor C46 on the board is connected across the head, and disconnecting this restored the pulses for a day, after which they disappeared again. The only other likely components were the pulse coupling capacitor C45 (10μF, 16V) and the HA11711 servo i.c. Changing these and soak testing the machine for five days cured the problem. Incidentally this type of i.c. is used in several different VCRs, and I've known it to fail on a couple of previous occasions. **D.S.**

Ferguson 3V29

We're getting a lot of Ferguson 3V29s with the complaint that when the machine has been on all day it will go into rewind whichever key is pressed. This is caused by the end sensor phototransistor going leaky. **M.P.**

Miller's Miscellany

Chas E. Miller

ALL the evidence suggests that if there's to be a bright future for TV dealers, VCRs will play a large part in it. My friends and acquaintances in the trade report excellent business in this respect, and it looks like being another good year. At around £300 the VCR represents astonishing value for money – especially when you make a comparison with the audio recorders of twenty five years ago. The prices of those often reached and exceeded the £100 mark – when a service engineer was lucky indeed to take home £15 a week! Even an old grouch like myself, with a marked distaste for most of today's taped films, is considering acquiring a VCR – now that the classic Ealing comedy films are to be re-released in the new medium.

One aspect of the VCR that may match the sound-only era is of owners recording TV programmes off air and never playing them back! (How many reels and cassettes have you got stashed away and never heard?) Another comparable thing is holiday photography, in that the use of a camera or VCR gets to be an end in itself, with the results largely ignored. Which leads me to think about those portable camera/recorder combinations now appearing all over the place. You do realise, don't you, that you could get invited to watch hours upon hours of instant boredom? Maybe it'll lead to a great new sales opportunity for pocket-sized bulk erasers, which could be smuggled in and used to good effect...

For this Relief, much Thanks!

Just about the most rewarding aspect of being a TV engineer for yours truly is that no one can force me to actually watch the programmes. In its earlier days when it was *Practical Television*, a more gracious age perhaps, the magazine assumed that its readers did a bit of viewing from time to time, between bouts of tinkering. There were comments on programmes and in particular a feature called "Underneath the Dipole", by a gentleman who used the pen name Iconos. I wonder what he would have made of today's trivia? To be truthful I must admit to watching the occasional programme, though I get the impression that the makers don't really want me to. They delay the start of the proceedings for so long with totally unnecessary title sequences that one gets the urge to switch off in despair. Just how expensive these titles can be was hinted at recently when a forthcoming children's programme had to be scrapped due to the ill health of the principal performer. It was stated that the cost of the abandoned titles had approached £10,000. I'd have knocked up a few of them myself for thirty bob if asked!

Public Disillusionment

My personal lack of enthusiasm for the programmes seems to be shared by the public. It's been said that disillusionment with TV broadcasting is the main reason for the growth of VCR sales and rentals. At the time of writing this (mid-January) there's much speculation in the press about the slump in TV audiences last Christmas. I had the unprecedented experience of having repaired sets left uncollected in the workshop until well into the new year. In former times their owners would probably have been hammering on the door on Christmas morning! This must be a warning to those smaller dealers and freelance engineers who depend for their incomes largely on TV servicing. I'm sure we'll adapt to the VCR in due course however. Who knows, when the large rental chains start selling off their older machines all sorts of business opportunities may open up.

Cable

One thing that won't do the smaller man much good is cable. It won't do the big boys much good either unless they can persuade the viewers to cough up the projected £400 connection fee, plus a hefty monthly rental. There was talk of a million customers being expected in eighteen months' time, though things have gone decidedly quiet since the prospective cable operators have had to sit down and contemplate the hard sales task ahead.

Having paid out a large sum to get plugged into the cable network, the viewer is going to expect value in terms of tip-top programmes. There's a limit to what can be done however, as we are already seeing with Channel 4. What programme making talent there is will just get spread around more thinly. I suppose more sport could always be laid on – like our editor, I remain stubbornly unconverted to this aspect of viewing. If this led to the public going over to cable TV in a big way, us independents would suffer a further substantial drop in income. As an ITMA character used to say, it's being so cheerful that keeps me going.

The Affluent Society

I was depositing some glassware at the local bottle bank last Sunday when I observed a gentleman casting a large colour set (it looked like a Finlux Peacock) into the neighbouring skip. TV sets can certainly depreciate rapidly. Ironically, I've one of these sets awaiting spares at present. The estimate from the suppliers is around £35 and the total cost to the customer will of course be substantially higher. Which is probably why you see so many TVs on rubbish tips.

Ike Hodge Get's Caught!

Ike Hodge was deep in his copy of *Television* when I called in to see him the other day. He motioned to me to take a seat, and I perched myself on an old G8 that had definitely seen better days whilst waiting for him to get through what he was reading. He had a look of rapture on his face.

"Good stuff this Les Long-Johns" he eventually said. "Does you good a bit of a laugh. That's the trouble with you and me. We're too serious. Dedicated I suppose you could call it."

I agreed that he had a valid point, and Ike continued. "Often feel I wasn't cut out for this job. With my sensitive nature I should have been a composer, or a ship's cook. What about you? A successful writer maybe? Well we all have our disappointments. Look at what happened to me the other day, and all because I was too conscientious.

It all started with this old bat coming in and asking me to sell her a picture valve. Said this nice young engineer had changed it on a couple of occasions but now he'd left the district. From what she said it was pretty obvious that she wanted a PY500 and I suppose I could have just sold her one and made a quick profit."

"Still selling those gash valves you strip out of ex-rental sets?" I asked.

"Gash!" he exclaimed. "I'll have you know I do a good trade with my guaranteed used valves."

"How long do you guarantee 'em for?" I asked out of curiosity.

"Not against going wrong" he said pityingly, "only that they've been used. What do you think my name is? Anyway, my better nature compelled me to offer to fit the valve for her – so that I could make any adjustments that might be needed.Did I mention that she lived at a pub?"

"You didn't but it figures. You were hoping for a free drink as well as a service charge."

He gave me a sorrowful look. "There's something so terribly mercenary about you. Anyway when I got there, and it was a nine mile trip into the country, it turned out to be a real big oldie. A 25in. hybrid. Must have weighed a ton. The PY had gone all right. Soft. But when I put in another it glowed red hot as soon as it warmed up."

"Dead short boost capacitor?" I suggested.

"Yes, and I didn't have one in the van. I was all for taking the set back and doing it on the bench, but I wasn't going to bust a gut lifting it on my own. And do you know, out of all the customers in that pub there wasn't one who didn't suffer from a bad back or slipped disc or something else that made it impossible for them to give me a hand. In the end I had to come back here and get a capacitor. It was Willy's day off, or I'd have taken him with me the second time. As it was I just had to hope the capacitor would do the trick.

So up came the picture, as good as gold, and the tube looked almost as good as new. The old dear was as pleased as Punch and was just about to pay me when there was a right old flash inside the set and a puff of smoke. The rotten tuning capacitor had burnt up and I didn't have one of those either."

"You didn't make a second journey, surely?"

"I'd no choice, had I? She was already muttering that this sort of thing didn't happen with the other nice man, and I could see there'd be nothing in it if I wasn't careful, so like an idiot I went through the whole procedure again. If I'd known what was going to happen I'd never have gone within miles of the place again. The set worked like a charm for five minutes after fitting the puffer, then pow, the h.t. rectifier, shorted blowing the surge limiter.

By now it was near tea time, so I told her the set would have to go back to the workshop come what may. In the absence of any other help I got the old girl to give me a hand. By then it was getting dark and perishing cold. I'd got about half a mile down the road when I realised that the steering was funny. Flat tyre, front near side. Took me ages to fit the spare, only to find that was flat as well. Had to get a tyre bloke out. Took the one wheel for repair and left me waiting there for half an hour. When he came back he wanted ten quid. Right I thought, that's going on your bill madam.

Not wishing for a repeat performance, I soak tested the set for a few days. Whilst doing this she phoned to say she was moving and would I return it to the new address? When she told me where it was I knew I was in for more pain. Of all places, she had to go and move to the top floor of a block of flats in one of the worst reception areas in the district. Willy and I najjered ourselves getting the set up four flights of stairs, and when we got it working the signal strength was so awful we had to promise to fit an aerial amplifier. Didn't even get a chance to fit it before the perishing set blew up again. Line output transformer this time, so it was back to the workshop once more with not a penny to show for all the effort so far – and me down the drain for another twenty quid for the amplifier.

About three days later madam phones to say she'd prefer a new set and would I supply one? It would have to be a 26in. model because she was used to a big picture."

"So that gave you the chance to make up for everything you'd lost so far!" I said brightly. "I suppose you picked out one of your most expensive clappers?"

"I did not" he retorted. "I recommended her to go to Tod Johnson down the road. Said I'd stopped selling sets."

"But you're not exactly friends" I gasped. "Why hand him a sale on a plate?"

"You figure it out" said Ike with a knowing grin. "Would you honestly want to install one of my quality sets in a top floor flat with aerial problems? As my dad used to say, cut your losses wherever possible – and if you can lumber someone else at the same time so much the better. I've heard that Tod's laid up with a bad back. D'you think I should send him some grapes?"

Digital Counter-Timer

Tony Jenkins
(WKF Electronics)

Part 1

THIS instrument has been designed to provide a convenient and accurate way of measuring, counting and timing events. Applications include checking and setting clock, subcarrier and timebase oscillators, checking frequency divider circuits, measuring time delays, and batch/transient counting. The term digital frequency meter (DFM) is more commonly used, but it's pertinent to point out that a pure DFM will not perform all the functions of which the present design is capable. DFMs do not usually have timing facilities for example, being restricted to frequency measurement.

Most of the full-function counter/timers available commercially are extremely expensive. These and DFMs tend to suffer from the limitations of being either mains powered and/or capable of reading only a limited range of frequency, usually to a low resolution. The present design avoids these constraints, offering the constructor the opportunity to build a portable, battery-powered instrument of great versatility. The frequency range is from less than 1Hz to in excess of 1·5GHz with eight digits resolution. There are full counter/timer functions and a choice of switchable inputs. The basic power consumption is some 10mA (excluding the prescalers), so that well in excess of a hundred hours typical use can be expected from a PP7 battery.

In considering the design, attention was paid to cost and ease of construction in addition to the technical specification. The result is a unit which is much less expensive than comparable commercial designs. Interwiring has been kept to the minimum by using the latest display technology. This simplifies construction and makes assembly errors less likely. So we have a convenient to build, cost effective, multifunction instrument that's truly portable.

Basic Design

The design is based on the Intersil 7226A eight-digit universal counter/timer i.c. This is similar to the well known 7216 but has extra control lines that simplify interfacing with a 7231A triplexed LCD display driver. A block diagram of the complete unit is shown in Fig. 1. From this it will be seen that in addition to the main logic there are two preamplifiers, which are identical, and two prescalers. The power consumption of the prescalers and preamplifiers is considerably more than that of the main logic, so these sections are switched off when not in use, i.e. when the appropriate input switch is not depressed. The main logic is capable of operating up to 10MHz, the prescalers extending the range to some 2GHz.

In designing the input selection arrangements the aim has been for maximum versatility in use. Thus input A can be switched to accept TTL level signals (5V) while input B provides input amplification, and input B can be switched to accept TTL inputs while either of the prescalers is in use. The user's "driving experience" will doubtless suggest many useful applications for these facilities.

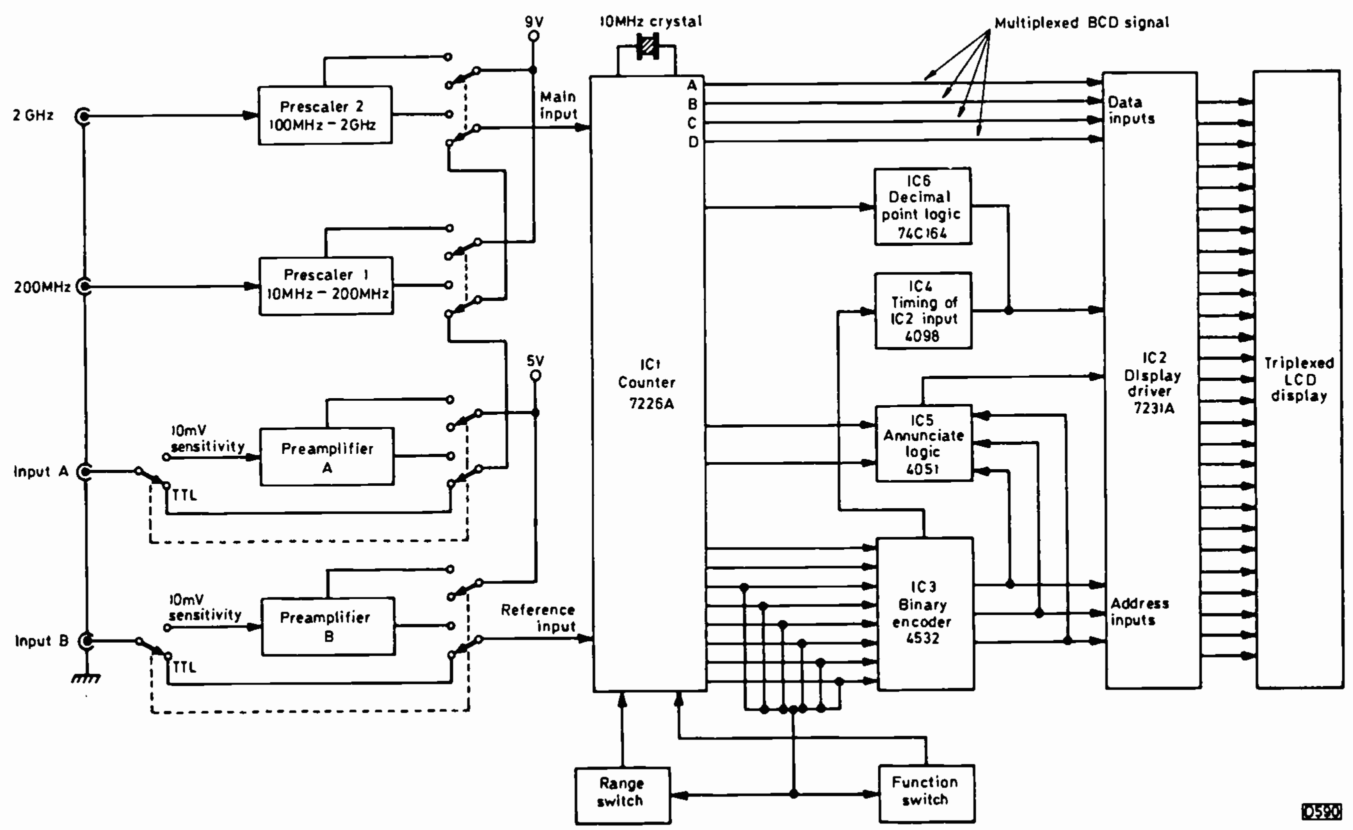


Fig. 1: Block diagram of the counter-timer.

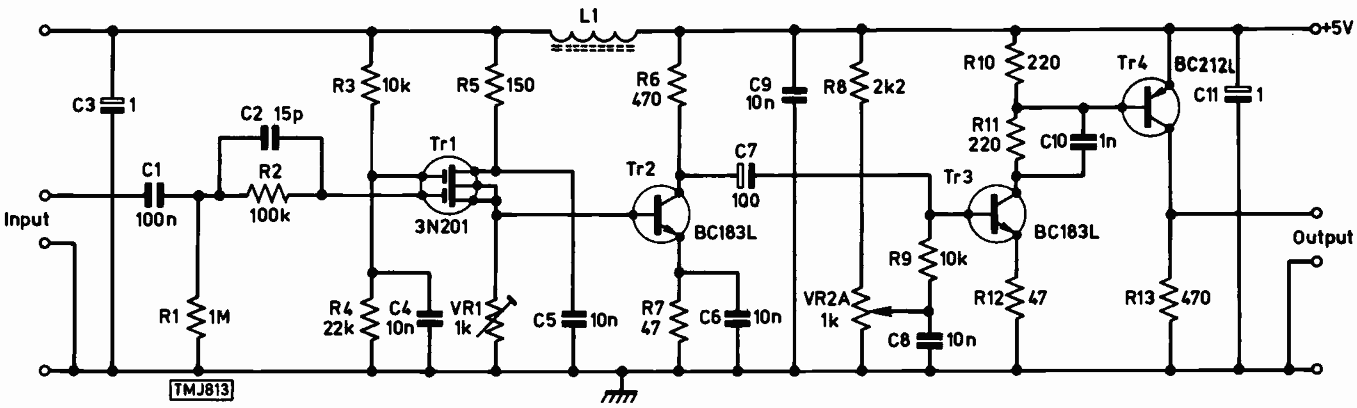


Fig. 2: Preamplifier A circuit. Preamplifier B is identical.

Fig. 6 shows the main logic circuitry. The data output from IC1 appears at pins 6, 7, 17, 18 while address outputs appear at pins 22-30. The latter drive the 4532 binary encoder IC3 which generates a binary coded output corresponding to the selected input. Pins 6, 7 and 9 of IC3 in turn control the address lines (37-39) of the 7231A display driver IC2. These lines tell IC2 how to interpret the incoming data. Each time any of IC1's address output pins (22-30) goes high (logic 1), IC3's enable output pin 15 also goes high. This triggers monostable IC4a, which produces a 50μ sec delay to allow time for the data and address lines to settle. The second monostable IC4b subsequently provides a trigger pulse which initiates writing of the information into IC2. The circuitry comprising the shift register IC6 and sections of the input selector switch maintains the decimal point in the correct position when the prescalers are in use.

Information for the display annunciators in IC2 – these indicate modes, range and measurement in progress – is selected by data selector IC5. This is driven by IC3's address outputs. Fig. 4 shows the connections between IC2 and the LCD display. Note that the display connector has one spare pin at each end – these should be ignored.

The Preamplifiers

The counter i.c.'s inputs (pins 2 and 40) are designed to be driven by TTL signals, so amplification is required for any other type of signal. There are two identical preamplifiers, for main input A and reference input B. In the design of these consideration was given to input sensitivity and impedance to enable the measurement of low-level signals using standard test leads. The preamplifier circuit is shown in Fig. 2. The initial stage consists of a dual-gate MOSFET to provide a high input impedance. This is employed as a source-follower to drive the common-emitter transistor Tr2 whose output is a.c. coupled to the base of Tr3 by C7. The bias at the base of Tr3 is controlled by VR2A, which with the complementary control VR2B in the other channel are the front panel "offset" controls.

The purpose of these controls is to allow the input

Main Board and Display Board Components

Resistors: 0.25W carbon film, ±5% except where stated

R1	10k
R2	10k
R3	47k
R4	47k
R5	10k
R6	10k
R7	15M 0·5W (metal glaze)
R8	10k
R9	100k
R10-15	10k
SIL1	2k2×8
SIL2	100k×8
VR1	220k miniature horizontal-mounting skeleton preset

Capacitors:

C1	1μF	35V	tantalum bead
C2	1μF	35V	tantalum bead
C3	68p		ceramic plate
C4	68p		ceramic plate
C5	47p		polystyrene
C6	100n	35V	tantalum bead
C7	10n		ceramic plate
C8	220p		ceramic plate
C9	1μF	35V	tantalum bead
C10	10μF	16V	electrolytic
C11	68p		ceramic plate
C12	10μF	16V	tantalum bead
TC1	5.5-65p		trimmer

Semiconductors:

D1-D4	1N4148	IC4	4098
Tr1	BC184L	IC5	4051
IC1	7226A	IC6	74C164
IC2	7231A	IC7	4069
IC3	4532	IC8	74HC14
		IC9	LM2931 25.0

Miscellaneous:

XL1	10MHz HC18/U crystal
SW1-10	See text
SW11	2-pole, 6-way p.c.b.-mounting rotary switch
LCD	8-digit triplexed display

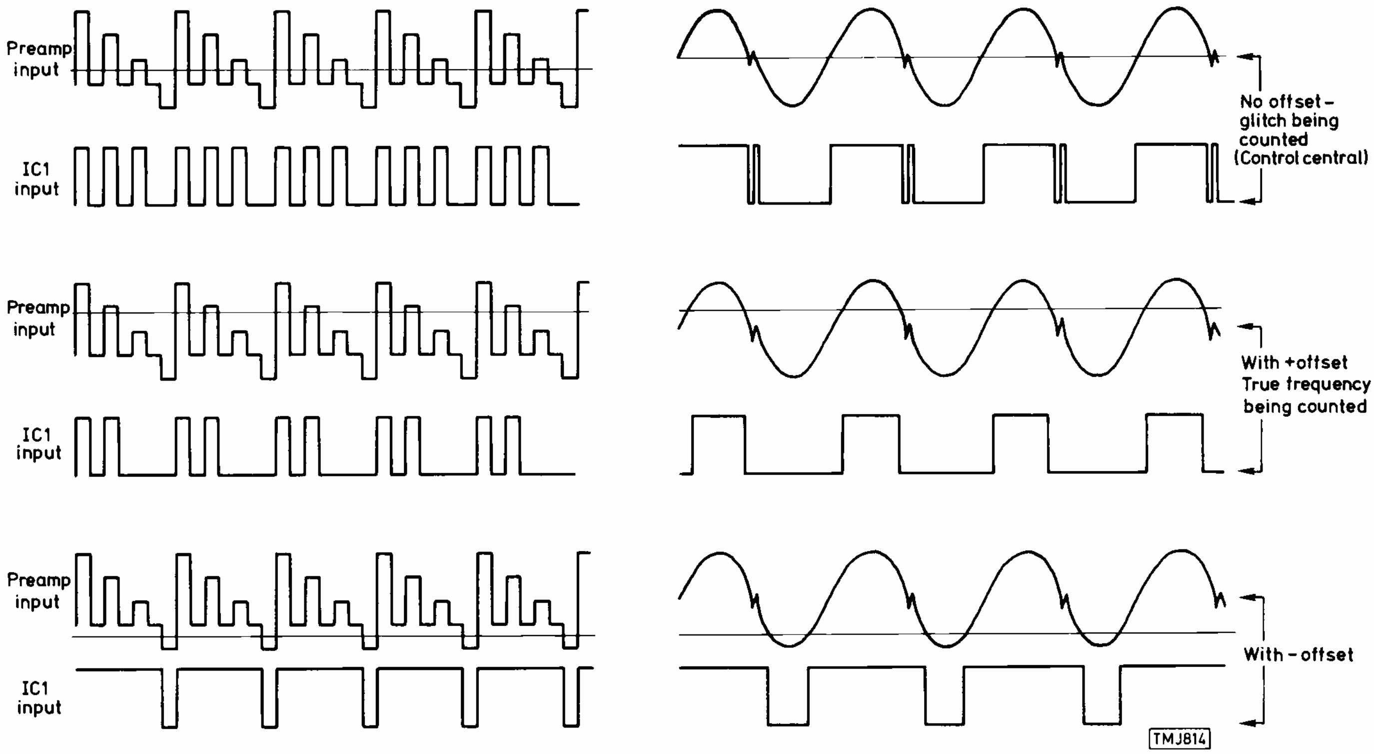


Fig. 3: Effect of the offset controls under ideal conditions.

waveform to be sliced at some point other than its average level, so that low-level noise or other unwanted signals are ignored, i.e. not counted into the reading. This desirable facility is often omitted from commercially produced instruments. The action is shown in Fig. 3.

The final gain and conversion to TTL level is provided by Tr4. Input capacitor C1 is included to block the d.c. component of signals being measured.

Either preamplifier is automatically selected and powered by the input selector switches. The display indicates when the amplifers are *off*, i.e. the switches are in the TTL position. It's sometimes useful to feed a TTL signal to one input and a low-level signal to the other. By depressing both the TTL and AMP switches the A input will provide amplification while the B input accepts a TTL signal. By *releasing* both switches, the reverse conditions apply. The B input can also be set for TTL operation while either of the prescalers is in use. To do this, depress the TTL switch and the required prescaler switch. The display indicates whichever combination has been selected, providing a useful check on the input conditions.

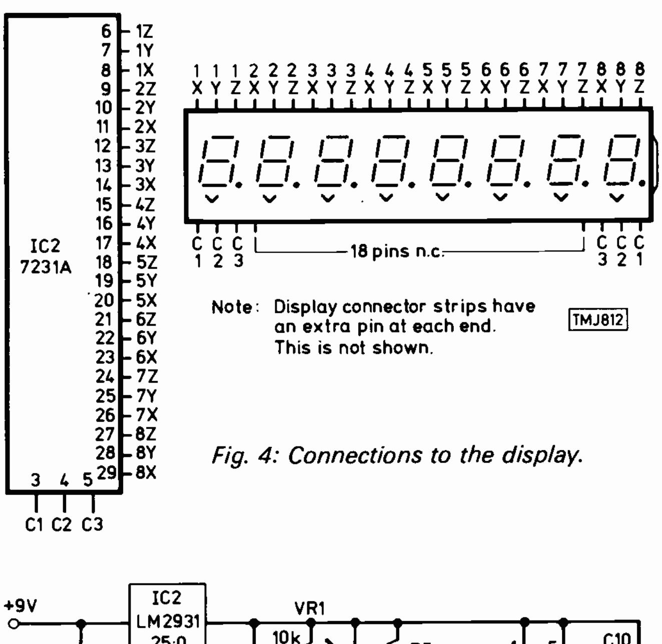


Fig. 4: Connections to the display.

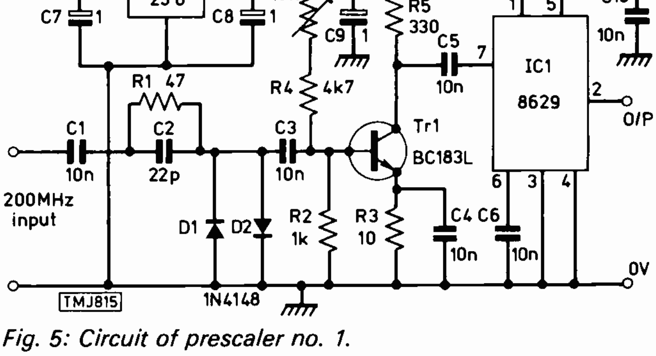


Fig. 5: Circuit of prescaler no. 1.

Prescaler No. 1

Fig. 5 shows the circuit of prescaler 1, which extends the range (set by the 7226A's 10MHz maximum capability) to 200MHz. The input signal is first amplified by Trl and then fed to the 8629 chip which divides the frequency of the input by a factor of 100. As with the preamplifiers, power is applied to the prescaler only when the appropriate input switch is selected. Selection of either prescaler automatically adjusts the position of the decimal point so that the output is read in MHz instad of kHz.

To Follow

Constructional details will start next month. Further component details and the circuit of prescaler no. 2 are also to follow. Printed boards for the project will be available from Readers' PCB Services Ltd. The unit will be available as a full kit of parts or built and tested from WKF Electronics. Further details and prices will be given in a later instalment.

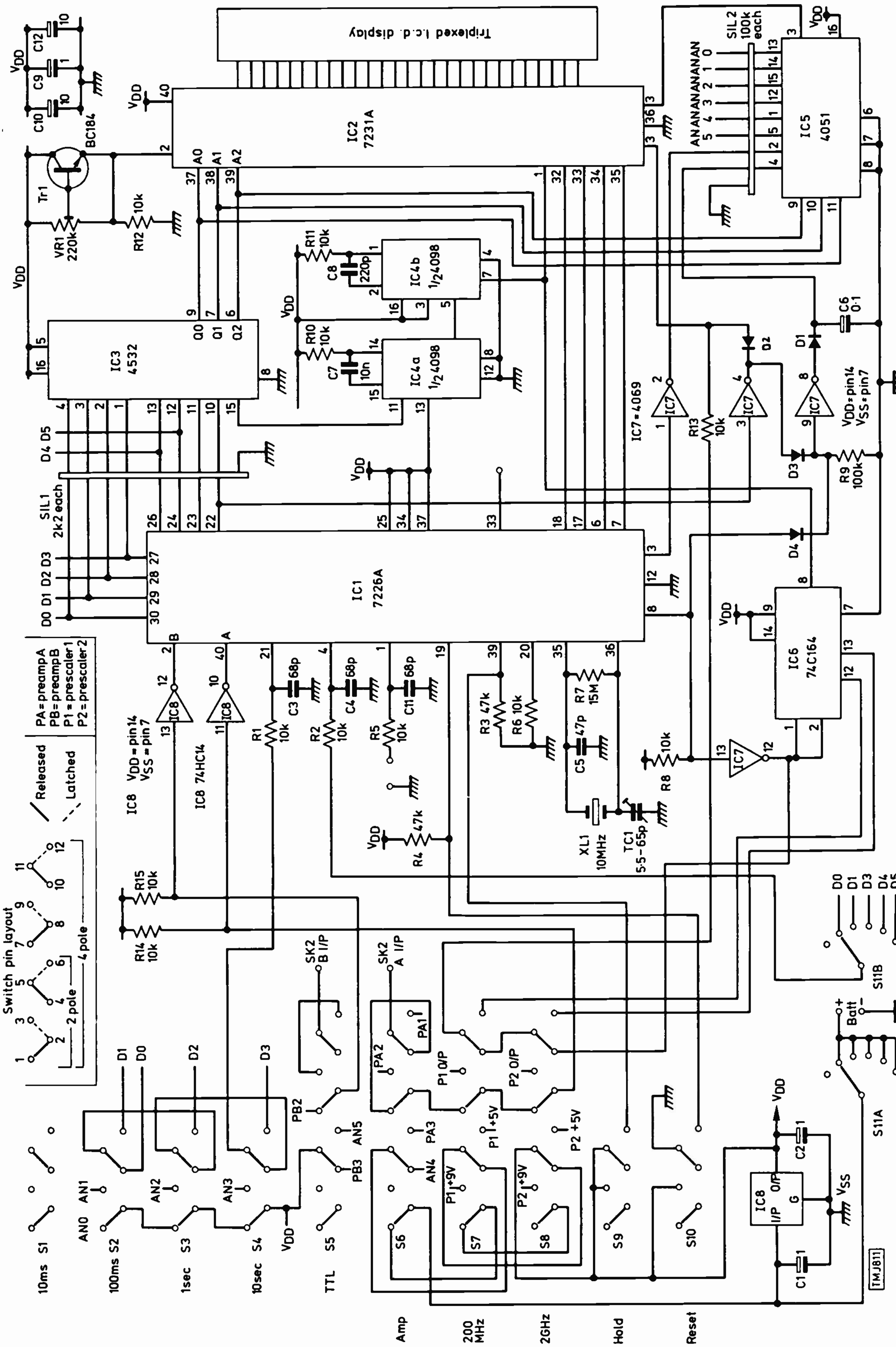


Fig. 6: The switching and logic circuitry.

Servicing Skantic Modular CTVs

John Brown

THE self-oscillating chopper circuit used in the Skantic Models 4751/5151/5661 was dealt with in some detail in the January 1982 issue of *Television*, along with the l.t. supply arrangements and the electronic trip circuit. The purpose of the present article is to cover the more common faults encountered in the rest of the chassis.

First, customer controls. Selection of channel 8 alters the flywheel line sync time-constant for VCR use. Individual channel tuning controls are situated in the drawer beneath the slider controls – push to open. Each tuning control has its own three-position band switch. Opening the drawer unit disables the a.f.c.

Above the channel 1 selector button is the "programmed picture" button. When this is depressed the colour, contrast and brightness assume internally preset levels. The colour and contrast are preset by PQ06 and PQ07 respectively: these two controls are on the channel selection module. Brightness is preset by PF01 which is on the decoder panel.

Two types of v.h.f./u.h.f. varicap tuners were used. Series 1 sets were fitted with tuner type R632, which fits into a raised black plastic socket with the aerial input being fed to the centre of a screened crossover unit.

In some areas of the UK (Southampton and Hatfield for example) sets fitted with this tuner suffered from herring-bone patterning. The problem was overcome by fitting tuner type F6002, as used in Series 2 sets. This is fitted flush to main panel-1 and there is no external crossover. Series 1 sets can be converted to take the later tuner by means of a small, easy to fit conversion panel which is available from Skantic (Luxor UK Ltd., Slough).

The i.f. circuitry is contained in the screened can that fits alongside the tuner. Buffer transistor TM01 (BF199) precedes the usual filter network. The tailored signal enters the MC1349P i.f. amplifier i.c. at pin 4, the amplified output at pin 8 being taken to pin 2 of a TCA270. Pin 5 of the TCA270 supplies a.g.c. to pin 5 of the MC1349P. Transistor TM02 (BC308B) provides delayed a.g.c. for the tuner, its input coming from pin 4 of the TCA270. PM01 should be adjusted for 8V at the collector of TM02 whilst receiving a noise-free picture.

Snowy pictures can be caused by a number of similar things. Decoupling capacitor CM21 (10μF) goes short-circuit to remove the 12V supply to the i.f. module. When CM19 (2·2μF) goes short-circuit the 10V supply to pin 2 of the MC1349P is removed. Either CM29 (47μF) or CM30 (22μF) going short-circuit removes the tuner r.f. amplifer's base bias – a fault in the TCA270 can cause TM02 to turn off with the same results. Buffer transistor TM01 is prone to going open-circuit base-to-emitter.

A second amplified output is taken from pin 1 of the MC1349P. This passes via buffer transistor TM03 (BF199) and mixer diode DM01 (OA90) to pin 14 of the TBA120U intercarrier sound i.c. The audio output at pin 8 is taken to the audio output module via the volume and tone controls. On Model 5661 a second audio signal from pin 12 is fed directly to the switched headphone and tape sockets at the rear of the set.

A word of warning before tackling no sound faults. If the set is a stranger in your workshop, check the small wire link on the power supply module. It should be in the RIS (5W) position. If it's in the 20AX (12W) position the a.f. module will be receiving a 34V supply instead of the required 22V, which results in lots of burnt a.f. chips and still no sound.

There are three main causes of loss of sound. The buffer transistor TM03 can go open-circuit base-to-emitter, while the audio output and TBA120U i.c.s frequently fail. Two types of audio i.c. were used, the TCA940 and SN76008. They are neither physically nor electronically interchangeable. The 100kΩ resistor RL01 associated with the TCA940 can also go open-circuit to cause loss of sound. The audio output module plugs into the rear of the slider control module.

The Decoder

The composite video signal enters the decoder module (Skantic call it the colour processing module) at pin XF15. From this point it takes two separate paths (see Fig. 1).

One is via CF14, RF27 and the luminance delay line to pin 14 of the TBA396 i.c., which acts as a black-level clamp, beam limiter, luminance amplifer and PAL delay line driver. The brightness, colour and contrast controls are d.c. coupled to pins 9, 12 and 13 respectively. The luminance output at pin 7 is d.c. coupled to pin 3 of the MC1327 colour demodulator/matrixing/PAL switch i.c.

The second path is via CF15, RF31, CF19, CF23 and spring link XF21 to pin 3 of the TBA395 i.c., which contains the a.c.c., burst detector, 4·43MHz reference oscillator, PAL bistable and colour-killer circuits. The chroma output (less the bursts) emerges from the colour-killer controlled pin 1 and is then fed via CF13 to pin 2 of the TBA396 for application to the PAL delay line driver. After passing through the delay line/matrix circuit the separated U and V signals enter the MC1327 i.c. at pins 8 and 9 respectively. This i.c. also includes the blanking circuits, the RGB outputs appearing at pins 2, 1 and 4 respectively.

On monochrome, the voltage at pin 1 of the TBA395 rises from 7·6V to 9V. This turns transistor TF02 (BC238C) on, damping the 4·43MHz trap LF02 to extend the bandwidth. Transistor TF01 (another BC238C) supplies the pulses for burst gating and black-level clamping.

No picture can be caused by CF01 (10μF) leaking: this fault can also be caused by the 6·8V zener diode DC07 on the RGB output module going open-circuit. If, when changing channels, the picture goes dark and then slowly recovers its normal brightness, RF18 (1MΩ) has gone high in value. A blank white raster is the result when CF11 (10μF) leaks.

Loss of luminance, often intermittent, is usually due to the delay line, especially if it's of the black rod type: it either goes open-circuit or develops a high-resistance leak to chassis.

Uncontrollable brilliance will be followed by operation of the electronic trip circuit. Switch off and remove connector XB2 from the RGB output module to disconnect the drives to the c.r.t. cathodes. This enables fault-finding to proceed in a more leisurely manner. The

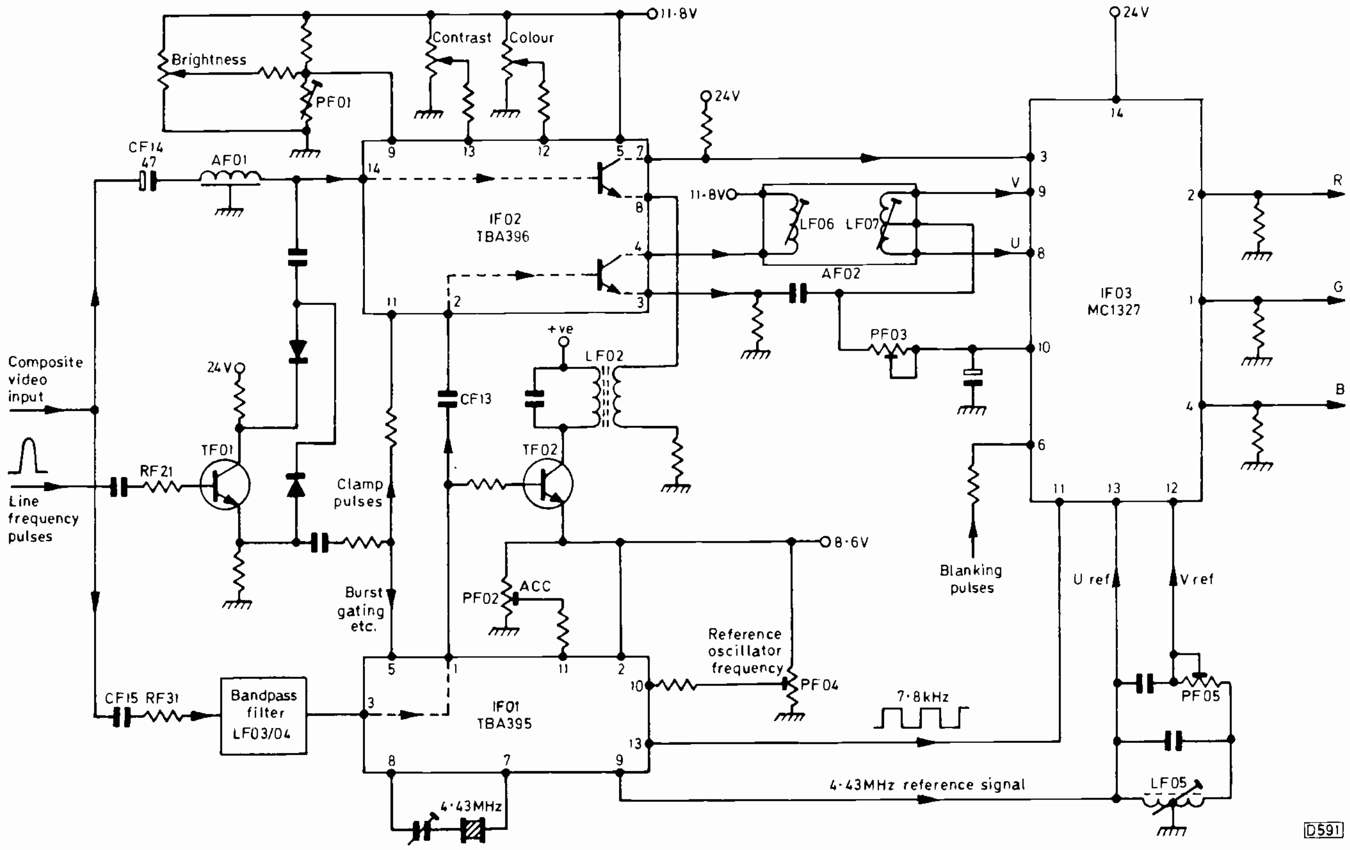


Fig. 1: Skeleton circuit of the decoder, showing the signal paths between the three i.c.s.

4·43MHz trap LF02 is the prime suspect – it tends to go open-circuit, removing the voltage from pin 8 of the TBA396 i.c. Second suspect is resistor RF21 (100kΩ) – when it goes open-circuit, there is no line pulse input to the base of transistor TF01 and as a consequence there will be no black-level clamp pulses to pin 11 of the TBA396 i.c. There are two other possibilities, CF42 (4·7μF) or the 6·8V zener diode DC07 on the RGB output panel going short-circuit.

With the colour control at maximum there should be 10V at pin 12 of the TBA396 i.c. When the problem is no colour, a useful starting point is transistor TF02's collector voltage. If this is zero, CF29 (47μF) is probably short-circuit. If the voltage is 9V, there's no chroma signal at pin 1 of the TBA395 i.c. Remove spring link XF21 and connect a shorting link from the pin next to CF23 to the similar pin adjacent to the preset PF03. If this results in some form of colour information on the screen, check CF20 (2·2μF), the TBA395 i.c. and associated components. If the result is still no colour, check the video path prior to XF21 and the reference oscillator components. If the voltage at TF02's collector is 24V, there is a chroma signal at pin 1 of the TBA395 i.c. Check CF28 (10μF), the TBA395 and the TBA396.

Unlocked colour can be due to CF32 (0·0047μF). Loss of red information can be due to either coil LF05 or capacitor CF40 (47pF) going open-circuit. Hanover bars are usually due to the PAL delay line going open-circuit – at the LF07 (output) end.

The Timebases

The sync module contains a TBA950-2 i.c., which functions as the sync separator and flywheel controlled line oscillator, and a discrete component field oscillator.

The composite video signal is amplifed and clipped by transistor TX03 (BC237B) on main panel-1, the output from this entering the TBA950 at pin 5 (see Fig. 2). Line drive pulses emerge at pin 2 and are fed to the base of the line driver transistor TH01 (BD232) on main panel-2. To set the line frequency, connect a shorting link between pin 5 of the TBA950 and chassis and then adjust PS03 for an upright, floating picture.

Line jitter followed by tearing can be caused by CS10 (47μF). Should the TBA950 fail, note that the Plessey type is not a suitable replacement as it requires different values in some of the external component positions.

Positive-going field sync pulses emerge at pin 7 of the TBA950. They are amplified and inverted by TS04 (BC237B) and used to control the field oscillator by turning TS02 on. The field oscillator uses the pnp-npn pair TS02 (BC307A) and TS03 (BC237B) in an astable switch circuit. When TS02 conducts, TS03 will turn hard on. As a result CS02 charges, and when the charge on its left-hand plate approaches the voltage at the emitter of TS02 both transistors switch off. CS02 then discharges via RS12/PS01/RS14, the next cycle starting with the arrival of another negative-going sync pulse at the base of TS02. The output at the collector of TS03 consists of a negative-going squarewave pulse. To set the field frequency, short-circuit the base of TS04 to chassis and adjust PS01 until the picture rolls slowly upwards.

Failure of TS04 causes no field sync. A rolling picture is usually caused by RS12 (130kΩ, 1%) going open-circuit. RS09 (820Ω) going open-circuit stops the oscillator and causes field collapse.

A field sawtooth is developed across CV01/2 on the field output module. These capacitors charge via RV01/2/4 and are discharged when a negative pulse from the sync module turns on diode DV02, thus initiating the flyback. This same pulse also turns on diode DV01, in turn switching off transistor TV01 (BC238C). The result of all this is a negative-going sawtooth with a superimposed positive-going squarewave pulse at the collector of TV01. This waveform is amplified and used to drive a class AB field output stage (of the type used in the Decca 100 chassis, Thorn 9000 chassis and Rank Z718/T20 etc. chassis). Height is adjusted by PV01, linearity by PV02, vertical shift by PV03 and EW symmetry by PV04.

In the event of field collapse, check that the 40V supply to the field output module is present at pin XV06. The most common cause of field collapse is transistor TV05 (2N3441) in the output stage going short-circuit. In this event the other output transistor TV04 (TIP31A) should

continued in next column

Simple VCR Servicing

Part 3: No Fast Forward or Rewind

Derek Snelling

NO fast forward and/or rewind are probably amongst the easiest of VCR faults to repair, though there are one or two pitfalls for the unwary, particularly with Betamax machines.

Let's start with the problem that the fast forward or rewind key won't stay down. Switch off the mains supply and see whether it will then latch. If not, you've a problem with the key latching – probably a worn or sticking latching bar. If the key does latch with the mains off, the problem is that the stop solenoid is tripping the key as soon as it's pressed. If the machine works correctly in the play mode, the stop solenoid and its drive circuit can be eliminated and the problem is probably due to the end sensor circuit operating.

In VHS machines this consists of a phototransistor which is usually connected to an i.c. that generates the stop solenoid output – the i.c. deals with a number of functions. Checking is fairly straightforward, and there are no adjustments.

In Betamax machines the end sensors consist of inductors whose inductance is varied by the foil at the end of the tape. This in turn varies the output level of an oscillator. The oscillator's output is independently adjustable for fast forward/rewind, and it's not unusual for adjustment to be required – presumably due to component value drift.

Adjustment is a matter of setting the oscillator's output level, using a scope in accordance with the instructions in the manual. If you don't have a scope and suspect that a machine might need this adjustment, note the position of the wiper on the potentiometer and then turn it an eighth of an inch anticlockwise. If this doesn't help, try adjusting it an eighth of an inch in the opposite direction. If there's still no improvement it's unlikely that the adjustment is off. If on the other hand this does cure the problem, check

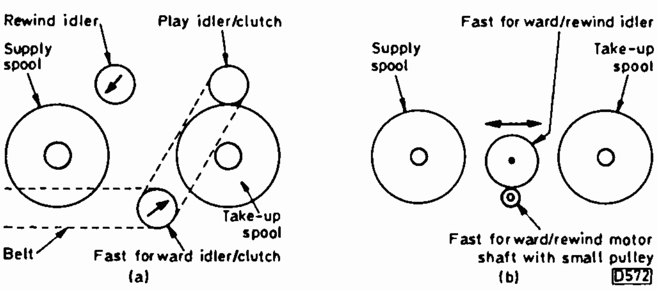


Fig. 1: Typical rewind/fast forward arrangements. (a) As used in Sanyo mechanically-controlled machines. (b) As used in Hitachi electronically-controlled machines.

that the machine will now switch off at the end of the tape, and turn the potentiometer back slightly if necessary. If adjustment doesn't help, the oscillator may be faulty. This is usually in an i.c. and failure is not unusual.

If the keys latch down but the machine doesn't rewind or operate in the fast forward mode the problem is probably mechanical. In the mechanically-controlled types of VCRs the power for fast forward and rewind is obtained from the capstan motor via various belts, pulleys and clutches. Problems here can be traced by following the arrangement from the motor to the reels and seeing where the movement stops. Likely faults are stretched belts and worn clutches and pulleys.

Pulleys can sometimes be given a new lease of life by lightly roughening the rubber tyre with a needle file and then cleaning with methylated spirit. It the belts etc. are all right, check that the reels are free to rotate in the fast forward and rewind modes and that the brakes are coming off properly.

A difference between the VHS and Betamax systems is that in the latter the tape remains laced up during fast forward and rewind. Because of this, several things can happen that increase the tape tension sufficiently to slow or stop rewind or fast forward whilst not affecting play. Possible problems are incorrect setting of the back tension arm, a worn head (check that the appearance is of polished chrome with no dull matt finish anywhere), or a worn upper cylinder (this is on top of the video head and should have a fine, grooved finish – it may need replacing if smooth and polished). The latter two problems are common on the Bush BV6900 and Toshiba V5470 machines. The Sanyo machine's head is constructed slightly differently and as yet I've had no problems with it in this respect.

When it comes to electronically-controlled machines, rewind and fast forward are usually provided by means of a separate motor (an exception is the new Hitachi VT11). Because of this the mechanical side is kept to a minimum, consisting of the motor and two pulleys (see Fig. 1). Mechanical problems are therefore rare, cleaning the pulleys and reels being all that's usually necessary. A more likely cause of the problem is that the motor fails to rotate. Things to check in this event are the motor and the drive circuit (a failing with the Ferguson 3V29/30 machines is the circuit protection device in the feed to the motor drive circuit). You may also have to check the logic circuits from the press button through to the drive circuit. Remember that a problem in the end-sensor circuit can prevent the logic circuit going into the required mode.

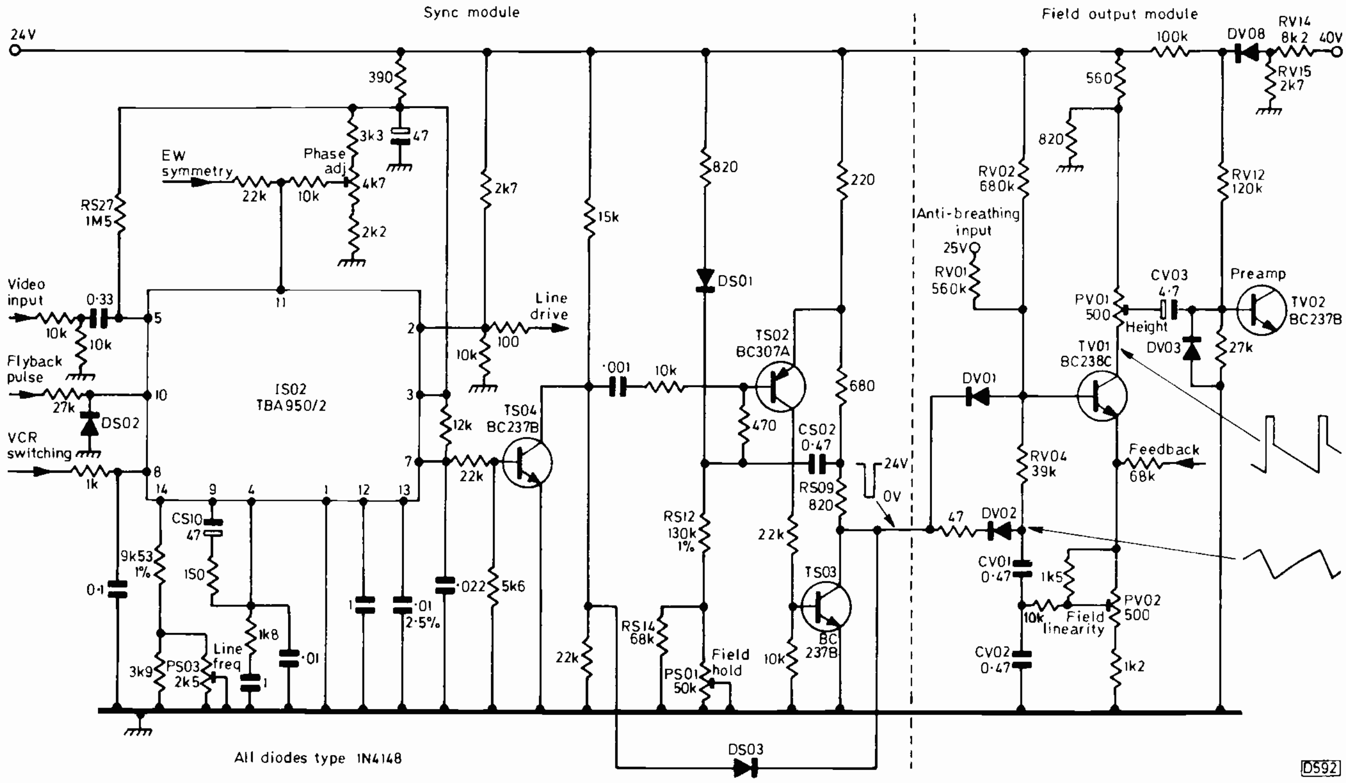


Fig. 2: The sync and the line and field generator circuits.

also be replaced. If TV04 is short-circuit, the driver transistor TV03 (BC327/16) is likely to be faulty. Other causes of field collapse are the coupling capacitor CV03 (4·7μF), RV16(2·2kΩ) or RV15(2·7kΩ) going open-circuit. In the event of RV15 going open-circuit there will be about 6·5V at the base of the preamplifier transistor TV02 (BC237B) instead of the correct 2·1V.

Slight cramping at the top of the picture, usually when the set has warmed up, is caused by the bias diodes DV06/7 (1N4001) in the output stage. Change them both even though they read all right on your meter. Severe top foldover can be caused by a leak in CV03 or a fault developing in TV03. Lack of height, together with fold-up from the bottom, can be caused by RV12 (120kΩ) going high in value. Slight fold-up on its own can be caused by TV05.

The line driver and output stages are fairly straightforward. The driver transistor TH01 (BD232) is transformer coupled to the BU208 line output transistor TH02. Horizontal shift is adjusted by PH01, linearity by LH04 and width by PK03 which is mounted on the convergence panel.

To gain access to the convergence module, insert a small screwdriver into the slot in the right-hand side of the cabinet: slide downwards to release the spring catch. The convergence module can then be separated from the cabinet flap, revealing a pictorial plan of the dynamic adjustments.

If the flyback tuning capacitor CH05 is a gold-coloured 0·0082μF capacitor, replace it with an 0·0091μF, 2kV type. It goes open-circuit, resulting in high e.h.t. and severe flashovers. The line driver transistor TH01 can be responsible for intermittent loss of the raster. No raster with RH08 (6·8Ω) burnt indicates a faulty tripler. Replace the BU208 at the same time. Lack of width with RH08 burnt indicates that CH08 (0·015μF) in the diode modulator circuit is faulty.

A loud line whistle can be due to either the line output transformer, the line linearity coil LH04, or both. Before ordering replacements it's well worth seeing whether you can effect a cure as some sets suffered from this problem from new.

A narrow picture with EW errors can be due to DH03 (SKE4F/2/08), LH06 or RH08 being open-circuit. If this is not the case check transistor TK01 (BC237B) and the associated components in the EW drive generator circuit on the convergence panel. EW errors with full width can be due to DH01/2 (same type as DH03) going open-circuit or DH03, CH13 (0·47μF), LH04 or LH05 going short-circuit. If these components prove to be normal, check TK01/2/3 and the associated components.

Odd Faults

Picture jitter accompanied by a hum bar is caused by the tuning voltage decoupling capacitor CX02 (1μF). Darkened corners of the picture are caused by diodes DX03/4 (1N4148). These three items are on main panel-1.

A hum bar which changes its position with changes in the settings of the customer controls is caused by CF01 (10μF) on the decoder panel.

RS27 on the sync module was changed from 820kΩ to 1·5MΩ during production.

Related Models

Certain models fitted with the 20AX tube instead of the Toshiba RIS tube are fitted with the same basic chassis. These include the 6661 which has touch-button channel selection, the 6662/6663/6665 which have automatic station tuning (AST), and the 5664/5674/6664/6674 which have AST plus infra-red remote control. These models have different field output, audio and convergence modules. There are also additional components on main panel-2. Models with AST have resistors RM21/22 removed from the i.f. module.

Modern CCTV Camera Tubes

Peter Graves

THE traditional vidicon camera tube with its antimony trisulphide photosensitive target has two main disadvantages. First low sensitivity, so that a high lighting level is required. Secondly image burn-in, sometimes permanent, if the camera is left looking at a bright image for any length of time. These problems can be overcome by using doped silicon as the photosensitive target: silicon targets offer good sensitivity and complete freedom from burn-in.

This article describes the construction, operation and main characteristics of the silicon diode array (SDA) tube and a variant, the silicon intensifier target (SIT) tube. With the latter an electron image intensifier is added to give a massive increase in the sensitivity. Since both types of tube are based on the use of a silicon diode array, we will consider this first.

The Silicon Diode Target

A typical SDA tube is shown in cross section in Fig. 1. Electrons from the indirectly heated cathode are focused into a narrow beam by the combined action of the voltages applied to the tube's electrodes and the steady magnetic field produced by the external focus coil. Pairs of scan coils, mounted at right angles to each other, deflect the beam to produce the familiar raster pattern at the rear of the photosensitive target. Pulses are applied to the cathode to suppress the beam during the line and field flyback periods.

The target is biased positively with respect to the cathode, typically by 8-12V d.c. The signal current flowing through the external load resistor (see Fig. 3) results in a signal voltage which is coupled to the first stage of the video amplifier. Fig. 2 shows the stages in the manufacture of the target. A silicon dioxide layer (an insulator) is first formed on one side of a slice of n-type silicon. Tiny holes are then etched through the silicon dioxide layer, each hole being some 5μm in diameter and 12μm from its neighbours. A typical camera tube target may have over 600,000 of these holes. Finally a p-type diffusion is applied, with the result that a pn junction is formed behind each hole. A thin sheet of high-resistance conductive material is afterwards laid over the oxide surface to prevent the build up of unwanted charges on the insulator – such charges would interfere with the correct operation of the tube. The completed target is mounted so that the n-type surface is exposed to the optical image that passes through the tube's glass faceplate, the p-type islands being scanned by the electron beam. The electrical connection for the external load is made to the n-type slice as shown in Fig. 3.

Operation

Each of the pn junctions comprises an individual diode, the diodes having a common cathode and separate anodes. The voltage applied between the tube's cathode and the target reverse biases the diodes, the electron beam acting as the return connection. When the beam touches the anode of each diode, electrons are deposited, charging the very small junction capacitance – the p and n sections form the plates of a capacitor, with the depletion region at the junction of the reverse biased diode forming the capacitor's dielectric.

The diode leakage current is very small (a fraction of a nanoampere), and the charge is substantially retained until the beam strikes the diode during the following scan. Nothing much would happen with the target in darkness: the diodes would charge and remain charged. Visible light falling on the n-type surface has enough energy to produce electron-hole pairs in the material however. Under the influence of the standing bias applied to the diodes, the holes move towards the anode of the nearest diode while the electrons move in the opposite direction. As a result, some of the charge produced by the electron beam is neutralised. The greater the amount of light falling on a particular area, the greater the number of electron-hole pairs formed and the greater the neutralisation of the charge at a particular diode. The overall result is that a charge pattern is built up on the target: little charge where the light level is highest, maximum charge where the target remains in darkness.

When the beam scans a particular diode, once every 40msec with a 625-line system, it restores the charge at that diode (until enough electrons have landed to repel further electrons). The effect at the other plate is that a current pulse is produced, these pulses forming the video signal.

The target arrangement with individual diodes is necessary because of the low resistance of doped silicon. With a continuous pn sandwich the charge pattern formed by the action of light would leak sideways and be neutralised as soon as it had been formed. Other types of target material have a high enough sideways resistance to maintain the charge pattern between scans. Silicon has advantages however. A silicon diode array tube is almost indestructable from the operational point of view. A camera tube using this type of tube can be pointed at the sun or a welding arc at close quarters without being damaged. This is particularly important for surveillance applications, where accidental exposure to the sun's image, direct or reflected, is a constant hazard.

Disadvantages

The SDA tube is not without disadvantages. Defective diodes appear in the picture as tiny black or white spots (depending on the defect), and a group can give an unacceptable blemish. The aim in manufacture is to produce targets with a diode defect rate of less than about 1 in 100,000. Another disadvantage is that the tube is more sensitive to red than to blue light (see Fig. 4), the response extending into the infra-red part of the spectrum. In some applications, such as discreet surveillance, this feature can be turned to advantage, but in many cases the infra-red response has to be filtered out to avoid unwanted signals from hot objects.

Perhaps the worst drawback is flooding or blooming: if the camera is pointed at a small bright light the image produced on the monitor will appear to be surrounded by an irregular pool of featureless white. The extent of the

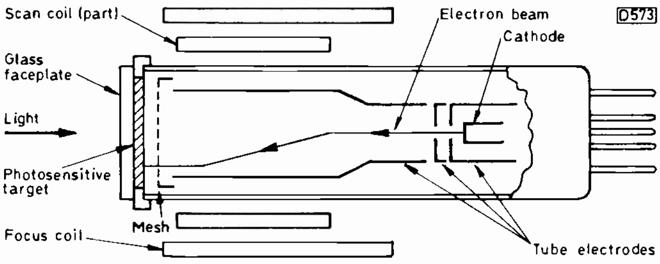


Fig. 1: Cross section through a typical silicon diode array tube. The scanning is orthogonal, i.e. the beam strikes the target at right angles over the entire surface. The mesh electrode behind the target contributes to this effect by reducing the velocity of the beam before it reaches the target.

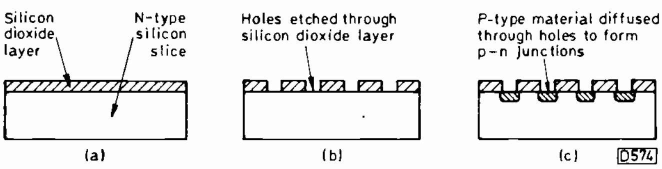


Fig. 2: Stages in producing the target.

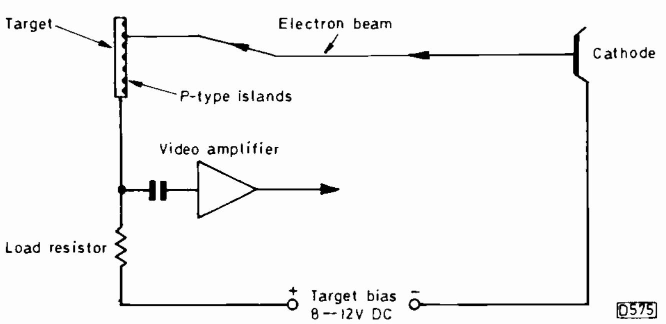


Fig. 3: Simplified signal circuit.

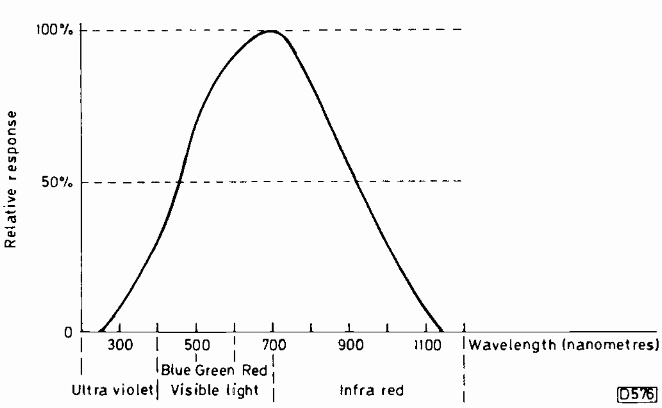


Fig. 4: Spectral response of the SDA tube.

pool will depend on the exact arrangement and relative size and brightness of the light and the background – in extreme cases the whole picture can be obscured by flooding. Consider the case of a camera pointed at a small but bright light against a black background. The target diodes under the influence of the light will be almost totally discharged whilst the surrounding diodes will remain almost fully charged. As a result, an electrostatic field will exist between the charged and discharged areas. If this is strong enough, there will be a sideways movement of electrons from the charged to the discharged area. In consequence the area of discharged diodes will expand until equilibrium is reached. The result is a white halo surrounding the light image.

A disadvantage compared to the antimony trisulphide vidicon is that the bias voltage cannot be adjusted to control the tube's sensitivity. The target bias is fixed and depends on the basic physics of semiconductor diode operation: such tubes should not be operated outside the recommended range. To keep the tube operating at its optimum level as the brightness of the external scene changes, some method must be used to keep the amount of light falling on the target constant. The obvious way to do this is to adjust the lens iris, and in many cameras the level of the video output signal is constantly monitored to produce a signal which, via a motorised servo system, automatically controls the lens iris position.

Much work is being done to improve the characteristics of the SDA tube. Its sensitivity, about ten times greater than that of the antimony trisulphide vidicon, coupled with its ruggedness and freedom from burn-in, nevertheless makes it a good all round choice for many applications.

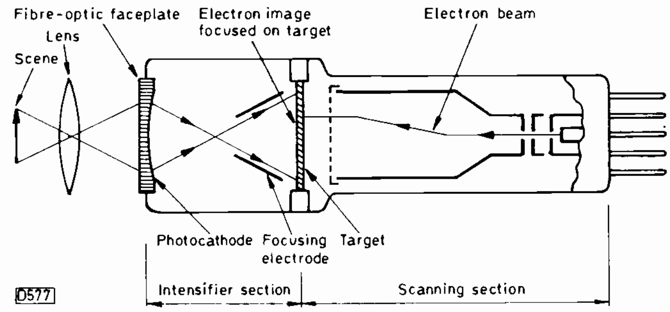


Fig. 5: Simplified cross section of a silicon intensifier target tube.

The SIT Tube

In addition to its ability to withstand very bright optical images without damage, the silicon diode array target is tough enough to withstand bombardment by high energy electrons. This characteristic is exploited in the silicon intensifier target tube, in which an SDA target is mounted in the same tube as an electron image intensifier (see Fig. 5). This type of tube can give usable pictures at illumination levels as low as 10^{-5} lux – say the light from a quarter moon or a dimly lit street at night.

The basic arrangement of the electron gun, target, scan and focus coils remains as described above. The image intensifier section is placed in front of the target: it consists of a photocathode with fibre-optic faceplate and an internal focusing electrode. The light input from the lens system is focused on to the flat outer surface of the fibre-optic faceplate, which also acts as the vacuum seal. The curved inner surface is coated with a thin photocathode layer (a complex mixture of sodium, potassium, caesium and antimony).

Light photons knock electrons out of the photocathode to form an electron image on the vacuum side – many electrons are emitted where the image is brightest, few electrons in dark areas. A high voltage (kilovolts) is applied between the photocathode and the target, negative with respect to the target. Thus the whole electron image is accelerated down the tube and is focused on to the target by the combined effect of the curved photocathode and the voltage applied to the focusing electrode. Note that the electrons forming the image are not focused into a beam: the image stays intact (in the two-dimensional sense) at the target.

The high photocathode-target bias accelerates the image electrons, and when they strike the target they give up their energy to form electron-hole pairs as before. There's an important difference between the SDA tube and the SIT however: in the basic SDA tube one light photon falling on the target creates one electron-hole pair, whilst in the SIT one light photon falling on the photocathode liberates one electron which after acceleration has enough energy to generate up to 2,000 electron-hole pairs at the target. Hence the enormous increase in sensitivity.

Gain of the SIT Tube

Since the energy given to the image electrons is determined by the accelerating voltage, the intensifier's gain can be altered by varying this voltage. A typical range is 4-9kV, the upper limit being determined by the risk of electrostatic breakdown around the faceplate and the lower limit by the amount of energy needed to overcome the inevitable energy loss at the target. Although the voltage required is high, the current requirement is very low and the photocathode voltage is normally generated by a flyback system driven from the camera's line timebase. This synchronises the power supply with the scanning, so that any interference arising from the supply will appear stationary on the picture. The smoothing of an asynchronous supply has to be much better as intererence from it will drift through the picture, which is a much more objectionable condition.

The low voltage supply used to power the e.h.t. generator can be varied to control the output voltage. This is easy to do electronically, and by combining the gain control electronics with the iris position servo circuit the tube's sensitivity can be adjusted to cater automatically for a wide range of illumination levels. A double servo loop is used, set up so that the photocathode voltage is kept constant at about 6·5kV while the lens iris is away from either of its end stops. This keeps the tube's signal-to-noise ratio at its optimum condition. Once the lens iris looses control (i.e. fully open or closed) the intensifier voltage is varied to increase the range over which the tube can be used. With a suitable lens, the tube can be used from midday to deep dusk without attention.

To anyone used to more conventional CCTV cameras, the sensitivity of the SIT camera comes as a surprise. Setting up the camera at the extreme end of its sensitivity range must be done in a darkened room, and sometimes the light from the monitor screen can overload it. Perhaps unexpectedly, the sharpness of the picture improves (within limits of course) as the light level drops. The reason for this is that at high light levels the e.h.t. is at minimum with the result that there is slight defocusing.

Because of their high sensitivity, SIT tubes are often used for surveillance applications. Another important application is for use in underwater cameras.

Intensified Intensifier Tube

A further version of the SIT tube, the intensified intensifier target tube or ISIT, uses a two-stage intensifier to increase the sensitivity down to almost the ultimate limits determined by photon noise. The increased sensitivity is obtained at the cost of increased noise on the picture and increased camera complexity – two high voltage supplies and their control circuits are required instead of one. Needless to say the tubes are much more expensive.

Alternatives

Despite its drawbacks the basic vidicon is still widely used since it's cheap. The CCD semiconductor type of image sensing device has been under development for many years now but remains expensive and has low sensitivity. An intensified version using an image intensifier of the type descibed above is also under development – the whole thing would be only a few inches in length. It will be interesting to see how long it takes for solid-state imaging devices to reach the performance standards attained by thermionic camera tubes.

Now and Then

Les Lawry-Johns

I WAS sitting at the typewriter wondering what I could say about that letter of mine in the February issue when this chap walked in. What about the letter? Well it was supposed to be a gentle leg pull of sorts. H.B. had had a brief chat with E.T. – the earthly one from the south coast who writes regularly in these pages. Advice had been obtained and in view of the E.T. mania recently – I'm talking about the other E.T. this time – we thought we'd sort of dress it up. It seems that some readers took it all seriously however, so apologies to anyone who may have been offended.

The Chap

Now what about the chap who walked in? Well he apparently wanted a used stereo record player complete with speakers – and they had to be good speakers at that. I just happened to have exactly what he wanted, and as it had been around for quite a while I offered it to him for twenty pounds. He though that was rather too much. "Take it off your hands for ten" said he.

I don't bargain with anyone, so I showed him the door and off he went. After he'd gone I got to thinking about it. We really are on the losing end in this trade. Twenty years ago that type of unit would have fetched twenty pounds or more, second hand, with no bother at all. Since then wages have multiplied by ten times or so, but you can still buy a new stereo record player for something like fifty pounds, which makes a used unit seem (to some) dear at twenty.

Economics

It's the same with repairs. Would the average person be prepared to pay ten times more than they did twenty years ago? Look at it another way. Thirty years ago if we fitted a new 12in. tube in a TV set it would cost the owner roughly twenty pounds. What was his weekly wage then? About ten pounds per week? Now we fit a 24in. monochrome tube in a set for roughly thirty pounds, and what is his weekly wage now? The reason of course is that new electrical goods are so cheap that to repair them is just not economic, though we still do it. Thus we are poor compared to what we were twenty years ago, and we are likely to remain so. End of moan.

The Rank T20

Mr. Grumpy's T20 was a nightmare. We'd fitted a new BU208A line output transistor, and as nothing else had showed up during checks and a soak test Mr. Grumpy had taken it home. We saw his car pull up outside and had an attack of the heart sinks. "It lasted only four hours" said Mr. Grumpy.

So we attacked it again. As the BU208A was once more short-circuit we again checked everything but could find no cause. Sure enough everything worked fine when another BU208A was fitted. We kept it on soak test for eight hours this time and it worked faultlessly. So Mr. Grumpy took if off again. And brought it back again.

This time we changed both EW modulator diodes, also the 0·91μF scan coil coupling capacitor, and fitted a new line output transformer. Another BU208A was installed and the set given a two-day soak test. Mr. Grumpy complained about the cost of the transformer and asked whether it was really necessary? So we suggested that he try it for a few days and if it went again we'd refit the old one. It did, and we did. There was no difference though, and this time the BU208A wasn't short-circuit.

The timebase wouldn't start until we shunted the line oscillator's start-up capacitor 4C19 with a 5kΩ resistor. Then it started working, and continued when the 5kΩ resistor was removed. The set was left looking into a mirror so that we could keep an eye on it.

After an hour or so we noticed that it was loosing width, and before we could do anything it had gone off – leaving some 200V on the BU208A's collector to show that it wasn't short-circuit. We had to start it up again with the 5kΩ resistor, so as the 910Ω resistor 4R16 in the 12V regulator circuit is notorious for messing about we changed it. The one taken out read perfectly all right, and we still had to start the set by hand as it were. This time it lost width and line hold after a couple of hours, so we changed the TBA950 line oscillator chip. It then worked fine for a long time before line hold was again lost and the set cut out. I cried but Honey Bunch summed it up in flash.

The Dry-joint

"Dry-joint" said she.

"All right, but where?"

"How should I know? I didn't ask you to sort out the knitting pattern last night, did I?"

So I stared at the right side line output panel, having stared at the timebase panel for some time. And suddenly I saw it. On the line driver transformer. It was just a thin line round one the base leadouts. Like a flash it was resoldered, together with every other connection in sight. The set came on straight away, and has remained all right since. I still have bad drams about Mr. Grumpy coming back, but he hasn't.

The Music Centre

Mrs. Earlybird brought in her music centre complete with one loudspeaker. It was a Ferguson Studio 20. Apparently her husband had repaired (?) the loudspeaker, and after trying it in both output sockets both amplifiers had packed up. I opened up the speaker and found that both leads were plugged on to the same speaker tag. It was thus a complete short-circuit, and after he'd plugged it into one output and killed that amplifier he'd done the same with the other one.

We removed the bottom screws and lifted the top off (record deck and cassette). All four 1Ω resistors in the ouput stages looked distressed. So we changed them and the four transistors for good measure and tested the unit before putting the top back on. It worked perfectly on both channels. So we put the carboard cover back on top of the ouput transistors and refitted the top unit. It still worked so we put the bottom screws back in and made a final check. One side worked, one side didn't. Smoke came out.

Out came the bottom screws and off came the top cover. The two 1Ω resistors on one side had burnt out. No, only one of them. Funny. I checked the current drawn and it was normal. Fitted another resistor and it kept its cool. Refit the carboard card and replace the top – after a tussle with the radio panel. Everything was o.k. so I refitted the bottom screws and tried again. One side o.k., smoke. By this time it was getting late and I called it a day.

The Dream

During the night I dreamt that I was a brave knight and fought everybody in a place called Camelot. I was called to the King's chambers and he was fixing a music centre. He unscrewed the transit screws to bed the deck down. Then he looked at me and bowed. "Look you" he said, "when you do this you bed down the record deck and the metal speed selector touches the top of the output transistor heatsinks or one of them and shorts it to earth, doesn't it?"

"Yes sire. It does to be sure, but there's a cardboard cover to stop it touching and I keep putting the cover back. I do really."

"Listen. Listen while I talk to you. There's a right way and a wrong way of doing everything. Now go."

So I went, and woke up. I stirred restlessly until I woke H.B.

"There's a right way and a wrong way of doing everything" I told her.

"Have you just found that out?" she growled sleepily.

"The King just told me, look you."

"Look you moron, there may be two ways but as sure as fate you'll always choose the wrong way first. Now go to sleep."

In the Morning

And so it was that the first job in the morning was to reverse the cardboard cover to prevent the speed selector touching the heatsink when the screws were tightened – after replacing the 1Ω resistor again of course.

If the transit screws had been left to let the deck float it wouldn't have happened.

I then took Ben for his morning walk. The Hillman Hunter still has a list to starboard, but now there's a bloody great CB aerial stuck in the centre of the boot. Not looking where I was going I felt unfamiliar ground under my feet. The council have filled in the pot-hole and tarmacked it over. Thank you council. And thank you readers for hoping I wasn't going to get my feet wet yet again.

Long-distance Television

Roger Bunney

JANUARY was remarkably active for DX-TV signals. The Quadrantids meteor shower produced high-level "pings and bursts" of signals during the 3rd/4th, with at times evidence of signals in Band III (channels E5/R6/E6), mostly unidentified. There were several minor Sporadic E openings (see later) to provide relief from the bleak weather, and an excellent tropospheric opening over the 19th-23rd produced signals in Bands I and III and at u.h.f. from central Europe. W. German u.h.f. signals were logged as far west as Holyhead, Anglesey.

An Excellent Tropospheric Opening

The build up to the tropospheric opening started with a slow-moving high-pressure system, and from about the 19th there were French u.h.f. signals at good levels here at Romsey. By the 21st, signals from W. and E. Germany and Switzerland were being received in the south and eastern UK in Band III and at u.h.f. There was a considerable improvement on Saturday the 22nd, when W. and E. German signals at good levels were received in Band III and at u.h.f. well into the midlands and the northern UK. At Romsey I found that Band III was generally more rewarding, with all the channels occupied by W. German signals! Garry Smith (Derby) logged CST (Czechoslovakia) chs. R10 and R11 at closedown on Saturday night, along with DFF (E. Germany) ch. E12. The 23rd was the peak day however. During the early hours DFF was present here at Romsey on ch. E5 with absolutely noiseless pictures, also on chs. E6 and E34.

From the logs received it seems that more intense signals were received in E. Anglia and the midlands than farther south. Reception was prolonged through the morning and into the afternoon in the midlands, whereas the signals tended to die away during the mid-morning in the south. Mel Wilson (Anglesey) logged Dortmund ch. E35 during the morning — over a difficult and shielded path. At Cambridge Cyril Willis noted "loads of W. German signals," several UK signals, a French ATV signal (F1EOM) and, unusually, the London free station Radio Horizon on 94·4MHz. During the evening we had the bonus of DR (Denmark) chs. E7/10 in S. Hampshire, with the PM5544 test pattern, but the W. German station count was declining sharply. By the morning of the 24th the rain had killed off everything here apart from NOS (Holland), though reception along the east coast continued during the morning, with intense Band III/u.h.f. signals from W. Germany/Denmark.

In general terms then an excellent tropospheric opening for most of the UK, with even Aberdeen enjoying signals from central W. Germany. A rapidly moving cold front on the 30th produced a short period of W./E. German u.h.f. signals along the south coast, while earlier, on the 9-11th, French/W. German signals had been received in the south/south east. Auroras were logged in the northern parts of Scotland on the 2nd, 7th, 15th, 19th (very intense) and 21st.

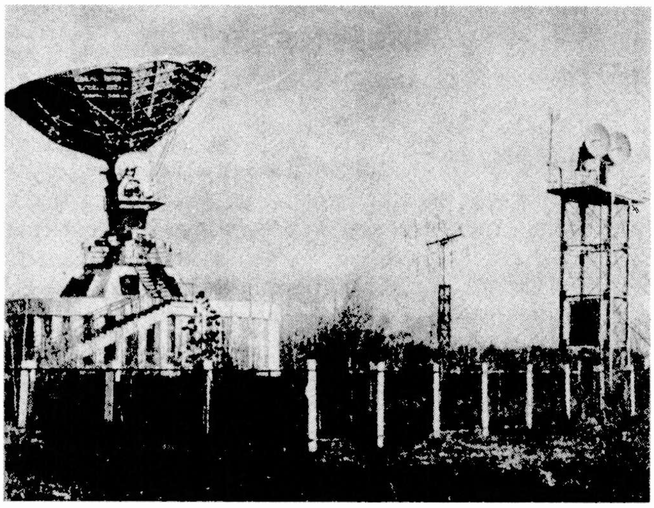
The SpE log is as follows:

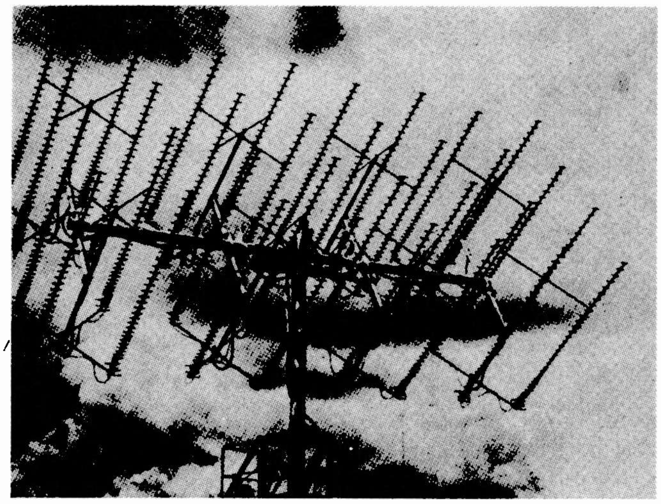
6/1/83	TSS (USSR) chs. R1, 2.
7/1/83	TSS R1, 2; MTV (Hungary) R1.
11/1/83	RAI (Italy) IA; TSS R1.
14/1/83	RTVE (Spain) E2, 3, 4.
15/1/83	Unidentified film on ch. E3 (1500).
17/1/83	MTV R1.
18/1/83	RTVE E2, 3, 4; JRT (Yugoslavia) E3; RAI IA; ORF (Austria) E2a.
21/1/83	TSS R1, 2; RAI IA.

The random and common daily MS signal pings have as usual been omitted —they are widespread and of short duration (under ten seconds).

All in all then an interesting month, and my thanks to the following who sent in reception reports: Mel Wilson (Holyhead), Cyril Willis (Ely), Hugh Cocks (E. Sussex), Simon Harmer (Presteigne), Iain Menzies (Aberdeen), Garry Smith (Derby), John Tellick (Surbiton), David Moller (Eastbourne), Brian Renforth (Torquay) and Ian Johnson (Bromsgrove).

Ryn Muntjewerff (Holland) comments that during the excellent tropospheric opening noted above a DXer at Horm, Holland, logged RAI-2 ch. E30 from Turin. John Tellick took a portable TV atop the South Downs on the





The photo on the left shows s.h.f. aerials at the USSR satellite station at Frunze – the main dish and outgoing microwave link dishes. The photo on the right shows the Yagi aerial system for receiving the Ekran 714MHz signals. Photos courtesy A. Wiese.

22nd and found Bands I/III and the u.h.f. spectrum jammed with French signals, including a 625-line Band III test card transmission from Paris ch. 5 (i.e. the new system). Incidentally it seems that the French fourth channel may not come into operation until March next year.

Light on SEBC

In the January column we mentioned a signal "SEBC" being heard on 106 MHz during an SpE Band II opening last summer. Ian Carnegie (Glasgow) reports that SEBC stands for Southern European Broadcasting Corporation, whose transmissions come from the pirate station Radio Bavaria Int. The station is in the German-speaking area around Bolzano, the output being beamed towards Munich. The mystery of an AFRTS signal on ch. A2, received via SpE from the same direction at much the same time, remains.

The USSR Satellite Service

Reference has been made on several occasions to the 714MHz satellite TV transmissions from the Ekran craft at 99°E — the output is high enough for reception throughout the northern/eastern areas of Russia using inexpensive installations. The Orbita series of satellites, operating at 4GHz, also carry downlink material intended for local reception and retransmission. Alexander Wiese has sent us some photographs showing equipment at an Ekran/Orbita ground station at Frunze, south of Kazakh Oblast. For 714MHz reception 32 stacked Yagis are used, each with some 40 directors! A large dish is used for 4GHz reception, with two further dishes to provide terrestrial microwave links.

The Eurikon Experiment

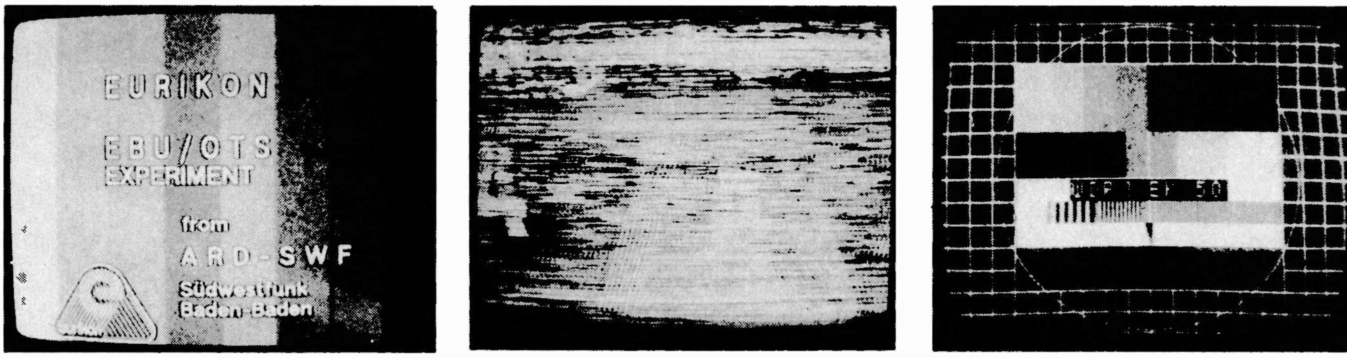
During the past year most W. European broadcasting organisations have been participating in a common programme that's been broadcast via the OTS satellite, the beam covering the European/Mediterranean area from Finland to Tunisia. Most of the transmissions have been scrambled, though the occasional programme has gone out unscrambled. Six digitally coded audio channels have been used. See photos on following page.

News Items

Macao: A TV service is shortly to be established in this small Portuguese colony. At present the nearest TV transmissions come from Hong Kong some sixty miles away.

Luxembourg: RTL has now started its multilingual "international" TV service, in German from 1200—1400 and English 1700-1900, followed by a thirty minute Dutch news programme and a feature film with Dutch/German subtitling, then French news. The service extends into Belgium, South Holland and the Mosel valley in W. Germany. The whole thing is by way of an experiment as a prelude to DBS transmissions, in order to gauge the reaction of the German/Flemish audience.

UK: The stereo TV sound tests from the BBC's Crystal Palace transmitter on ch. 33 (see Teletopics, December 1982) have been noted after normal transmission hours, accompanied by a variety of test slides including the rare SMPTE test card. Announcements made on the sound



Left: Eurikon DBS test identification logo, unscrambled. Centre: The same signal but this time scrambled. Photos from A. Wiese. Right: Test pattern received from the Ederkopf WDR transmitter on ch. E50. Photo courtesy Ryn Muntjewerff.

indicate that tests are in progress. Some of the tests were by chance transmitted from Rowridge, Isle of Wight.

In brief: In addition to the TSS-1 transmitters being established in E. Germany (see last month) we understand that several TSS outlets have been set up in Czechoslovakia to serve the Russian army — total so far three. . . The NOS (Dutch) and RTB-F (Belgian) ch. E3 transmitters are to stay in operation for some time . . . A 50MHz amateur beacon (GB3SIX) is in operation 24 hours a day on Anglesey, beaming west. It was received in Hartford, Connecticut at 1700GMT on December 31st.

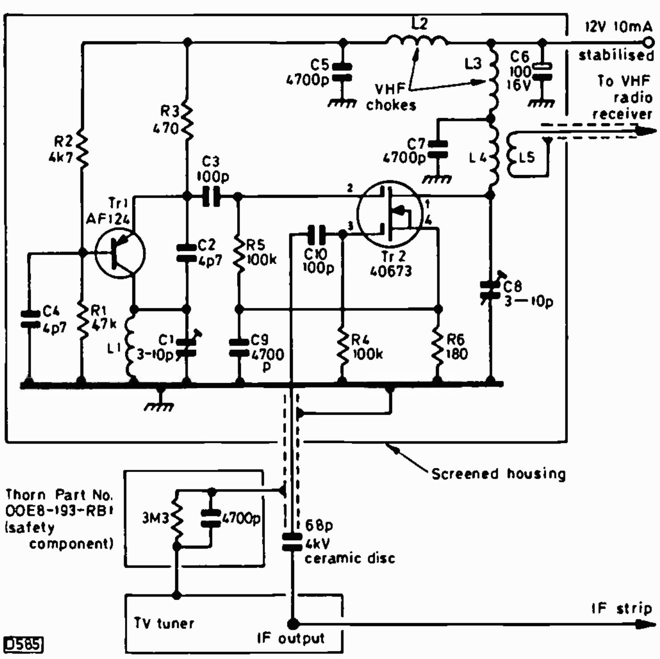


Fig. 1: Circuit diagram of the sound converter.

Receiving 5·5/6·5MHz Sound

Robin Crossley's tunable sound i.f. circuit, featured in the January column, proved of interest to readers. The Benelux DX Club has since sent details of a converter devised by Piet Jansen (Rotterdam) and Gerard Boerema (Eindhoven). The circuit is shown in Fig. 1: it's relatively simple, using a bipolar transistor and a dual-gate f.e.t. The AF124 transistor oscillates at around 135—140MHz, its output being coupled to one of the gates of the f.e.t. The i.f. signal from the TV receiver's tuner is coupled via C10 and an external capacitor to the other gate. The output, at around 102MHz, is developed across L4 and coupled by L5 to an f.m. tuner/radio receiver which acts as a variable tuned i.f. strip.

The board layout is shown in Fig. 2, and it will be seen that the two main coils L1 and L4/5 are printed. Alignment is simple, though a local TV transmission is required. Couple the input from the TV tuner to the converter and adjust C1 and C8 to 5pF. Sound should be heard from the f.m. radio receiver. Fine adjustment of C1 will give the correct output at 101—102MHz. C8 provides final peaking. Once set up for say a 6MHz intercarrier sound signal, tuning the receiver up or down by 0.5MHz will provide reception of the other standard sound spacings. Note that the components used to couple the tuner's output to the converter must be correctly rated for safety reasons. Our thanks to the BDX Club for permission to publish these details.

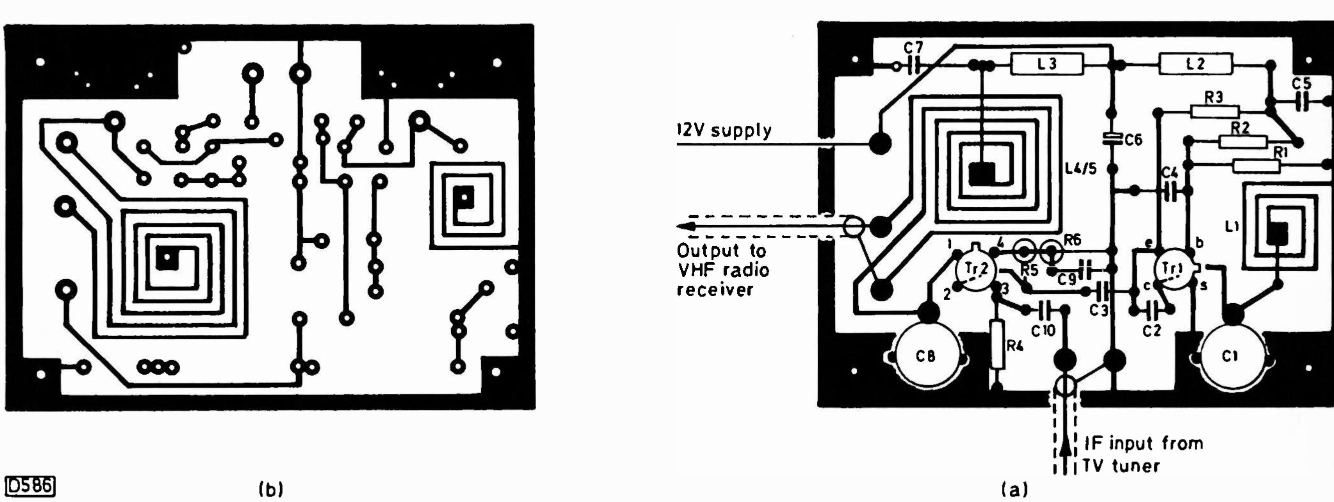


Fig. 2: Printed board pattern and component layout for the sound converter.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £1·00 postal order (made out to IPC Magazines Ltd.), the query coupon printed below and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

THORN 3000 CHASSIS

There's lack of width, about two inches at each side of the screen, and the voltage across the beam limiter resistor R907 is high at 3V instead of about 1·5V. A new tripler has been tried without improving matters.

Try removing the shift choke L504 from the timebase panel. If normal operation returns, this proves that L504 has shorted turns. If the fault persists, it's likely that either the line output or the e.h.t. transformer has shorted turns. Unfortunately substitution of T503 and T504 is the only way to determine which one is responsible.

SONY KV1810UB

There's lack of height at the top and bottom, with flyback lines at the top and thick bright lines across the centre. Sometimes the picture flickers and normal operation is restored for several days. The faults then return. I've tried replacing the coupling electrolytics in the field timebase circuit.

The main suspects are the output stage emitter decoupler C523, the output transistors Q503/4 and the driver transistor Q502. Substitution is the only sure check. First however flex and tap the panel to ensure that dry-joints or similar faults are not to blame.

BEOVISION 3400 CHASSIS

Intermittent loss of field scan was followed by complete loss of vision and sound. The trip resistor 2R143 in the l.t. regulator circuit was found open-circuit and the series regulator transistor 0TR8 turned out to be faulty. Putting these matters right restored the vision and sound but with the 32V line at about 40V and no regulating action.

It appears that 0TR8 is being turned hard on. If your replacement is correctly wired and intact, the driver transistor 2TR28 has probably been damaged. A less likely cause is the error detector transistor 2TR27. Ensure that the negative output from the bridge, at 2R140, is not earthed due to a solder blob or trapped wire to 0TR8.

GRUNDIG 5011

There's a tuning fault. Only channel two works, with perfect sound, picture and colour. When the touch pads for any of the other channels are touched there's a heavy hissing sound and the picture shrinks.

First thoroughly clean the touch pads with methylated spirits in case there is any conductive deposit around the number two selector. R312, which is in series with the channel two selector, can be disconnected to prove the point. Alternatively R312 could be noisy – try swapping it over with one of the other series resistors as a check. If these actions fail, it's likely that IC222 (SN16861NG) or IC221 (SN16848N) in the channel selector circuit is faulty.

DECCA 30 SERIES CHASSIS

When the set is first switched on the picture appears with light and dark vertical bands at the centre. These tend to expand across the screen and reduce in intensity after a minute or so, leaving a normal picture. After about a quarter of an hour however the red and green convergence for some three inches at both sides of the screen goes quite suddenly. The relevant convergence controls don't seem to be in distress.

The central striations may be due to failure of one or other of the line output stage valves – PL509 and PY500. If these prove o.k., check the line output valve's screen grid decoupling capacitor C432 (0·1μF) and the boost capacitor C436 (should be 0·22μF). The RG line convergence problem should respond to replacing the clamp diode D412 (Y933) and checking for hair-line cracks or dry-joints on the convergence panel in the vicinity of the RG line tilt coil L417.

THORN 1590 CHASSIS

There's a comprehensive field fault – rapid rolling, bottom foldover, poor linearity, flyback lines and a one inch black band at the bottom. Normal results are obtained when the meter is connected to the base of VT15, one of the transistors in the field multivibrator circuit. Reducing the value of the cross-coupling capacitor C71 from 0·22μF to 0·18μF also provides a cure.

The two transistors in the field oscillator are suspect and their forward and reverse resistances should be checked. Then check the values of the resistors in the hold control circuit, particularly R79 (120kΩ).

TELEFUNKEN 709 CHASSIS

To start with the screen is bright with no picture. Some minutes later there are black flashes across the screen, then the picture appears. The sound is not affected. On one occasion the picture came up immediately but was later lost for about ten minutes.

It will be necessary to check through the luminance channel, starting with transistor T104 in the i.f. unit. The very small choke (L140) in this transistor's emitter circuit has a habit of going open-circuit – check this for intermittency. Check the plugs and sockets where the luminance signal goes off to the brightness and contrast controls – if loose, these can cause loss of signal. Transistors T611 and T612 have been known to have loose leads

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TELEVISION APRIL 1983

due to poor soldering. The delay line can also be badly soldered.

THORN 3000 CHASSIS

There's a vertical bar which is 0·2in. wide and 0·8in. from the right-hand edge of the screen. The bar is patterned, the patterning changing in a random manner. There's no degradation of the picture to the right of the bar, which seems to be more of a hiccup in the flyback than foldover.

We suggest you check C514 (4·7μF) which decouples the supply to the line output stage, C515 which decouples the line driver transistor's supply, and make sure that the ferrite beads have not been removed from the line output transistor. In stubborn cases the fault can be minimised by decoupling the supply to the tuner with 0·01μF and 25μF capacitors in parallel, fitted at the tuner. Check that the leads to the tuner are dressed away from the chassis and that a good earth connection exists between the two. Fully advance the r.f. gain control R5.

TEST CASE

244

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

THE CURRENT mini-boom in the sales of personal computers and the advent of breakfast TV have, in this part of the world at any rate, resulted in a steady demand for second sets. Where the customer can afford a new small-screen receiver, either colour or monochrome, the sales department gets the benefit. Very often however a refurbished set at a low price is required: our service department now has a flourishing trade in "bargain basement" sets – ex-rental and trade-in models that have been overhauled, titivated and are marketed by our versatile engineer/salesmen John.

For inexpensive small computers such as the Sinclair ZX81 the ideal monitor is a 20 in. monochrome set with a picture tube in good condition – the characters and graphics are small, and call for a set with good focus capabilities. We favour ITT sets fitted with the VC200 chassis for this application, and whilst preparing a batch of these sets for a school John came across an SV054 with a ballooning picture. The raster was of the correct size at very low beam current, but the slightest brightness increase made it expand in all directions. At average brightness levels little more than the centre circle of the test card could be seen, bloated and distended. Plainly the e.h.t. regulation was in trouble!

The e.h.t. rectifier stick D10 (TV20) is the most common culprit when this symptom is present, so in went a new one. When the set warmed up, the picture was as elastic as before. The line output stage valves, PL504 and PY88, are the next suspects, so a couple of sparkling new ones were fitted – with absolutely no effect on the fault! A new PCF802 line oscillator valve followed them in, once more to no avail, so John settled down with the AVO and circuit diagram to suss out the problem.

He established that the width/e.h.t. stabilisation control was working correctly, and that the h.t. supply to the line output stage – 240V at pin 9 of the PY88 – was about right. The line output transformer derived 20V l.t. supply and the boost voltage were present and correct *at all settings of the brightness control.* John then brewed some tea whilst seeking inspiration. It came in the form of a decision to check the d.c. resistance of the line ouput transformer's e.h.t. overwinding and to confirm the continuity of the e.h.t. leads and connectors. The overwinding resistance corresponded with that of a known good transformer, and there were no breaks or high-resistance contacts in the e.h.t. circuit.

What next? The tube's outer conductive coating was then examined: it looked all right, and an ohmmeter check confirmed that it was correctly earthed to the metal chassis. John next hooked up an e.h.t. voltmeter to the tube's final anode connector. What a surprise! The set is now in a neat row with its eleven companions at the local school's lab. What shiny new component does it contain?

ANSWER TO TEST CASE 243
– page 267 last month –

Active filter circuits tend to be taken for granted, but strange effects can arise as last month's puzzle showed. The touble was in a Pye set fitted with the Philips G11 chassis, the symptom being breathing at the sides of the raster due to a 100Hz ripple on the h.t. line. All conventional fault-finding approaches had, it seemed, been exhausted.

There's one component in the circuit that does nothing most of the time – the 27V zener diode D4021. It's normally held non-conductive by a bias voltage of some 8V, being included in the circuit simply to protect the filter transistors Tr4032/3 from excessive voltage at switch on. When C4040 and the other smoothing capacitors are discharged, these transistors can be subjected to an excessive voltage surge. At switch on there's zero voltage at the h.t. fuse F4037: D4021 conducts, limiting the voltage across the transistors to about 30V until the normal working conditions are established.

In our problem set this zener diode was leaking – like a seive, the technician commented – putting an excessive bias, with superimposed ripple, on the base of the driver transistor Tr4033. A new zener diode restored normality, with the raster sides as straight as flagpoles and the correct 153V at the decoupling capacitor C4040.

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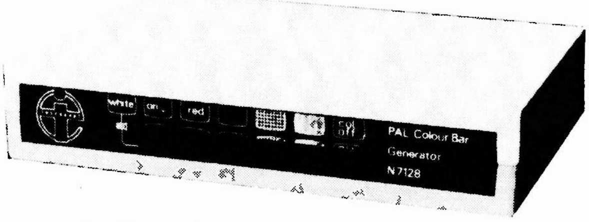

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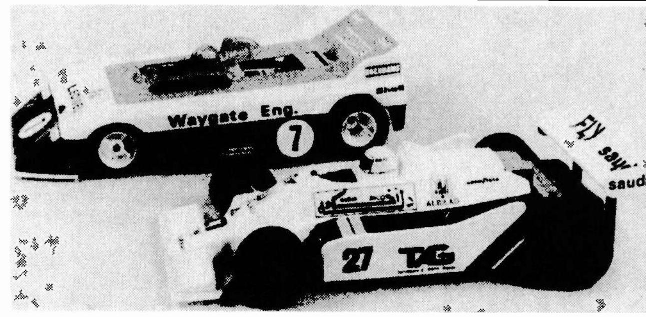

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6×4	15 ohm	£1.00
7×3	70 ohm	£1.00
5×3	8 ohm	70p
7×3	16 ohm	£1.00
8×5	8 ohm	£1.00
2¾" dia	8 ohm	75p
3" dia	8 ohm	75p

Diodes

BY 127	10p
BY 133	10p
BY 134	10p
BY 164	30p
BY 176 type	25p
BY 179	40p
BY 184	25p
BY 187	10p
BY 190	40p
BY 194	30p
BY 196	30p
BY 198	10p
BY 204/4	8p
BY 206	8p
BY 210/400	5p
BY 210/600	8p
BY 210/800	10p
BY 223	50p
BY 226	15p
BY 227	15p
BY 229/400	30p
BY 237	5p
BY 254	10p
BY 255	10p
BY 296	10p
BY 298	10p
BY 299	10p
BY 527	20p
F 247	10p
XK 3123	50p
Thorn A1	10p

Line Transformers

G8 Trans. Philips	£7.50
G11 Split Diode	£12.00
CVC820 Split Diode ITT	£10.00
CVC40 Split Diode ITT	£10.00
GEC 2040	£5.00
Pye mono	£3.00
Rank mono T704A	£3.50

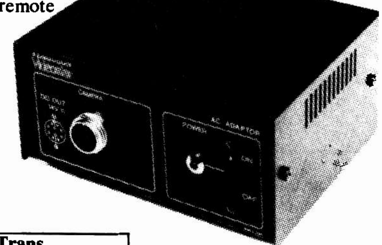
CVC32 ITT	£7.50
EHT Split Diode Leads	£1.00

Triplers

11 TEZ Rank	£3.00
9000 Thorn	£5.00
KT3	£4.00
CVC-20-25-30	£4.00
G9 Philips	£4.00
GEC 2110	£4.00
9500 Thorn	£4.50
2040 GEC	£3.50
G8 Philips	£4.50
Decca 80 100	£4.50
LP1194 Pye 731	£3.50
Grundig TVK 52	£2.50
11TBQ	£3.00
11THY	£4.00
D22 for Pye 18" colour portable	£4.00
LP 1193/63	£4.00
BG 100/41	£3.25
BG 100/61	£3.25
3500 tripler	£3.50
New Philips Infra Red Transmitter 9ch & Vol. & brightness change	£7.00
THORN Tuner Panel. 6 Slider pots, Knobs, touch button. Ultrasonic transducer, ICs, components & mains switch	£3.75
GEC Portable Line Trans.	£3.00
Philips Infra-Red (full remote transmitter) Philips KT3 16C928/20C934 Pye KT3 7228/7324 K12 26C 797/1ST 66K 1826	£12
3500 Triplers	£3.50
MLO	
G11 Tuner Units	£6.00
G11 6 Button Key Switch	£2.00
G11 E/W Transformer	50p
G11 Line OSE Tran.	50p
G11 Transient Suppressors 245V	10 for £1.00
G11 Scan Coils	£5.00
KT3 AE Sockets	25p
4000 Thorn Frame Panel	£5.00
4000 Thorn Power Supply	£3.00
4000 Thorn Line OP Panel	£20.00
NPN PNP 80V 6 Amp TO66 O.P. Trans.	pair 25p
GEC IC CBF16848. SN16861. SN1682	each 50p
Thorn 3500 IF Panel NEW	£3.00
Thorn Tuner Panel 6-100K Pots & Components NEW No Tuner	£2.00
6 button 100K pots + cursors on panel for varicap tuning	£1.50
THORN 1600 mains lead: switch: 3 slider assy.	£2.00
5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T	£7.00
Control panel 5 sliders + mains lead	£1.50
Tube base + base unit for 820 Euro chassis	£4.00
CVC 9 IF panel and decoder	£7.00
GEC Line O/P Trans. & Rec Stick for Portable	£3.00
CVC 20/25/30/35/40 decoder panel	£10
CVC 20/25/30/35/40 decoder panel (untested)	£5
CVC 40/45 IF panel	£5
Mains Panel with switch and lead	£1.50
Thorn 3500 6 push button unit & cable form	£1.50

International Rectifier EHT Diodes G770/HV34 6KV	3 for 8p
6A/600V Stud Diodes	20p
6A/1000V Stud Diodes	20p
SKE 1/02	20p
EHT Rectifier wire ends 16Kv	10p
25A473 PNP C/P	10p

Mains in 110-120-220-240V A.C. 50Hz Adaptor. For black and white camera. Power consumption: 12V A. Output voltage: 14V D.C. Dimensions 150mm (w) × 80mm (h) × 120mm (d).
Accessories: Mains lead and video/audio remote cable (2 metres)



£5.50

Rec & Trans

G11 Ultrasonic t/text transmitter G26C 674/02 G22 C66/02	£19
Infra Red (full ramote transmitter) Dynatron TV CTV 62, 63, 64	£19
40K Transducer	50p
PHILIPS NE511N	£1.20
LM337M Reg.	30p
Thorn T605 1 V NPN TO66 80V 6A	10p
20 GEC Black Spark Gaps	£1.00
G11 Line Driver Transformer	35p
2 SD350A BU208A	£1.00
G11 IF Detector	£3.00
G11 Teletext Transmitter	£19.00
BG200/43 Tripler	£3.00
DECCA IF 80-100	£3.50
G11 Time Base Panel	£12.00
AEC V/Cap Resistor Unit	
UHF with IC SAS660 SAS670	£3.00
Thorn 900 Sound OP Panel NEW	£1.00
U321 T/Unit on Panel Cum 40 ITT	£6.00
Z714 RANK IF Panels 6MHz 1 I.C. SL437F	£3.00
Z909B RANK IF Panels Export 5.5MHz 2 I.C.'s TBA1205B TCA2705Q	£2.50
Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s TBA750+SC9504P+ SC9503P	£1.50
Tuner Unit VHF Sylvania GTR Videon MTS900 BIP VHF	£2.50
G11 dynamic correction panel	£6
CVC 20 Front panel with sliders + mains input panel	£4
THORN 3500 Tuner panel (ELC 1043/05 + pots)	£7
CVC 40 PUSH BUTTON ASSY with sliders: complete with lamp assy + pots	£14
CVC 5 Mains on/off + 5 pots	£2
GEC Convergence panel (We have 1000's) to clear	£1

Universal Focus. Fits Pye, Thorn and Decca Units.	
Large Type	75p
Decca Small	75p
ITT Small for use with Split Diode	50p
Thorn 3500 Focus Unit	£1.50
TV11	50p
Remo TV12SP	50p
TV13	50p
TV14	50p
TV18	60p
TV20	£1.00
TV30	£1.00
TV45	50p

NEW & COMPLETE WITH ALL IC's & GPO PLUG VIEWDATA DECODER PANELS (MALLARD) NORMALLY £150 to clear £15 (no data supplied)

Condensers

1500/16	20p
3300/16	20p
10000/16	25p
3300/18	20p
470/25	5p
680/25	5p
1500/25	10p
2200/25	10p
3300/25	20p
4700/25	25p
5000/25	25p
1500/30	20p
3300/30	30p
1500/35	10p
2200/35	25p
220/40	5p
400/40	25p
680/40	5p
1250/40	20p
1500/40	20p
200/40	25p
2000/40	25p
2200/40	25p
2500/40	25p
3300/40	25p
6800/40	35p
750/50	10p
1000/50	20p
1250/50	25p
2000/50	20p
3000/50	25p
15/63	5p
2200/63	50p
250/64	10p
140/100	25p
470/100	20p
800/160	50p
G11 0.91/210 scan coil correction	25p
.1/250	5p
G11 0.47/250	10p
2,2 250v	10p
4n7/250 tested 5KV	25p
22/250	15p
47/250	10p
100/250	20p
500/250	50p
GEC600/250	60p
800/250	40p
8/300	8p
4/350	5p
8/350	8p

Infra Red and Ultrasonic G11 Teletext Decoder Panel	£30
RANK & ITT Mains Remote On-Off Switch (720R)	£1.50
RANK & ITT Mains Remote Switch 2865 ohm	£1.50
G11 Mains Switch	40p
ITT Mains Switch 4 amp	30p
GEC Mains Switch 4 amp	30p
Petrick Mains Switch 4 amp	30p
G8 Mains Switch	75p
Mains Dropper PYE 3R5+15R+45R	50p
Thyristor 600/4 amp C106/2	24p
G11 Preh Red LED P/Button for C.H. Change	20p
2SC2073 on Heat Sink 150 NPN 1.5 Amps	7p
RANK TOSHIBA Transductors TPC-2011	50p
Remote Unit THORN 11 I.C. Mains Transformers Relay & 5 volt Reg & Component Unit	£2.25
Thorn I.C. board with 11 various sn 74 I.C.'s	£1
CVC 5 Mains on/off +250K+100K+500K+50K+500K Pot on Panel	£2.00

12/300	10p
16/350	25p
50/350	10p
220/350	30p
700/350	50p
22/375	15p
330/385 CVC 820HT	60p
0.1/400	15p
.56K/400v	20p
8/400	15p
33/400	20p
220/400	50p
440/400	40p
33/450	15p
220/450	40p
0.1/600	15p
.047/600	15p
0.1/800	15p
0.047/1000	10p
0.01/1000	10p
0.1/1000	10p
0.0047/1500	10p
1n8/1500	15p
2n2/1500	15p
9n1/1500	15p
G11.11000/1500	15p
G11.8200/2KV	15p
0.1/2KV	20p
10n/2KV	15p
3n9/2KV	15p
210/8KV	10p
0.0015/2KV	10p
5n2/2KV	10p
7500pf/2KV	10p
4n7/2KV	15p
8n2/2KV	15p
0.0082/2500	15p
1800/4KV	5p
4.7nf/5KV	10p
180/8KV	10p
270/8KV	10p
1000/10KV	10p
1200/12KV	10p

Multi-Caps

Thorn 3500	
175/100/100/350v	£2.00
KT3/200/25/25/385v	£1.00
47/220/350v	60p
150/150/100/100/100/320v	£2.00
2500/2500/63v	50p
470/470/250v	50p
150/200/200/300v	70p
100/200/325v	40p
400/200/200/350v	£1.50
200/200/100/300v	60p
200/350v + 300/100/32/300v	£2.00
200/200/100/32/350v	£1.50
200/47/350v	60p
100/300/200/100/16/350v	£2.00
200/100/100/375v	£2.00
100/100/35v	60p
150/150/100/100/325v	£2.00
100/350 + 300/200/100/16/275v	£2.00

ITT Panels

CMA 10	£2.00
CMA 11	£2.00
CMA 30	£2.00
CMA 40	£1.50
CMC 10/2	£5.00
CMC 15	£10.00
CMC 16	£4.00
CMC 19	£12.00
CMC 45	£1.50
CMC 47	£1.00
CMC 54	£10.00
CMC 56	£5.00
CMC 58	£8.00
CMC 59	£8.00
CMC 67	£3.75
CMC 67/2	£4.00
CMC 68	£4.00
CMD 40	£5.00
CMF 25	£2.00
CMF 40	£2.00
CMH 10	£1.50
CMH 31	£1.50
CMK 12 (untested)	£4.00
CMN 20	£1.50
CMN 40	£1.00
CMP 10	£2.00
CMP 11	£2.00
CMP 40	£2.00
CMS 11	£2.00
CMS 40	£2.00
CMU 14	£8.00
CMU 30	£7.00
CMU 40	£7.00
CMU 45	£5.00
VMC 34	£5.00
VMC 44 + 45	£4.00

SENDZ COMPONENTS

D. Whitworth,
63 Bishopsteignton, Shoeburyness,
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Telephone: 0702 332992
ADD VAT 15%, 50p P&P.
Goods despatched on receipt of order.
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Tuner Units

ELC1043/05 Mullard	£6.00
ELC1042 ,,	£5.00
ELC2000 ,,	£7.00
EL2060 ,,	£7.00
ELC2060 on panel NEW	£5.00
U321 (UHF) Mullard	£6.00
U322 (UHF) ,,	£4.00
V314 (VHF) ,,	£5.00
ELC1043/05 Thorn	£5.00
Small V/Cap Mitsumi UHF ,,	£4.00
VHF ,,	£3.00
VHF Rotary Mitsumi	£1.00
Portable & rotary Tuners Sanyo & Mitsumi UHF	£5.00
Mossfit UHF VHF NSF. ET021 DX	£8.00
Sylvania UHF VHF F6013 (Fits Rank)	£4.50
Sylvania UHF	£3.00
Sylvania VHF	£3.00
Decca Bradford Tuner 5 Button	£4.00
NSF AEG UHF/VHF	£6.00
Small Tuner DX 175-220MHz Auto Changeover	£5.00
9000 Thorn Tuner on Panel	£7.00
D.P.D.T. switch Black knob: Chassis or PCB mount	4p each or 40 for £1.00

Quantity Reductions

BY204/4	25 for £1.00
BY206	25 for £1.00
BY210/600	25 for £1.00
BY298 3 amp/fast/R	20 for £1.50
BD239	20 for £2.00
MR856	20 for £1.50
BU126	10 for £6.00
BU208	10 for £5.00
BU204	20 for £8.00
BU205	10 for £8.00
BU105	10 for £8.00
2SC2122A	10 for £8.00
BF458	10 for £1.00
BD136	10 for £1.25

Mixed Packs

Pack of mixed coloured wire	£1.00
25 LED red/yellow/green	£1.50
20 I/C Holders	£1.20
20 Large LED Red	£1.00
20 Small LED Red	£1.00
10×20 Turn 100K Pots	£1.00
100 Mixed Transistor	£2.50
20 Convergence Pots	80p
100 Mixed Sticks	£1.00
10 Thermistors	50p
20 Slider Pots	£1.00
30 Presets	50p
40 Pots	£1.50

50 High voltage ceramic condensers	£1.50
Mixed Mounting Kit for Power Transistors	50p
300 Condensers	£1.50
300 Resistors	£1.50
150 Electrolytics	£2.00
15 Bulbs	40p
100 Diodes	£1.50
100 Fuses	£2.00
100 W/W Res.	£1.50
300 Carbon Film Res.	£1.50
20 Slider Knobs	70p
6 Mixed UHF Aerial Isolating Sockets, some with long leads	£1.00

Diodes

1 Amp 1600v	7p
3 Amp 100v	7p
3 Amp 1200v	10p
9000 Thorn O/P Transistors with Heatsink T903 8v	£1.00
7 Seg Display, Led Red	50p
TA7607	£1.00
TA7609	£1.00
TA7315	£1.00
Delay Lines	
TAU80	£1.00
DL11	50p
DL20A	80p
DL50	£1.00
DL70	£1.00
DL600	£1.00
DL700	£1.00
Luminance Delay Line MDL-CBL Min.	50p
3.15 Fuses	4p
Co-Ax Joint	12p
Co-Ax Belling Lee Plug	12p
UHF Modulator CCIR	£3.00
Infra Red Emitting Diode	20p
NE286H Small Neon Lamps GEC	5p
Mullard 5 Watt Amps. LP1162 New	75p
Tube A31/510	£5.00
A31/300	
12" Tube Hitachi	£12.00
15" Tube Hitachi	£8.00

Integrated Circuits

AM25LS23PC	£1.00
BAV40	40p
BRC-M-200	50p
BRC-M-300	60p
CA270CE	50p
CA270CW	50p
CA3065	50p

Tyne T/V I.C. SN76545N	£3.50
VHF 3 Transistor Rotary Tuner Units D.X. TV. NEW	£1.00
Eisenmann Nicad Charger 5.5v 150MA	£2.00

CA3089Q	50p
CA3094AE	50p
CA920AE	£1.00
CA1310	£1.00
DM7492	50p
HEF4016	50p
HEF4053BP	50p
M1025	£2.50
M102485	£1.00
MC476p	£1.00
MC1327	£1.00
MC1330	60p
MC1349	50p
MC1352	£1.00
MC1358	£1.00
MC14013	£1.00
MC14066BCP	£1.00
MC14069	£1.00
MCM2114	£1.00
ME511N	£1.00
MEM4956PT	£1.00
MM5611	£1.00
N64100	£1.00
PD2114	£1.00
SAA1020	£4.00
SAA1021	£4.00
SAA1024	£2.50
SAA1025	£2.50
SAA1130	£2.50
SAA1272	£3.00
SAA5000	£1.50
SAA5000A	£1.50
SAA5010	£3.50
SAA5012	£2.50
SAA5020	£3.50
SAA5030	£3.50
SAA5040	£2.50
SAA5050	£3.50
SAS560	£1.00
SAS570	£1.00
SAS660	£1.00
SAS670	£1.00
SL901	£3.50
SL918-SL917 MOD	£2.50
TAA320A	50p
TAA470	£1.50
TAA550	30p
TAA570	75p
TAA611	£1.50
TAA621	£2.00
TAA641	£1.50
TAA700	£1.00
TBA120A	40p
TBA120AS	40p
TBA120SA	40p
TBA120B	40p
TBA120SB	40p
TBA120U	40p
TBA120C	40p
TBA1441-TBA440	£1.00
TBA231	75p

TBA395	50p
TBA396	75p
TBA440	£1.00
TBA440C	£1.00
TBA480Q	£1.00
TBA510	£1.00
TBA520	£1.00
TBA530	£1.00
TBA540	£1.00
TBA540Q	£1.00
TBA550Q	£1.00
TBA560CQ	£1.00
TBA560C	£1.00
TBA570	£1.00
TBA641BX1	£2.00
TBA673	£1.00
TBA720A	£1.00
TBA750Q	£1.00
TBA800	40p
TBA810S	70p
TBA820	70p
TBA890	£1.00
TBA920	£1.00
TBA920Q	£1.00
SN29848	50p
SN7472N	20p
SN75108AN	£1.00
SN76001	£1.00
SN76003	£1.00
SN76018	£1.00
SN76008	£1.00
SN76023N	£1.50
SN76033	£1.50
SN76115	50p
SN76131	50p
SN76226	£1.00
SN76227	60p
SN76228N	£1.00
SN76530P	60p
SN76532N	50p
SN76533	£1.00
SN76544N	£2.00
SN76546	£1.00
SN76552	£1.00
TBA480Q	£1.00
TBA820	£1.00
SN76650	50p
SN76660	40p
SN76620AN	50p
SN76666	50p
SN76707N	75p
SN76708N	75p
ML232R	£1.20
BJT6016	£1.20
ML236E	£1.50
ML2378	£1.50
ML238B	£3.50
BTT822	£1.00
BTT6018-ML2378	£1.50
BTT8124	£1.00
BTT8224	£1.00
TDA2522	£1.00
UA783P3C	40p
UPC1365C	£1.50

KT3 2SD 200 Line Transistor	£2.00

Semiconductors

BT100A	30p
BT106	£1.00
BT106 Plastic	50p
BT11-BT120	£1 ea
BT109	£1.00
BT138/10A	70p
TBA950	£1.00

TBA990Q	£1.00
TCA270	£1.00
TCA270Q	£1.00
TCA940	£1.00
TCA4500A	£1.00
TCA640	£1.00
TCA650	£1.00
TCA660	£1.00
TCA270S	£1.00
TCA270SQ	£1.00
TCA740	£1.00
TCA800	£1.00
TCA830	£1.00
TCEP100	£2.25
TDA440Q	£1.00
TDA1003A	£1.00
TDA1010	£1.00
TDA1170	£1.00
TDA1190	£1.00
TDA1327A	£1.00
TDA1412	30p
TDA2010	£1.00
TDA2140	£3.50
TDA2530	£1.00
TDA2532	£1.00
TDA2540	80p
TDA2541	£1.00
TDA2575A	£1.00
TDA2590	£1.00
TDA2593	£1.00
TDA2560	50p
TDA2600	£3.75
TDA2653	£1.00
TDA2002	£1.00
TDA2640	80p
TDA2680	£1.00
TDA2690	£1.00
TDA2593	£1.00
TDA3190	£1.00
TDA3500	£2.00
SN16862AN	£1.00
SN16964AN	50p
SN29764	£1.00
SN297728N	50p
RGP30G	10p
MPSA43	10p
BTY80	20p
BLY49	30p
E1222	20p
MJE511	25p
MJE340	28p
MJE2801	30p
MJE2955	50p
Sanikron Diode SKE262/04	30p
SN6550/3R	£1.00

Transistors

AC121	20p
AC128	20p
AC151	20p
AC153K	20p
AC142K	20p
AC176	20p
AC176K	20p
AC178K	20p
AC187K	20p
AC188	20p
AC188K	26p
ACY21	25p
AD143	50p
AD149	50p
AD161/162	pair 40p
AF139	25p
AF239	25p
AF367	25p
AU113	£1.20
BD437/438 on heat sink	60p
BD507	50p

BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD532	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD595	35p
BD596	35p
BD646	50p
BD681	25p
BD807	20p
BD948	30p
BF115	20p
BF127	20p
BF137	20p
BF157	20p
BF160	20p
BF161	20p
BF167	20p
BF173	10p
BF178	25p
BF179	30p
BF180	20p
BF181	20p
BF182	20p
BF184	20p
BF185	20p
BF194	20p
BF195	10p
BF196	10p
BF198	10p
BF199	10p
BF200	20p
BF222	10p
BF224	15p
BF238	20p
BF240	20p
BF245b	20p
BF256	10p
BF257	20p
BF258	25p
BF259	25p
BF262	15p
BF263p	25p
BF264	15p
BF271	10p
BF273	10p
BF274	10p
BF301	10p
BF324	25p
BF336	30p
BF337	25p
BF338	25p
BF355	30p
BF362	20p
BF363	15p
BF367	15p
BF391	15p
BF394	10p
BF419	30p
BF423	15p
BF448	30p
BF450	20p
BF457	10p
BF458	30p
BF459	30p
BF468	30p
BF469	30p
BF470	30p
BF480	50p
BF594	10p
BF597	10p
BF694	10p
BF757	30p
BF758	30p
BF761	30p
BF858	30p
BF871	30p
BFR79	15p
BFR39	15p
BFR52	7p
BFR79	15p
BFR81	15p
BFR87	10p
BFS60	10p
BFT34	15p

BFT43	10p
BFT84	8p
BFW11	20p
BFX29	30p
BFX84	25p
BFY50	15p
BFY90	15p
BRX43	15p
BSY95a	10p
BTY80	20p
BSX19	17p
BSX20	17p
2N930	5p
2N2222	8p
2N3055	40p
2N3583	50p
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2N4442	£1.00
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2N5983	30p
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2SB474	30p
2SB566	10p
2SC733	10p
2SC1030	£1.00
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2SC2122A	£1.00
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2SK30A	10p
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BC107	10p
BC108	10p
BC109	10p
BC113	10p
BC114	10p
BC115	10p
BC116	10p
BC125	10p
BC139	10p
BC141	25p
BC142	25p
BC143	25p
BC147	10p
BC148	10p
BC149	10p
BC153	10p
BC154	10p
BC157a	10p
BC158	10p
BC159	10p
BC160	25p
BC171	10p

BC172	10p
BC173	10p
BC174	10p
BC182L	10p
BC183	10p
BC184	10p
BC187	10p
BC204	10p
BC207	10p
BC212	10p
BC213	10p
BC214	10p
BC237	10p
BC238	8p
BC239	10p
BC245	8p
BC250	8p
BC251	10p
BC252	10p
BC257	30p
BC262	10p
BC298	10p
BC300	30p
BC301	30p
BC303	30p
BC307	7p
BC308	7p
BC309	10p
BC327	10p
BC328	10p

BC337	10p
BC338	10p
BC347	10p
BC349b	10p
BC350	20p
BC365	10p
BC384	10p
BC394	10p
BC413	10p
BC414	10p
BC416	10p
BC440	30p
BC447	10p
BC454	10p
BC455	10p
BC456	10p
BC460	25p
BC462	10p
BC463	10p
BC478	10p
BC527	10p
BC532	10p
BC546	10p
BC547	10p
BC548	10p
BC556	10p
BC557	10p
BC558	10p
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BC635	10p

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BD124 (metal)	£1.20
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BD222	30p
BD226	20p
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BD233	30p
BD235	30p
BD238	30p
BD239	15p
BD243a	30p
BD250a	30p
BD252	20p
BD253B	50p
BD331	20p
BD332	20p
BD416	25p
BD433	25p
BD437	25p

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CVC 20/2 mains panel NEW	£2.00
CVC 20/3 chassis	£30.00
FED4/1220/4 3 pin ITT 1. MFD 4 Amp Mains Filters	50p
ITT Mains Filter .1/250v/	
CVC 20 to 45 chassis	50p
Pots 10 k with Switch	25p
Pots 47 k with Switch	25p
Mullard Surface Wave Filter RW 153P Colour TV Filter	40p
Mullard Surface Wave Filter RW 154 Colour TV Filter	40p

Crystal T/V

T/V 4.433-619KHz	50p
6 MHX Crystal	50p
8.8867-238KHz Min	50p

Filters

5-5MHz	15p
6MHz	25p
BFU455K	5p

Thyristors

BT119	£1.00
BT120	£1.00
2N4444	£1.00
BRC4443	75p
TICV106D: TO92 Case 2A/400V Miniature	10p
G11 Thyristor	60p
Decca 80-100	60p
G11 Teletext Decoder Panel Philips	£30.00

Thermistors

VA1104	35p
ITTP7266312	15p
PTH451 AOR	15p
PT37P Fits Pye & Bush	25p
PT34	20p
BLY49	50p