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TELEVISION

SERVICING · VIDEO · CONSTRUCTION · DEVELOPMENTS

NEW SERIES

Colour Receiver Project Part 1

Also: Understanding Electronic Logic

TELEVISION

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A. Cooke

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., King's Reach Tower, Stamford Street, London SE1 9LS.

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We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved". Send to the address given above (see "correspondence").

this month

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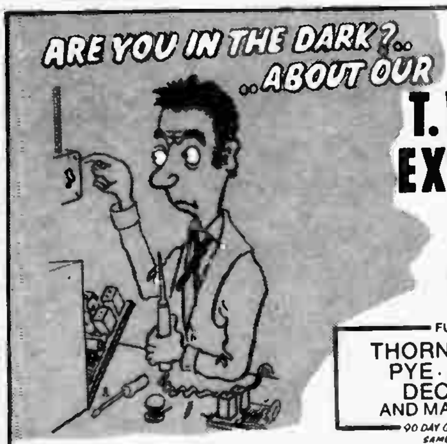

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Give the OBA a Chance!

The government's white paper on the future of broadcasting proposes that the UK's fourth TV channel should be run by a new broadcasting authority, the OBA (Open Broadcasting Authority), and that it should be financed partly by advertising and partly by a government grant. The proposals put forward in the white paper seem to have made little public impact however, doubtless due to the unfortunate timing of the paper's publication – at the run up to a likely autumn general election.

The government has taken its time in reaching a decision, as indeed did the Annan committee in putting forward its proposals following its long enquiry into the future of broadcasting, started in 1974. We have gone on record before in supporting the idea of the OBA, and continue to do so. We don't like politics to enter these pages, since they are largely irrelevant to the concerns of a technical magazine. The decisions now necessary on the future of broadcasting in the UK have become political ones however, a matter we feel to be one for public regret. It seems to us a pity that a non-party enquiry should be set up to consider the future of broadcasting but, when it comes up with modest though imaginative proposals, the decision on whether or not to accept them gets tossed back into the party political arena. It should have been possible to have achieved an all-party approach to the question of how we are to make use of the broadcasting frequencies available to us. But, dare we mention it, there are of course considerable commercial interests at stake.

The conservative party has come out against the idea of the OBA and in favour of making the fourth channel ITV-2. It says this would be cheaper, which is true. But the cost of setting up and running the OBA would be quite marginal. You could argue that ITV-2 would be in a better position to provide quality programmes since the ability of a wholly commercial network to obtain advertising revenue would provide the cash necessary to do so. But there's the rub. You can sell advertising only if you can guarantee a substantial audience, and this automatically means heavy reliance on wide appeal programming. The conclusion seems inescapable: if we want a new TV channel which will provide something different from the present run of programmes offered to the public, it'll have to be run on different lines (the BBC is not interested in running another TV channel).

The reaction of many members of the public to a fourth channel seems to be that we've already got enough TV thank you! This is precisely why the idea of the OBA is so important, and why it should be a better solution than ITV-2. It's a question of trying to provide a wider choice, a genuine alternative to what's being broadcast by the present three networks: this is surely what the public is entitled to expect from its fourth channel when it gets one.

Since broadcasting is a matter that doesn't rate all that highly amongst the concerns of those involved in the day-to-day political life of the country, decisions on it are unfortunately all too likely to be taken at the last minute and for the wrong reasons. The decision about the fourth channel is particularly important however. We're not going to get another opportunity for a long time to set up an organisation with a fresh approach to TV broadcasting. What's required in reaching this decision is delicate judgement and imagination, but these, unfortunately, are qualities that don't tend to flourish in the hurly-burly of day-to-day politics.

It could be of course that the OBA would not turn out to be a useful source of alternative programmes: the point however is that it should be given a worthwhile opportunity to see what it can achieve. The BBC and IBA have turned out to be successful institutions. Let's see whether the OBA can also do so.

COVER

We don't need to tell you what's on the cover. Roy Palmer's daughter Vivienne. The nearby set is displaying the Philips PM5544 test pattern. A later type of field timebase i.c. was adopted for the final version of the set, giving greatly improved field linearity.

Teletopics

VIEWDATA SERVICING AND DEVELOPMENTS

GEC Semiconductors is offering a tailor-made training course in Prestel (viewdata) terminal servicing – claimed to be the first such course. A group of Granada TV Rentals engineers has already attended the course, at GEC's East Lane, Wembley centre. A company spokesman comments that GEC will prepare courses for ten or more engineers, with the syllabus tailored to meet the group's exact requirements. Costs are likely to be around £100-£150 per person – the Granada course lasted for three days, with the majority of the time being spent in the workshop doing "hands on" training. GEC Semiconductors is deeply involved in work on the specialised i.c.s required for this application. Two new purpose-designed i.c.s to allow a full typewriter keyboard to be linked to a viewdata terminal by remote control are under development by GEC. These devices, one for the transmitter unit and one for the receiver, will be able to handle up to 256 control channels. GEC comment that ultrasonic links are insufficiently flexible with this number of channels, leading to the use of infra-red links instead. Prototype versions of these i.c.s are expected to be available to setmakers by the end of the year.

According to GEC, sales of the present generation of Prestel and teletext modules are going very well, though high-volume production has not yet started. About 2,000 complete kits are understood to have been ordered from GEC. These are sold as complete printed board assemblies, a set of four separate modules being required for a complete Prestel-teletext system. The sets of boards are being sold to setmakers at around £250-£300, but GEC expect the price to fall dramatically – to around the £25-£30 mark – when specialised i.c.s for the application become available. This is expected to be within eighteen months or so.

TV INVESTMENT

An important investment programme has been announced by Mullard. £24 millions is to be spent on further improving the manufacturing facilities at the company's Durham colour tube assembly plant and in establishing a production line for 20in., 90° colour tubes at the Simonstone plant. The programme is backed by a £4·5m grant under the government's industry support scheme, and will cover a three year period. Investment at Simonstone will total £13·1m and at Durham £7·8m. There will be further investment at Washington, where the neck components for the new 90° tube will be made, and £0.9m at Crossens where the related magnetic components will be manufactured.

The investment, in what Mullard call Project Vanguard, is considered to be vital in enabling an enhanced and expanding range of colour tubes and ancilliary components to be offered to meet setmakers' requirements. Mullard aim to increase their share of the UK tube market from around half in 1978 to over two-thirds by 1981 – both figures based on a total market of some 1·8 million sets. The project is also intended to strengthen Mullard's export performance – 40 per cent of tube output was exported in 1978.

Mullard's managing director Jack Ackerman commented that the government's grant is a clear recognition of the need to maintain, through viable UK-based tube production, a healthy and prosperous TV setmaking industry in the UK.

It's interesting to note that whereas 110° deflection has come to be the accepted standard for the larger sizes of self-converging in-line gun tubes, for the smaller sizes – 20in. and below – 90° has remained the accepted standard.

Meanwhile Thorn have announced an increase in their planned investment for rationalising colour set production – from £5m to £8m. The investment will go largely into automatic production and testing equipment. Production is to be concentrated at Thorn's Gosport and Enfield plants, and the aim is to achieve internationally competitive sets and costs.

Increased demand for the Philips TX monochrome portable chassis has led to the second increase in production capacity this year at their Lowestoft TV factory.

SPONTANEOUS CHANNEL CHANGING

A reader recently sent us a cutting from a Scottish paper with a story about a set changing channels due to a budgerigar's bell. We've come across similar occurrences before – due to jangling keys and so on. Such things can happen with simple remote control systems when harmonics cause the remote control system to operate. With more elaborate remote control systems error protection is built in, the system operating only when it counts bursts of signal which it converts to pulses.

Random channel changing can also be caused by the discharge of static build up. Rank have encountered this problem on some of their current chassis, and to overcome it are now fitting a 50mm square piece of self-adhesive PVC tape across the gap in the Claylastic trim at the bottom of the c.r.t. The tape is attached along the centre line of the trim and then taken down towards the bottom of the cabinet so as not to be seen from the front. Part number of the tape is 1252 0159.

VIDEO NEWS

National Panasonic point out that while their new VHS-standard Model NV8600 VCR is compatible with other machines made to this standard it nevertheless incorporates exclusive features such as direct motor drive and a diecast chassis for operating stability and robustness, and is "not just a relabelled version of somebody else's machine". The NV8600 shares the same basic specification as other VHS machines, and is in the same price range at £750 including VAT.

There seems to have been a considerable fall-off in domestic video recorder sales in the US recently – figures as high as 50 per cent have been mentioned – which could well account for the increased interest being shown by Japanese VCR manufacturers in the European market. We might yet prove wrong, but it's never seemed to us that the VCR is likely to become a mass-market item.

IPC have entered the video market with a package of ten prerecorded videocassettes providing what they call "alternative television". The cassettes are to the Philips N1700 standard, but production of cassettes to the VHS standard is planned to start in November. There are no plans so far to produce cassettes to the Sony Betamax standard. The packs are available only as a complete package containing the ten different tapes, and the price to dealers is £269.40 exclusive of VAT. Pack one covers sailing (58 minutes), equestrian games (52 min), the 1977 British Open Golf Championship (52 min), a history of golf (one hour), the world of birds (56 min), a history of Le Mans motor sport (52 min), angler's corner (one hour), Wimbledon 1977 (52 min), a history of Wimbledon (50 min), and skiing (58 min). A display box and point-of-sale material are included, and a national advertising campaign is planned. Further details can be obtained from IPC Video, Surrey House, Throwley Way, Sutton, Surrey SM1 4QQ, telephone 01-643 8040.

The first ever purpose-built TV games centre, called Silicon Chip, has been opened at 46 London Road, Kingston, Surrey (01-549 6657). The fittings include seven TV sets to enable devotees to try the large number of games held in stock, ranging from the simple four-game monochrome units to highly sophisticated microprocessor-based colour cartridge types such as the Optim Majestic video computer. The games can also be demonstrated on a projection unit with a 42 × 52in. screen – the projection unit itself can be supplied for £845 plus VAT.

General Instrument Microelectronics have introduced a new set of MOS microcircuits for use in cartridge-based programmable TV games systems. Known as System 8601, the circuits include a clock generator, colour encoder, modulator and a selection of cartridge microcircuits – enabling fully programmable games systems to be built at low cost.

Each games system will consist of a console into which individual game set cartridges are slotted. Each console will contain the clock, encoder and modulator as well as the game controls, switches, power supplies, etc. Each cartridge contains the individual games microcircuits plus interface circuitry. All sets will feature realistic sound generation and on-screen scoring.

Some of the cartridge-mounted microcircuits are already available, including the 8610 "Supersport" (20 games), the 8765 "Motorcycle" (8 games) and the 8603 "Road Race" set (3 games). Three more circuits – the 8607 "Target" (12 games), the 8606 "Wipeout" (24 games) and 8605 "Warfare" (10 games) – will go into production within two months, with more to follow before the end of the year.

GIM introduced the AY-3-8500, which became the video games industry's standard i.c., in 1976.

INTELLIGENT GAMES CHIP

ITT have released details of a new i.c., type SAA1080, which provides ten games and is intended for use in conjunction with ITT ultrasonic or infrared i.c. remote control systems. The SAA1080 is incorporated inside the set, the player push-button control units being connected to the remote control transmitter. The games provided are: blockade, war at sea, solitaire, master mind, nimb, game of chance, othello, nine men's morris, five in a row and wolf and sheep: the first six are played by a single player against an electronic adversary, the last four requiring two players.

DATA RECEPTION

A code of practice is in preparation to give riggers guidance on the installation of aerials for data reception (teletext). As mentioned in these pages before, ghosts constitute a serious problem with data reception. It's also vital in weak signal areas to orientate the aerial for maximum signal pickup. Tests carried out by the IBA revealed that in some locations turning the aerial by 10° reduced the teletext signal to virtually nil, while in others a turn of 30° either way made no difference. In 67 per cent of cases studied where difficulty with reception was investigated the problem was due to a weak signal: in 33 per cent of cases the problem was a weak signal plus reflections.

EMO AND EUROSONIC SPARES

Tele-Part (13 Worcester St., Wolverhampton WV2 4LU) tell us that that French manufacturer Matra Electronique has discontinued the production of EMO colour sets, a number of which were imported into the UK. The name EMO has been taken over by L.M.E. (Le Materiel Electronique), who are handling the after sales service of Matra produced sets and have appointed Tele-Part as their UK agents to handle all matters relating to the servicing of these sets.

SERVICE NOTES FROM RANK

Switch-off spot suppression has been added to later versions of Rank's current UK-produced monochrome portable chassis T16A. The modification is simple and can be added to earlier versions if required. R57 (180kΩ) from the brightness control to the 100V rail is replaced by a BZX79/C47V zener diode, with its cathode to the 100V rail and its anode to the brightness control.

The 1·6A mains fuse (7FS2) fitted in the T20 chassis has been changed from a glass cartridge type to a ceramic tube (HRC) type.

In versions of the Z718 and T20 chassis using electromechanical tuning an 0·1μF capacitor has been added between the tuning preset sliders and the screen lead earth in order to prevent bent verticals when the a.f.c. is switched on.

TELETEXT COURSE

In response to requests from those who have attended its previous courses on teletext systems, the South London College (Knights Hill, London SE27 0TX, telephone 01-670 4488) is now offering a course which devotes more time to teletext reception. The short course consists of nine special lectures on receiver decoders and will be held on consecutive Tuesday evenings starting on October 10th. The lectures will last for approximately two hours each, and the fee for the course, which is intended for television and telecommunications technicians and engineers, is £6.50.

TRANSMITTER NEWS

The following relay stations are now in operation:

Corwen, Clwyd BBC-Wales channel 22, HTV-Wales channel 25, BBC-2 channel 28. Receiving aerial group A.

Greenhill, Dyfed, BBC-Wales channel 21, HTV-Wales channel 24, BBC-2 channel 27. Receiving aerial group A.

Kingussie, Highland, BBC-1 (Scotland) channel 40, Grampian Television channel 43, BBC-2 channel 46. Receiving aerial group B.

Montpelier, Bristol, HTV-West channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

Praa Sands, Cornwall, BBC-1 channel 55, Westward Television channel 59, BBC-2 channel 62. Receiving aerial group C/D.

Truro, Cornwall, BBC-1 channel 58, Westward Television channel 61, BBC-2 channel 64. Receiving aerial group C/D.

All the above transmissions are vertically polarised.

Never Knock a Neck

Les Lawry-Johns

I didn't like the look of them from the moment they walked in. She was short and fat and an ignoramous to boot. He was short and lean with a pinched look and another ignoramous to complete the pair.

The Saga of Grace and Sid

"If we bring our set in and tell you what's wrong with it, will you put a picture valve in?" she demanded. Before I could think up a telling reply, he staggered in with an ageing dual-standard Bush.

Breaking off the conversation I'd been having with the cat, I surveyed the wreck with a pessimistic eye. "Getting on a bit, isn't it? Think it's worth doing?"

"That's a good set that is," said the self-elected female spokesperson. "It only wants a picture valve."

Having been a coward all my life, particularly when faced with a loud mouthed woman, I connected the set to the mains and stuck an aerial in the socket.

The sound came on reasonably well, but after a long delay all that appeared on the screen was a very very dim raster which did not respond to the brightness. Obviously the tube. Just to confirm this I took the back off and checked the tube base voltages. All correct, grid swinging with the brightness control setting, but with no effect on the dim raster.

I told them that all the valves in the world wouldn't help and that the tube was at fault.

"How can it be the tube?" said the brain of Britain. "There was a lovely picture on it last night, wasn't there Sid?"

"I can't see it being the tube," Sid said dutifully. "Lovely picture last night, just like Grace said."

"Well there ain't no picture on it now," I bawled. "The tube's clapped. Finished. Buggered it is." So saying I tapped the neck of the tube with the handle of a screwdriver.

A nice flash of black and white picture appeared for a split second, then relapsed back to the dim raster as before.

"Do that again," said Sid. "I saw something come on there, there must be something loose."

"Loose, loose, of course it's loose. It's loose inside the tube you twit. Look." I gave the neck another clout. On came the picture in a brief flash, then off it went again.

"Well," said Grace. "That won't cost much to put right, a little thing like that. We'll go up to two pound but no more."

"Oh yes, two pounds all right," pronounced Sid.

That was enough for me. On went the back, out came the aerial, off went the mains. "Sorry, perhaps you ought to get a second opinion. It's beyond me."

"You mean you're not going to do it?" Grace quivered with indignation.

"No I'm not and that's that."

So off they went with lots of uncomplimentary remarks clouding the air as they left.

Later that day they stalked in again.

"We came back to tell you you don't know anything about television sets. There's nothing wrong with that tube. Tell him Sid."

"You nearly made me throw that set away," moaned Sid. "But I took the back off and just cleaned the dust off from under that rubber cap on the side of the the tube and the picture is perfect. And I don't know anything about 'em."

"I do," said Grace. "I used to work in a TV factory and I'm telling you the tube ain't gone. You didn't ought to be 'ere you didn't."

Lots more was said before they went.

My fault of course. I shouldn't have knocked the neck.

I wonder what they said later when it reverted to the open-circuit condition again and there was no more dust to wipe off. I'll never know.

Troubles with a VC300

Kevin came in. He's done quite a few good turns for me in the past, so when he brought in a small ITT Featherlite VC300 which was worrying him I didn't hesitate to take the repair off his hands. The first symptom was field collapse, but the resultant white line was wriggling a bit. So we attacked the field circuit first, and quickly found one of the output transistors (T11, TIS91) open-circuit. In went another and the scan opened up, but with an undulating raster which proclaimed a nasty hum on the main 11V line. This was due to the mains bridge rectifier of course, and another went in without much ado.

This left a clear picture except for a few random flyback lines which appeared to move about the screen as though the sync was about to be lost and the picture about to roll, which it didn't and the field lock was very firm.

Flyback suppression, I mumbled to myself. Now although we've serviced these sets time and again, we were not familiar with the flyback suppression circuit and it was a bit irritating to observe that the lines would vanish for minutes at a time and then reappear, particularly if the panel was disturbed. This prompted us to diagnose (wrongly) a dry-joint or the like. Some time was spent chasing around from the field timebase to the blanking transistor T5.

At last we changed this (using a BF337 as a substitute), and were rewarded with a clear picture which lasted for about fifteen minutes before the picture became impossibly grainy with hissy sound. Back on familiar ground unfortunately. Check aerial socket, cable to tuner, remove tuner from panel. Take off covers. Put tuner back, check voltages. First stage transistor emitter voltage wrong and varying. Trace to where the emitter resistor is returned to earth via a screening peg. Nice crack around peg. Resolder. O.K.

Remove tuner, refit covers and put tuner back. No more trouble. Thanks Kev. With friends like you I don't need enemies.

Taffy's Turntable

We thought you might like to hear this one. We were asked to call to attend to a radiogram which had the complaint that although the radio section worked the turntable would not turn. We left it until there was another

call in the area and then popped in to see old Taffy.

"What's wrong Taff?" Taffy growled and gurgled as was his wont (he'd had a few during the lunch hour) so we decided to find out ourselves.

Usually this type of BSR changer grinds to a halt due to old, thick grease on the centre spindle. This stops the motor rotating, which it doesn't like and is thereafter reluctant to spin again even when completely free. It has to be spun a few times with perhaps a spot of oil on the top bearing until it gets its magnetism sorted out when it will then start up on its own. The turntable did indeed seem to be stuck fast on the centre spindle. Having freed it and lifted it off we were prepared to clean the centre spindle and the turntable bush, and lightly oil them. We were not prepared for what we found however. There was no motor fitted.

"Taff, Taff. Are you there Taff?"

"Whassermatchure, woswrong?"

"There's no motor in your radiogram Taff."

"No motor, no motor. Wodyoumean no motor? Theremusbe one. The radio's been going all morning. Matter of fact" – as his head cleared he climbed on his dignity – "matter of fact the thing's been working for six months on Radio Two. Never shift it."

"You don't need the motor to work the radio Taff. It only turns the records round."

"You'll have to ask the wife about that. She looks after all that sort of thing. She fixed it some time ago when the music was going slow. The music has been all right since but I haven't played any records you see."

"Is the wife around Taff?"

"No, she's in Finland. She sent me this greetings record but I can't play it because it won't go round. That's why I asked you to call."

Back to square one.

Feeling somewhat baffled, I went back to the radiogram and Taff wandered off to another room, grumbling to himself. Removing the rear cover of the gram, we found the motor on the floor of the cabinet, still with its leads connected. Switching on the juice made the motor buzz, but it wouldn't go round. Applying a drop of oil to the top bearing and raising the spindle up and down a few times seemed to free it off. Spinning it by hand helped it to start and away it went after that on its own. A careful search also located the three circlips which hold the motor fixings on top of the rubber bushes, so back the lot went and having cleaned off the centre spindle and bush the turntable spun freely.

"O.K. now Taff. Where's the record the wife sent you?"

In came Taff. Mumble, mumble. Eventually he found it. His wife's message was loud and clear. After the first greeting, she said. "You'll have to get the gram done before you can play this. Tell the man that the motor is underneath because I couldn't get the clips back and it won't go round anyway."

Taff gave me a baleful look. "If you'd played that before you started, you'd have known where the motor was." I quit.

Distorted Picture

The next call was nearby. I wish I hadn't bothered. It was yet another Pye 691 hybrid colour set.

The complaint was a distorted picture. Folded up from the bottom, then widespaced lines up to two thirds, then a bright kink, then severe compression up to the top.

The owner sat at the table and gave me his advice.

"It won't take long to do. The last chap fixed it in a couple of minutes with a screwdriver. I suppose it'll take you longer if you're not used to the set."

"Why didn't you get him to come back and do it again?"

"He doesn't do them now. He gave me your phone number, so I thought I'd give you a chance if you're just starting up."

Off came the back cover. The field output transistors were the older BD124 types on the horizontal heatsink. Check these. Apparently in order. Check the AC128 driver transistor. Again o.k. Check resistors, o.k. Check electrolytics in turn, disconnecting each first. All had capacitance, none showed any significant leakage. Legs aching, panic setting in. No spare panel, no service manual. Check diodes, o.k. All supply voltages present and mid reading on BD124s not far out. Try presets. Produce weird effects but nothing of any value. Could be on convergence panel? Some messy work had been done here. Give up.

"Sorry, it'll have to go back to the workshop."

He sat at the table and drummed it with his fingers. "The last chap said it would need a panel before long. Have you got one?"

"Yes, but I'm not sure that's the answer."

"Can I have it back for tonight? – it's not much fun looking at the portable."

"It 's not much fun sorting this out either!"

So load the thing into the waggon and take it back to the shop. Back at the ranch there were lots of other things to sort out but we finally got on to the Pye. Try another field panel. No joy. Open up the convergence panel and make good scorched connections, poor pots and dry joints. Check electrolytics. No joy.

Check continuity of circuit from field panel to convergence and to scanning assembly. All o.k. ... Scanning assembly ... Oh no! Try to check windings and thermistor. Not conclusive, only confusing.

Lady wants leads soldered on to transistor radio battery box which is falling to pieces anyway. Fit new box and connectors. Back to Pye.

Have we got a spare scanning assembly? Yes. Strip off tube base, blue lateral, convergence assembly and scan coils. Fit new coils, connect up but can't find one lead. Finally find it jammed up behind front of new assembly. Check connections, refit convergence, blue lateral assembly and base socket. Won't go on properly. One tube pin bent. Get it on.

Make sure all is in order. Switch on. Joy at last. Set up and converge. Return set to owner.

"Picture's not as bright as it was before you took it." Fit new PL802. No picture at all. Remove CDA panel and make good deteriorated soldering and small cracks around PL802. Nice bright picture.

"How much?! You blokes must be making a fortune at this job."

No Signals

I thought I'd make an early start the following afternoon, as I'd an uneasy feeling that things were not going to be plain sailing. Four colour sets and one mono, no two the same (for a change).

We made the nearest one the first call. This turned out to be Mr. Peacock's Dynatron. The Pye group chassis fitted was a 697. No picture, no sound except a loud hissing noise. That was Mr. Peacock's description. Bright as a new pin we first made sure that the aerial plug was in. It was.

Take the back off. Wave a neon over the line output section. Lights up, plenty of juice over that side. Check h.t. on CDA panel. None except at supply plug and socket on the right side of panel. Easy. Remove panel and note nasty black mark round track from socket. Clean up and jump a lead from the socket to the nearest relevant solder blob. Assemble and clip up. Switch on.

Sound o.k. Picture arrives after a time. Tune in after battle with remote control and receiver buttons. No colour. Check here, there and everywhere (Mr. Peacock watching). Find plug out of decoder panel, probably caused by upending CDA panel. Refit plug. Colour returns to screen and to my cheeks. Mr. Peacock was looking mystified.

"I thought the sound side was all transistor" he said.

"It is."

"Well, when you were checking with your meter, why did you mutter to yourself about no h.t. I always thought transistors could work on low voltage."

Oh Gowd, I thought. Here we go again.

"The transistors were being supplied. That's why they were hissing at us. But the tuner wasn't tuning you see."

"Oh I see. The tuner needs h.t. Fancy that."

I was in a hurry so I didn't go on any further and left him thinking that tuner transistors must be pretty hefty devices.

Very Dark Picture

The next call wasn't far away. This was to a Ferguson set with a 3500 chassis. I was only praying that the tripler hadn't gone and buggered up the e.h.t. transformer, which appears to be our lot of late. Mrs. Dewdrop answered the door.

"Hallo Les," she greeted me.

"Hallo Dorothy, doing some decorating I see."

"Yes, I hang one strip of paper per day so I don't get bored with it." It takes all sorts to make a world, but that's about the daftest thing I've heard for a long time. It's not my business however and I wasn't going to ask what she did the rest of the day.

So we attacked the TV. In fact there was a very dark picture in the background, so the trippler was o.k. after all.

A dark picture on a 3500 means that the beam limiter should be the first item to receive attention. R907 (1·5Ω) should have about 1·5V across it (manual states 1.3V). If the voltage is higher, the brightness is backed off. The line timebase current flows through this resistor to earth so the resistor monitors the line output stage current and, if the circuit is not defective, it limits the beam current.

The voltage across R907 read over 3V, so there was either excess current flowing due to a fault in the line output stage or the resistor was not all that it should be. The dark picture seemed to be of the right size, and the c.r.t. first anode voltages on the convergence board were well up.

So we switched off and measured the 1.5Ω resistor which read 3Ω. We'd thoughtfully put a packet of 1·5Ω wirewounds in the box (spares box, not the TV) so it didn't take long to put a new one in. The voltage was now nearly 2V, which was still high. Checking around showed no faults, and the picture was good with plenty of brightness. So we didn't argue with it. By this time Dorothy had hung her daily strip, so all work was now complete.

Smoking Bush

Off we went to the next set, a Bush monochrome one that had smoked. It was an elderly dual-standard 23in. receiver (TV148 series).

Investigation showed that one of the h.t. feed resistors on the left side lower electrolytic block had been cooking. This was 3R59, 3·3kΩ. It feeds one lead over to the timebase panel, another over to the receiver unit. There was a low resistance reading to earth, and unplugging the leads proved that the short was on the receiver unit. So we disconnected the system switch and swung down the chassis in order to peer behind it with the aid of our little torch. The tracks lead off here and there, but a close look on the component side revealed a blackened disc ceramic. Snip, snip and out it came. No short. In went another disc with the right voltage on it but the capacitance somewhat smudged. Swing up chassis. Make sure plugs are in and system switch is in 625-line position.

Switch on. Nice noisy raster, lovely rushing noise on sound. Plug in aerial. Push in buttons. Nothing to speak of at all. Check that aerial is in u.h.f. socket, ignore the three buttons which give whistle (who wants 405?). Finally tune in terrible picture. Oh dear. Surely the smudgy disc capacitor couldn't do this?

Call Mr. Latterly who assures me that the picture was good before the smoke. Then he noticed what I was trying to tune in. It was a BBC-2 test card.

"We never get BBC-2."

Wearily I plugged the aerial into the v.h.f. socket and selected the other buttons for 405. Bright BBC-1, not bad ITV.

"That's more like it. Did you think we had a BBC-2 aerial?"

Intermittent Colour

Feeling a little tattered we moved on to the next casualty, which we confidently thought to be a 3000 chassis HMV. On turning it round and seeing the row of knobs on the left side realisation burst. It was a 2000 chassis, and since the complaint was no colour I was frightened. This was mainly because we don't meet many 2000 chassis, and those we do meet generally need only power components – zeners, wire wounds etc.

The lady of the house refreshed my memory of the complaint. No colour for some time and then it tries to come in and sometimes does, but never right away.

"Is there anything I can get you?" she asked solicitously.

"Do you think I could have a mirror and a hairdryer?"

She looked at me and my hair. "It does look a little rough, but do you think this is the right time to do something about it?" she ventured.

I combed my hair viciously. "I need them for the set, not for me. The dryer to warm things up a bit and the mirror to see when the colour comes in."

She went out and I remembered that I had a dryer in the spares box in the van. This was just as well because when she came back she was wheeling an enormous hooded affair on a stand.

She did however have a suitable mirror, so with this propped up in the right position and my dryer blowing away like made we were ready to attack the enemy.

The decoder board is at the bottom centre and we carefully covered the suspect areas with hot heat. Chrominance amplifiers, colour killer and reference oscillator, nothing escaped our ruthless scorched earth policy. It didn't do much good though, except for occasional half-hearted bursts now and again.

I tried to be clinical, though this never really comes off. Remove panel in its entirity and examine closely. So we unplugged the plugs and removed the board. We looked and looked, checked here and there and finally pronounced our judgement: "buggered if I know."

So back went the panel, in went the plugs and on went the set. Glorious colour. Considering the age of the tube, it was well nigh perfect. A tweek up on the gray scale and nothing was left to be desired.

"Aren't you clever," said Mrs. Post.
"I suppose I am really" I admitted.
"What was wrong then?"
"Er, there was apparently an intermittency in the chrominance interconnecting connections you see."
"You mean a poor connection."
"Yes, I suppose you could say that."
"And the hairdryer found it?"
"Er, no. It might have done but it didn't. Perhaps it will next time." So off we went again. So much for the 2000. Kids' stuff really. Sets like that don't frighten me.

Ah Doric, I Knew Him Well

Which left one. Ah Doric, I knew him well.

As a matter of fact it was the first time one of these sets had come my way. I'd no servicing information on it, which doesn't make a lot of difference because I have great difficulty in reading anything anyway. I always seem to try to do things first and then have a go at reading the instructions afterwards. The owner however had a complete manual, which was presented to him when he retired from his firm a couple of years ago – together with the set of course.

I was amazed to find the imposing looking set in front of the window, with the coaxial cable connected to a small set-top aerial which was perched in the centre of the carpet.

"Do you always have the aerial there?" I asked.

"Most of the time," he said. "Except when we want BBC-2 when we put it on top of the set."

The reception area wasn't all that good, and it seemed a clear cut case of spoiling the ship for a hap'th of tar. Our's is not to reason why however.

Apparently the picture would completely lose it's "body" after an unspecified period, becoming a sort of plastic near negative with only some colour noise in the background.

Without consulting the manual, this suggested an i.c. or transistor failure somewhere between the detector and the splitting point of the luminance and chrominance signals. Wherever that was.

So we consulted the manual and got involved with an "SF" panel which we eventually found wasn't there (only on cable receivers it said). We had another go and found the relevant panel for "aerial" receivers, ending up on the top of the decoder panel around some likely looking BC148s.

Since the picture was acceptable at that moment, the voltages tallied with those given in the manual. When the "plastic" condition occurred, the voltages on one went haywire.

Consulting the circuit again we found that this was d.c. coupled to the preceding one which was reading right. So the d.c. coupling wasn't.

In fact the coupling agent was the luminance delay line so we hadn't got our diagnosis right in the first place. The one thing we didn't have with us was a luminance delay line, but to prove the point we jumped a lead across the suspect one and the picture stayed on and the voltage remained right. We expected a degraded colour picture, but it was as good as it had ever been with the aerial in the centre of the carpet (what's a ghost or two when you already had three!)

We told Mr. Sparerib that we would be back with a delay line later, but that he wouldn't notice the difference until he had a better aerial.

So back to the workshop, to the turntables that won't turn, the auto-ejects that won't eject, the cartridge player that went bang and the telly's which won't tell.

Colour Receiver Project

Part 1

Luke Theodossiou

GREAT changes in TV receiver techniques have occurred over the past few years. It doesn't seem all that long since a large, clanking mechanical tuner fed a substantial, hand-wired chassis with an array of things that lit up. If the tube was a colour one it would have a large deflection yoke, another large assembly for radial convergence, and a number of other bits and pieces. There were masses of adjustments, and the least said about the power consumption the better. We've been going through a period of rapid change however. Everything from the tuner to the tube has undergone substantial development. Tiny tuners can be digitally controlled, the latest colour tubes have as little impedimenta as the monochrome tubes of a few years ago, and what lies between can be taken care of by a compact array of solid-circuit electronics.

It seemed time for a fresh look at a colour receiver project for the constructor. Since an up-to-the-minute colour receiver contains less than a monochrome set a decade ago, neither construction nor setting up should present much trouble, while a receiver that utilises as many of the latest techniques as possible provides a very useful lesson in the present state of the art. So here we go.

Design Philosophy

Perhaps the biggest problem we had was in deciding just where to call a halt and say the design must stand as we can do it at a particular point in time. Had we waited another year for example we could have used some of the more sophisticated i.c.s we know are in the pipeline. Although the overall rate of development is fast however, individual devices often take a considerable time to get from the development sample to the off-the-shelf stage. Setmakers are confronted with the same problem of course. The answer is to divide the chassis up into a group of modules which can be updated as developments reach the stage of full-scale production.

The overall emphasis has been to make the receiver as simple as possible consistent with high-quality reproduction. Commercial setmakers have the same basic aim. With production costs constantly rising, simplicity in design is essential in order to maintain competitive prices while at the same time making the profit necessary to remain in business. The only way in which this can be done is to minimise the amount of individual circuit alignment and testing required in the factory and to reduce the component count as far as possible. The ultimate result is increased efficiency all round. One great advantage that a project for the individual constructor has over the production of a commercial receiver is that decisions on capital investment don't have to be made. Thus the design of the set can be altered without having to take into consideration the possibility that a lot of costly assembly equipment may have to be scrapped or altered. This doesn't mean we've been chopping and changing the set up till the last minute. Well, not quite. But what it does mean is that we've got some slight edge over commercial designs in terms of being able to adopt new techniques and devices.

The accompanying photographs show how little hardware is required in our design. No currently available commercial set uses so few components. The problem of engineering a project doesn't stop with getting hold of a handful of samples and finding out that good reproduction can be obtained however. In the interests of reliability, detailed component specification is necessary. It's also essential to ensure that at least one supplier is available for every component.

Warning!

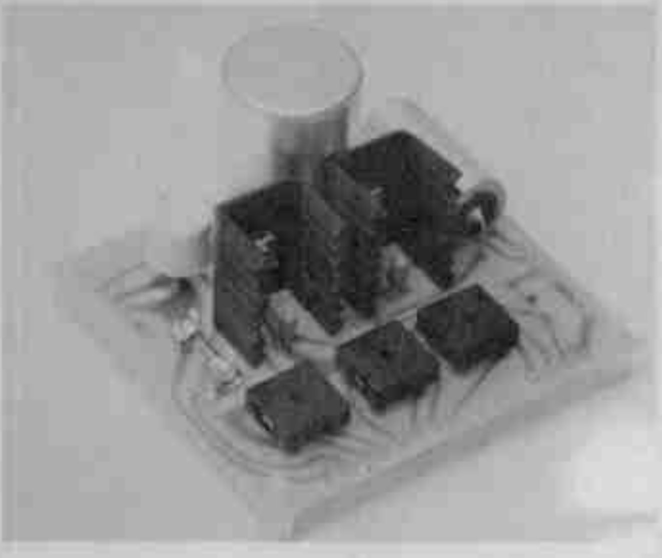
The use of printed circuit boards, which will be available to readers through Readers' PCB Services Ltd., and components as specified guarantees a project which the constructor with some experience and knowledge should be able to tackle with confidence. But though it may all look very simple, if you haven't had much experience and have little understanding of what the circuits are doing you'd probably do best to enlist the help of a friend who has. Very high voltages (an e.h.t. of around 25kV) and substantial currents are involved, with the result that mistakes can be expensive.

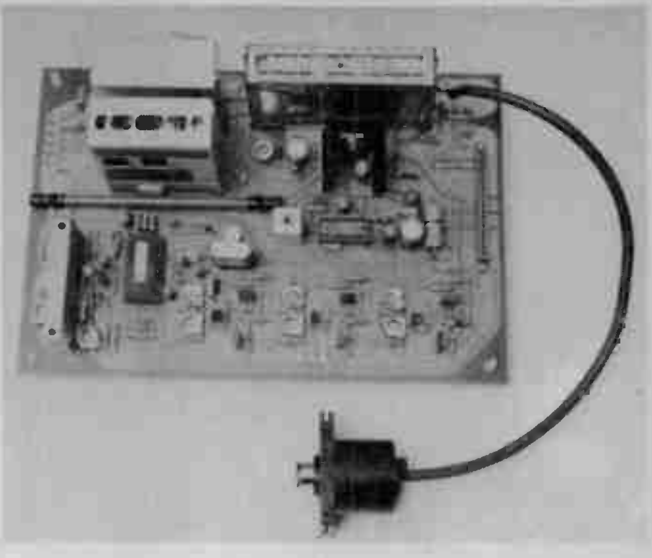
The Project in Outline

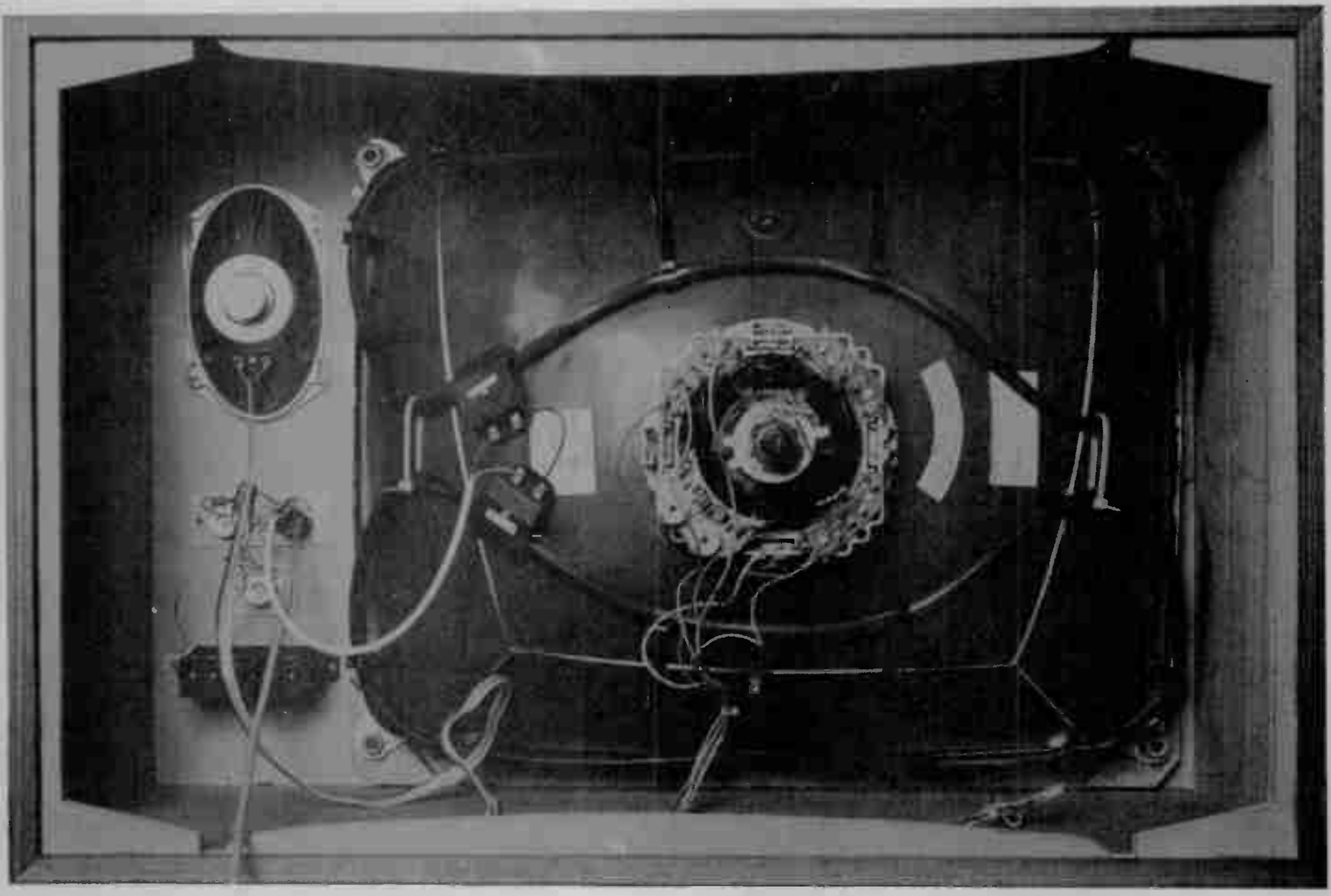
With the exception of a few components which for obvious reasons are attached to the cabinet all the components are arranged on four printed-circuit boards – including the tube base panel. The first one, which we are describing in this first article, is the power supply board which feeds the receiver with all the supplies required. Subsequent articles will deal with the other boards in turn, and we suggest that constructors build each section up as it's published. In this way the total cost will be spread over several months. Having dealt with each board in turn, interconnection details, testing and setting up procedures and some hints on fault-finding will be given. There will then be a couple of important options: an ultrasonic remote control unit (the editor, who tends to keep away from constructional items because he has difficulty remembering which end of the soldering iron is which, has enjoyed playing with this), and a built-in teletext decoder unit.

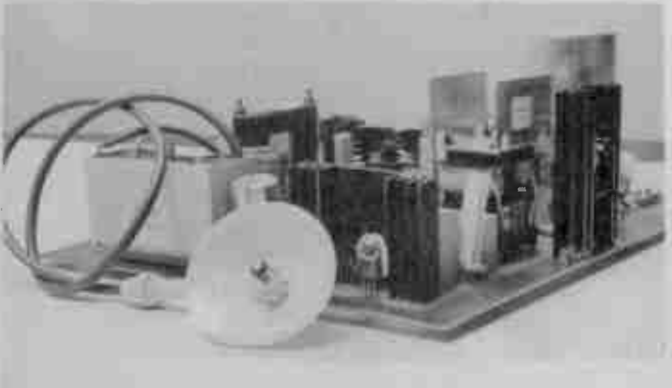
Technical Features

We felt that mains isolation was a very desirable feature, not only from the point of view of safety, but because it allows the use of direct connections in and out of the receiver – to a high-fidelity audio system for example. So a mains isolating transformer was one of the starting points in the design.









Above: Rear view with all boards removed, showing the cabinet-mounted components (except for the mains transformer).

Top left: The power supply board (Molex connectors not fitted).

Top right: The signal board, which includes the decoder and RGB output stages and provides a mounting for the tuner and i.f. modules.

Left: Profile view of the timebase board.

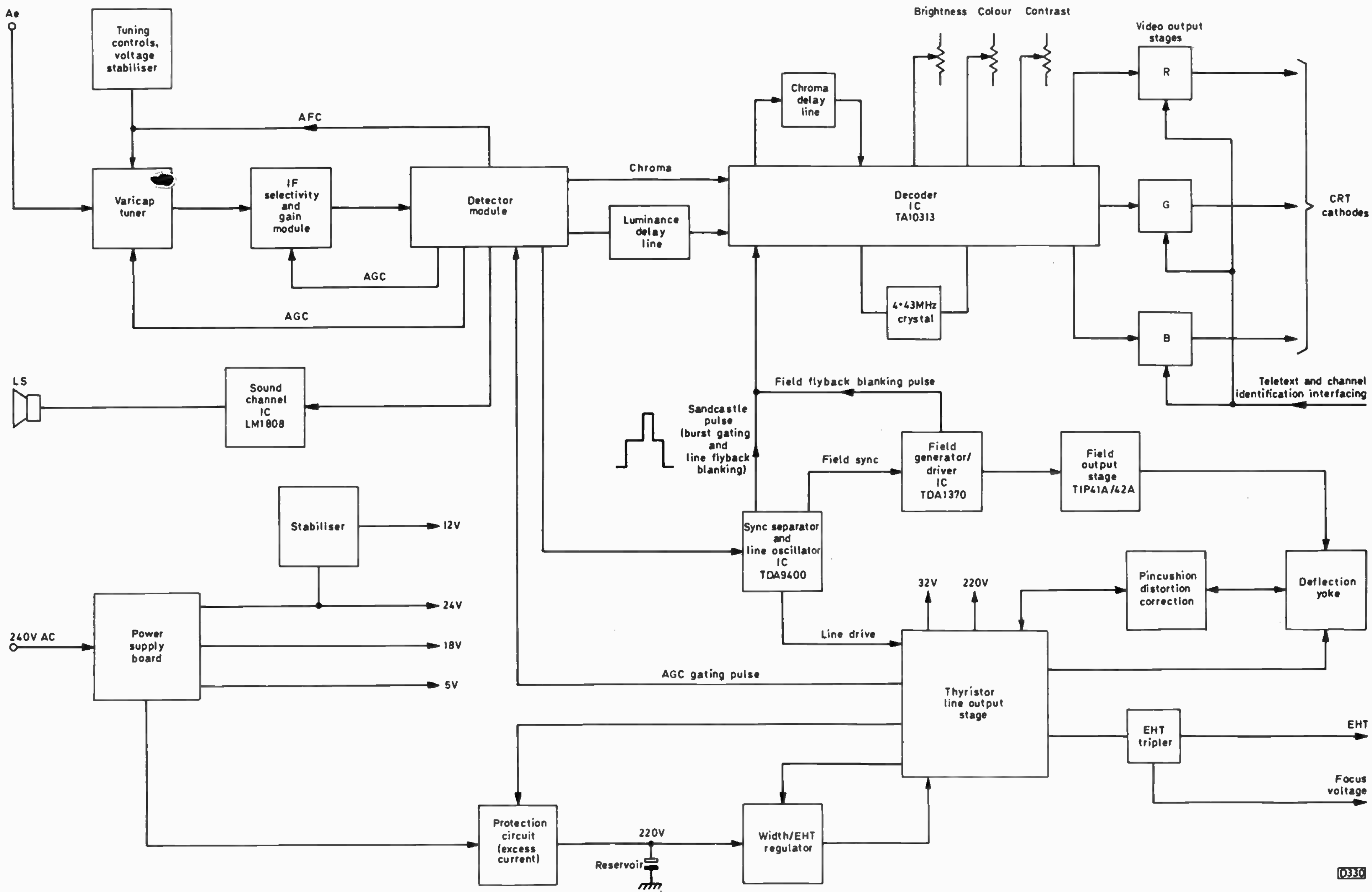


Fig. 1: Block diagram of the complete receiver.

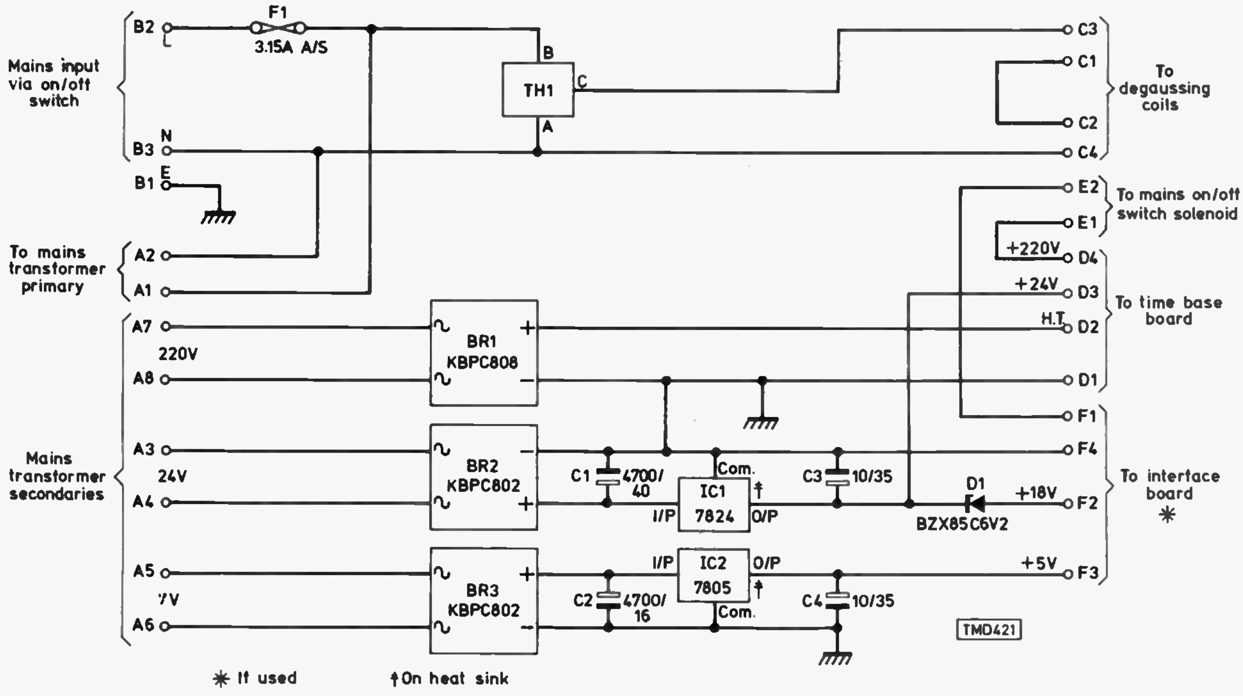
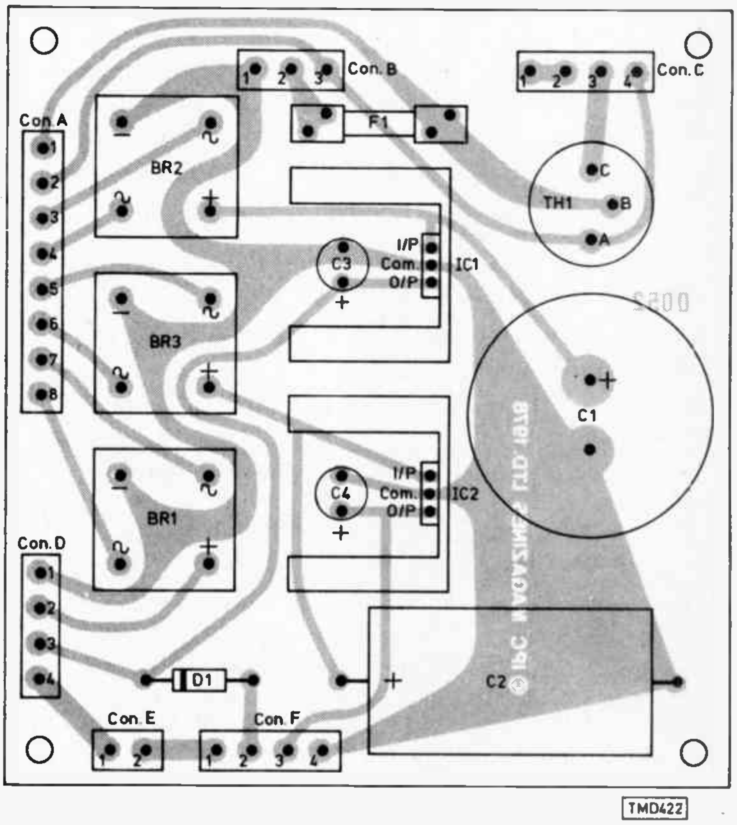


Fig. 2: Circuit diagram of the power supply section. The h.t. reservoir capacitor is on the timebase board, along with the excess-current protection and width regulator circuits.



COST

At the time of going to press it has not been possible to cost the project, and it's likely to be a while before we can provide an estimate. This is simply because many of the components used in the prototypes have been manufacturers' samples, and it's not yet known at what prices suppliers will be able to offer them to individual customers. We will publish an estimated likely overall cost as soon as this is possible. Meanwhile, those interested should watch the advertisement pages over the next couple of months. Bear in mind that the aim of the exercise is not to undercut the cost of commercially produced sets, but to see how the latest technology can be exploited to provide a simple yet high-quality design suited to one-off construction.

Fig. 3: Power supply board component layout.

★ Components list: power supply board

BR1	KBPC808 (or RS Components 262-084)
BR2, 3	KBPC802 (or RS Components 262-078)
TH1	2322-662-98009 (Mullard) or PT37P (ITT)
C1	4700μF 40V Siemens can B41070
C2	4700μF 16V Siemens tubular B41010
C3, 4	10μF 35V tantalum bead
D1	BZX85 C6V2
F1	3·15A anti-surge 20mm
Misc.	P.c.b. fuse clips; 0·2in. pitch p.c.b. connectors
P.c.b.	D052 from Readers' PCB Services Ltd.

Mains transformer: Primary: 240V
Secondaries: 220V, 1A
24V, 2A
7V, 2A

The mains transformer will be available from regular advertisers in the magazine.

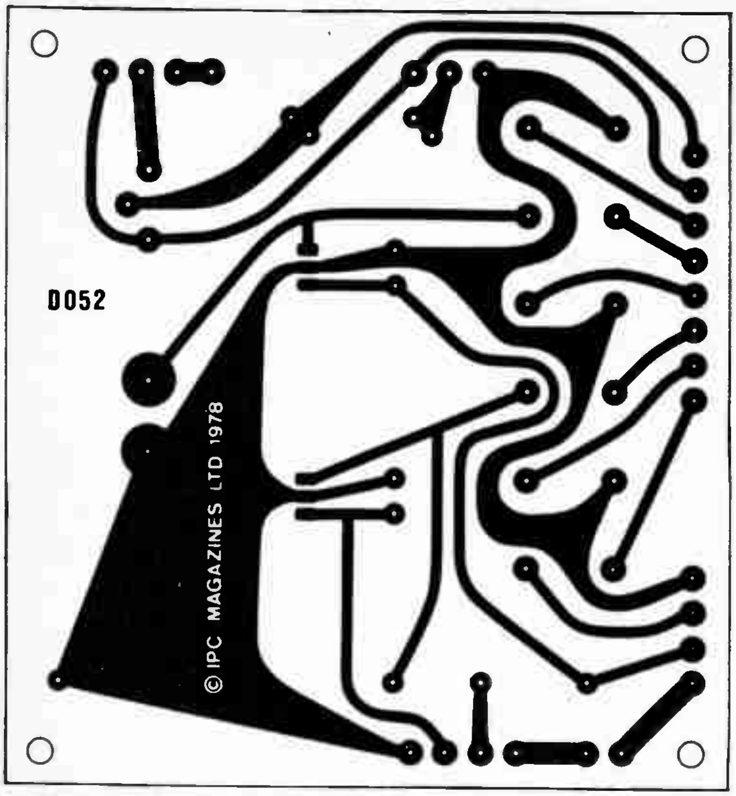
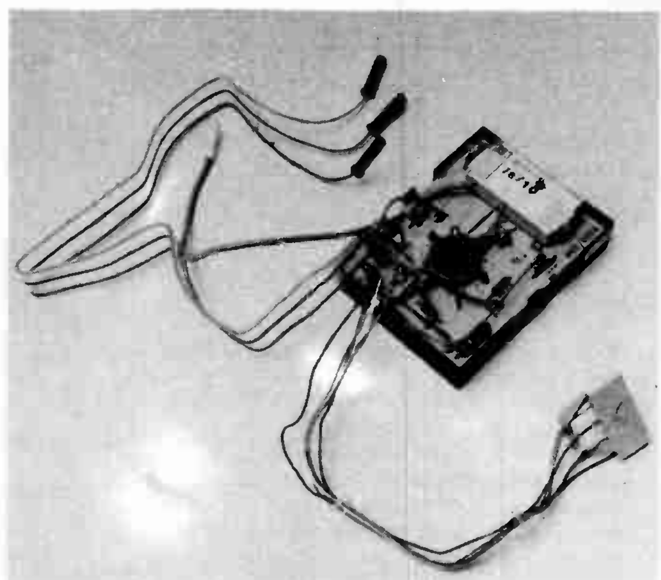


Fig. 4 (left): Power supply board print pattern. Scale 1:1.

Right: This month's board: the power supply unit.

Far right: View of the tube neck components, which are all preset and sealed.

Below: The c.r.t. base board. In view of the safety factors involved (high focus voltage, spark gaps etc.) this is a ready-made unit. Different connections will be used.



Apart from mains isolation, other major features of the design include:

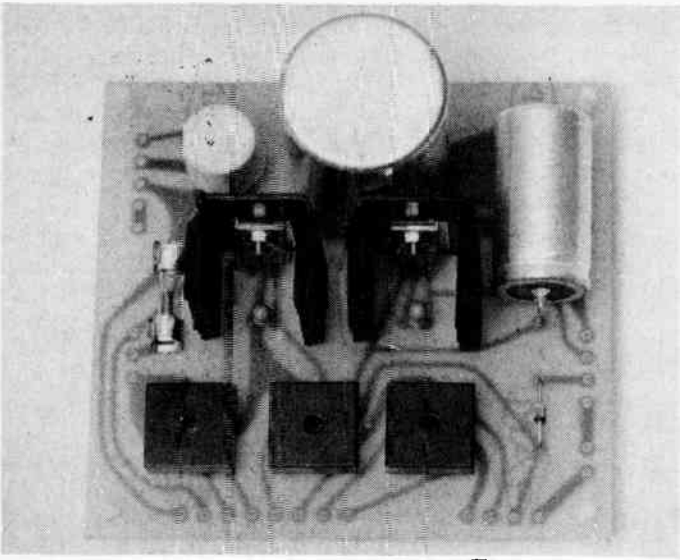
- Use of the latest pin-diode varicap tuner.
- Prealigned i.f. modules.
- A single-chip colour decoder.
- Class AB RGB output stages.
- A single-chip sound channel.
- A thyristor line output stage.
- Single-chip field oscillator/driver with a pair of discrete output transistors.
- Use of one of the latest sync separator/line oscillator i.c.s.
- A 110° RCA self-converging, precision-in-line (PIL) tube with integral, toroidally wound scanning yoke.

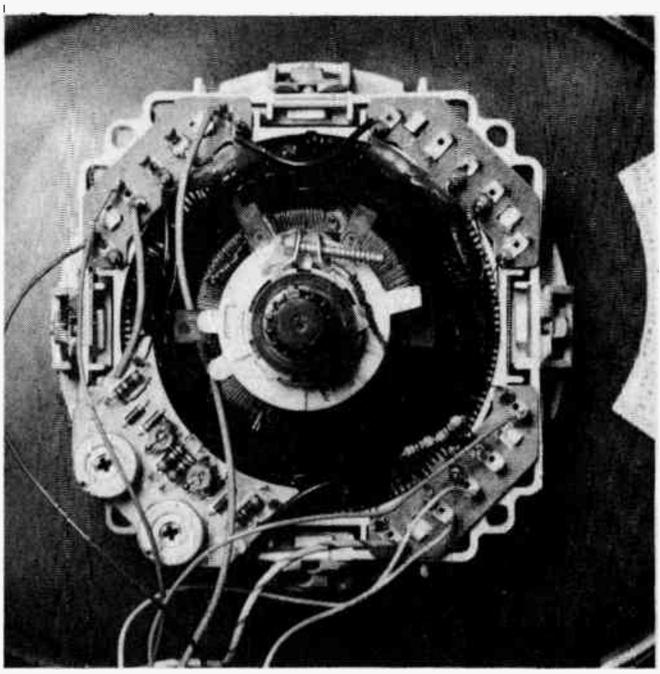
Choice of CRT

The use of the RCA PIL tube was fundamental to the whole concept of the set. The reasons for choosing it instead of one of the other in-line gun tubes currently available are worth mentioning therefore. First, it was felt that the RCA tube is particularly easy for the constructor to use, since the neck components are all permanently attached to the tube and thus don't require any setting up. Another desirable feature is that no convergence adjustments at all are required, unlike some in-line gun tubes which still require some adjustments, though very few, to take manufacturing tolerances into account. Finally, the author prefers the overall focus performance of the PIL tube. The latest generation of these tubes is being used, with the super-arch mask and with higher transmission glass and pigmented phosphors to provide increased brightness and a greater contrast ratio. Pricewise there's little difference between the tubes available. RCA have appointed Solus (Electronics) Ltd. of Kirkwood Road, Cambridge CB4 2PF as agents for the supply of these tubes in the UK. The tubes can be obtained by individual readers directly from Solus.

Options

The options which make the basic receiver more versatile involve the incorporation of a Trifax module for teletext decoding, with an interface board, and a remote control system which calls up the teletext pages in addition to controlling the channel, brightness and colour. We suggest that constructors wishing to include these options should use the larger, 26in. (67cm) tube since a full page of teletext is rather tiring to read on the smaller size screen. The alternative is to use a 22in. (56cm) tube. This is a matter of preference of course and the decision is left entirely to the individual constructor. The only components





which change (apart from the cabinet of course) are the degaussing coils and retaining clips.

Block Diagram

Fig. 1 shows the basic receiver in block diagram form. The receiver section is straightforward and conventional, though extremely compact due to the use of two preassembled i.f. modules and the single RCA TA10313 i.c. for colour decoding. This i.c. provides R, G and B outputs to drive the class AB output stages. Amongst the advantages of class AB circuits are the reduced dissipation, absence of a high-dissipation load resistor, low output impedance and tolerance to supply voltage variations. An LM1808 i.c. takes care of the intercarrier sound amplification and demodulation, and provides a 2W audio output.

Thyristor Line Output Stage

The main feature that might cause some surprise is the use of a thyristor line output stage, since this is inherently more complex than a transistor line output stage. The latter would involve a fairly complex h.t. regulator circuit however, while a very simple width/e.h.t. regulator system can be used with a thyristor line output stage. Overall therefore, taking both the power supply and line output stage into consideration, the use of a thyristor line output stage is the simpler solution. It's also ideal for driving the PIL tube with its low-impedance, toroidally-wound deflection coils.

The Power Supply

The power supply circuit is shown in Fig. 2. It's very simple since the regulator and excess current protection circuits form part of the timebase module, while the 220V supply required for the RGB output stages and the 32V supply required for the field timebase are derived from the line output transformer.

The mains transformer has three independent secondary windings each feeding a bridge rectifier. Knowing the problems that bridge rectifiers cause in commercial receivers, we decided to use some fairly beefy ones. These are rated at 6A continuously and can withstand very high peak currents.

The h.t. reservoir capacitor is on the timebase board, with the associated protection and regulation circuits, and these will be described when we come to deal with this board.

The main l.t. supply is stabilised by a 24V regulator. The use of a zener diode in series with the 24V rail provides the 18V supply required by the remote control receiver circuitry.

The third secondary provides, after rectification and regulation, the 5V rail required by the Tifax module and some of the interfacing circuitry.

The basic remote control system enables the set to be switched off but not on. To obtain the latter function, a special switch incorporating a solenoid is required. The power supply board contains some link connections to enable this to be added.

If teletext and remote control are not required, D1, BR3, C2, IC2 and C4 will not be needed and can be left off the board. They can obviously be added at a later date if you decide to add the options.

Degaussing Circuit

A double positive-temperature-coefficient (PTC) thermistor controls the degaussing action. This device is produced by both Mullard and ITT and results in the simplest possible degaussing circuit, dispensing as it does with the usual resistor.

Non-isolated Chassis

Some constructors may wish to dispense with the mains transformer, operating the set without mains isolation. This is perfectly feasible, though we don't recommend it. If this course of action is adopted, it's essential that the mains earth connection is not used and that the c.r.t. clamp band is connected to chassis via an *RC* network. We'll describe this when we come to deal with the tube. With a non-isolated set a 24V, 2A mains transformer will be required, while if teletext and remote control are added a 5V supply will also be necessary. These supplies can be obtained either from separate transformers or a combined transformer. In either case it's essential that the transformer(s) are adequately rated.

CONTINUED NEXT MONTH

Faults Encountered...

Dewi James

I think the main reason I enjoy TV servicing so much is the variety of sets that come in for repair. That's perhaps one of the advantages of working for an independent dealer.

Hitachi CSP680

Take the Hitachi CSP680 colour set that came in the other day. The initial fault displayed was no sound or raster, though the line timebase whistle was present and the e.h.t. sigh could be heard. Then after about thirty seconds a blueish horizontal line appeared on the screen, indicating that the field timebase was inoperative. The regulated 120V h.t. line measured high at 145V. The real problem however was no 12V l.t. supply. This is obtained from a rectifier (CR25) which is fed from a tap on the line output transformer. Absence of this supply is often due to a short-circuit in the tuner unit, but there was no short-circuit this time. The rectifier itself proved to be all right, and there was a line-frequency waveform at its anode – we realised later that its amplitude was very low. The fault was eventually traced to an open-circuit connector in the lead from CR25 to the line output transformer – an open-circuit in the d.c. sense, as there was sufficient capacitive coupling within the connector for the line-frequency waveform to appear at CR25's anode.

The moral I suppose is that I should read my instruments from time to time instead of using them merely as indicators. The fact that there was a waveform at the correct frequency at the diode's anode was no reason to assume that there should be a d.c. output.

Sony KV1810UB

Another recent encounter was with an 18in. Sony colour set – a KV1810UB. It came in completely dead, with the 2·5A mains fuse F601 blown. It was simple enough to ascertain that the chopper and line output devices were both short-circuit. These are gate-controlled switches, type SG613, a sort of cross between a transistor and a thyristor. Replacing them and fitting a new fuse restored the set to normal operation, but back it came two days later with the same fault. Another two days passed and back it came again (remember the story "half way down I met the bricks half way up?"). As the trouble seemed to be intermittent we decided to see what advice Sony could give. Replace C624 (47μF 25V) which decouples the 19V rail on the power regulator board and the flyback tuning capacitor C542 (1,800pF, 1·5kV) on the timebase (VH) board they said. This advice proved correct.

Sony suggest the following quick checks on this set where the problem is no sound or raster:

(1) Check F601, the chopper SGS Q603 and the line output SGS Q510.

(2) Measure the resistance between the 130V stabilised rail and chassis both ways. The reading should be 500Ω one way (positive to pin 19 of the power regulator board, negative to chassis) and 6kΩ the other way (negative to pin 19, positive to chassis). If low suspect the field output transistors Q503/4 or the sound output transistor Q901.

(3) Measure the resistance between the 19V rail and chassis both ways. The reading should be 350Ω with positive to pin 17 of the power regulator board and negative to chassis, and 500Ω the other way round. If low, suspect the line driver transistor Q509 or the chopper SGS driver transistor Q604.

Since the power supply operates as a closed-loop system, depending for its operation on pulses obtained from the line oscillator, it may be necessary when fault finding to connect an external 19V supply to the l.t. rail. Connect between pins 15/16 (chassis) and pin 17 of the power supply board, with a silicon diode in series with the positive side to provide protection against voltage surges.

Wouldn't it be nice if all switch-mode power supply faults involved smoke and burnt bits? For an account of the operation of the KV1810UB's switch-mode power supply see the July 1977 issue of *Television*.

Kuba Florence

A Kuba Florence 26in. colour set appeared on the bench the other day with the fault very little brightness. It didn't take long to discover that the trouble was lack of c.r.t. first anode voltage. Now the c.r.t. first anode supply is rather unusual, though those familiar with the Philips G6 chassis will recognise the idea (see Fig. 1). The first anode preset controls are connected between a 410V supply derived from the boost rail and a "floating" supply which is obtained by rectifying ±350V line flyback pulses. The pulses are fed via C584 and C585 to diode D580 for rectification, and the trouble was that C585 (0·0047μF, 1·25kV working) was short-circuit.

Another of these sets displayed a picture whose bottom half was completely missing. The voltages in the field output stage were completely wrong. A glance at the circuit diagram revealed that the field output stage is connected between +25V and −27V supplies: the latter was missing. So the fault was in the power supply, where the shunt regulator transistor TR602 (TIP31) was found to be defective, a replacement restoring normal scan. Shades of the Pye hybrid colour chassis.

A fault we get from time to time on these sets is brightness troubles due to the beam limiter diode D104. The latter is connected between the BD115 luminance output transistor and the cathodes of the c.r.t. It operates in the same way as in several monochrome sets such as the Pye

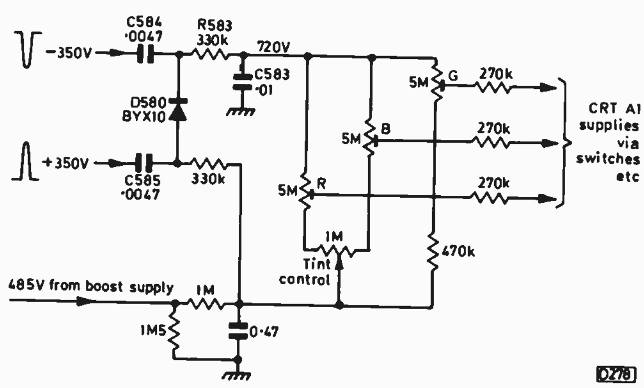


Fig. 1: The c.r.t. first anode supply circuit used in the Kuba Florence. When D580 conducts, the right-hand plate of C584 is charged positively. R583 and C583 provide smoothing. C584 and C585 are rated at 1·25kV.

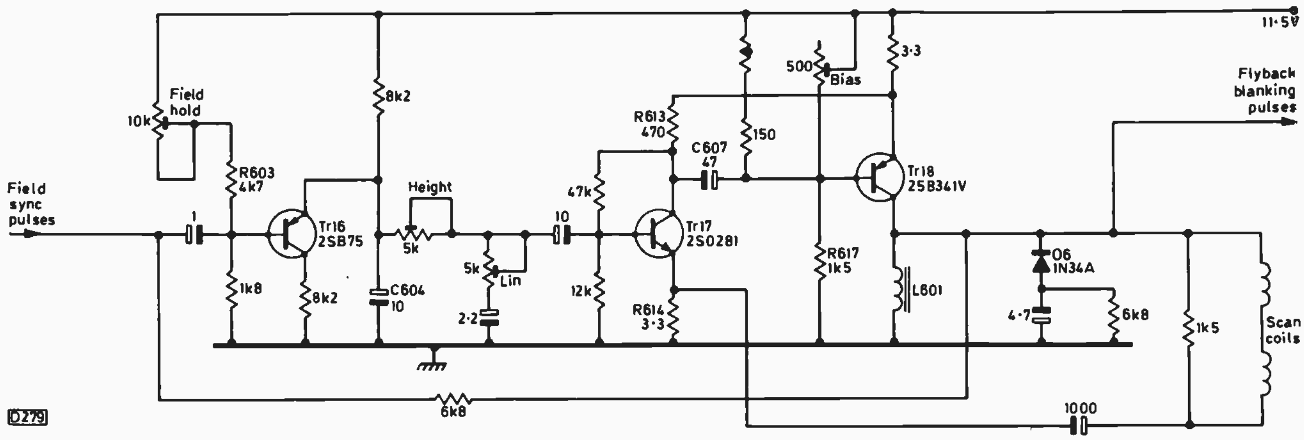


Fig. 2: Field timebase circuit used in early Hitachi monochrome portables. D6 and the associated components limit the field flyback pulse amplitude. Oscillation is sustained by feedback from the output transistor Tr18 to the base of the oscillator transistor Tr16.

169 (see page 540, August issue, for a description of the principle).

ITT Hybrid Colour Chassis

Our main UK line is the ITT range. I recently had a set fitted with the CVC9 chassis giving fairly loud bangs and buzzes from the loudspeaker. To realise that the fault was due to a break in the printed circuit board didn't take long, to find it did! The grid of the audio amplifier triode is returned to chassis via D57 which is on the line output board. It's part of the sound muting during warm-up circuit. The open-circuit was between D57's cathode and chassis.

On a set fitted with the CVC8 chassis the fault was described as "poor frame". On examination this turned out to be something of an understatement. The lower two thirds of the picture were relatively normal: the top third was expanded, with the scanning lines criss-crossing like an expandable wooden fence. It occurred to me that the trouble might be due to an interaction between the line and field circuits, the most likely culprit being the raster correction transductor. This proved to be the case, a replacement restoring normal scan.

ITT CVC20 Chassis

We had one of the newer CVC20 chassis in the other day with the fault no raster. The fusible resistor R100 which damps the line linearity coil had sprung open, though the coil itself was not open-circuit. Instead, there was a hairline fracture in the print leading to the coil. Similar symptoms occur if the EW modulation transformer is leaky (one winding is connected in series with the line scan coils).

If you have the vaguest suspicion that someone has been tampering with one of these sets, check the 125V line. If the voltage is too high, the e.h.t. can flash over dramatically.

Also on this chassis, watch out for field foldover at the bottom of the screen due to C27 (1,000μF), the bootstrap capacitor in the field output stage.

The later versions of this chassis (CVC20/2, CVC30 etc.) are proving to be much more reliable. We had a dead CVC20/2 in the other day however, with no l.e.d.s alight and the 2A fuse F3 open-circuit and completely blackened. It didn't take long to discover that the BU126 chopper transistor was short-circuit. This sometimes happens spontaneously, but on earlier versions it can be due to R80 (150kΩ 1W close tolerance) which biases the base of the chopper driver transistor, especially if it's light brown in colour. Later sets have a resistor that's more red in appearance. These checks proved o.k. however, but on fitting a new BU126 and switching on the only l.e.d. to light up was LED6, proving that the -320V supply was present. The fault was due to the 125V supply rectfier D18, a replacement restoring normal operation.

Problems with Portables

With the summer months we get a lot more portables coming in. Take the Hitachi P32 we came across the other day (in fact it came off a mussel boat) with sound o.k. but no raster. Waveform 10 at the base of the line driver transistor was as shown in the manual, but there was nothing at the collector. A replacement transistor (TR702, 2SA673) restored normal operation. We've had a little trouble on this model with the line driver transformer T702 going open-circuit, and also on occasion C742 (0·01μF) going short-circuit – this short-circuits the base of the line output transistor to chassis.

A similar chassis is used in the Hitachi TW12L, TWU67 and TU75 series. We've had the following faults on these sets. First the electrolytic C502 (1μF) which feeds the base of the sync separator transistor going open-circuit to cause no sync or short-circuit to give no vision or sound. Another cause of no sync has been the sync pulse amplifier/phase splitter transistor TR15's collector load resistor R511 (470Ω) going open-circuit. In the field timebase we've had the coupling electrolytic C607 (47μF) between the field driver and output transistors going short-circuit to remove the bottom half of the picture, and R617 (1·5kΩ) from the base of the field output transistor to chassis going open-circuit to remove the top half of the picture. Little vertical scan, with just a folded picture across the centre of the screen, can be due to either the field charging capacitor C604 (10μF) or R603 (4·7kΩ) from the slider of the field hold control to the base of the field oscillator transistor TR16 going open-circuit. We've traced no field scan at all to the driver transistor's collector and emitter resistors R613 (470Ω) and R614 (3·3Ω) respectively going open-circuit – apart from more obvious things like the oscillator transistor etc. The rather unusual field timebase circuit is shown in Fig. 2. In fairness I must point out that these faults have been collected over a period of several years.

We had a Toshiba portable Model B1201 in recently with the symptoms field roll plus very bad field linearity – severe cramping at the top and elongation at the bottom of the raster. The trouble turned out to be due to the field charging capacitor C308 (22μF, 16V) being open-circuit.

– continued on page 657

Video Notebook

D. K. Matthewson, B.Sc., Ph.D.

Obtaining Preview on the N1502

One of the more popular modifications to the Philips' N1500/1501 series of VCRs was one which enabled a picture to be displayed in the fast forward/rewind positions (see May 1977 *Television,* page 382) so that the operator could get an idea of the whereabouts on the tape of different scenes. The modular construction of the N1502 is rather different from the open p.c.b. layout of its predecessor however, and to obtain the same preview effect a different approach is required. Examining the service manual is not very rewarding, as all the functional units are shown as "black boxes", with none of the internal circuitry shown. The only circuits shown in detail are the standard boards such as the power supply etc.

After some head scratching it was discovered that the stop-motion button could be pressed into service to give the desired effect. This entails linking pins 1 and 2 on SK8. After this has been done, depressing the stop-motion button will result in the VCR displaying the off tape signal: the incoming audio signal is also suppressed.

Improved Auto Stop: N1700

Here's an official modification to the N1700 to improve the operation of the automatic stop. Remove R123 from panel 11 (circuit C in the manual), reduce the value of R135 from 220kΩ to 100kΩ, and add a BAW62 diode in series with a 220kΩ resistor between the junction of R124/C116 and the +11 (40V) supply. The latter assembly should be mounted in an insulating sleeve on the print side of the panel, with the resistor connected between the output from bridge rectifier D103 and the anode of the diode, and the diode's cathode connected to the junction of R124/C116.

Grundig Super Video System

I was interested to see the new Grundig four-hour VCR at the 1978 Audio-Visual exhibition. The new format used is called Super Video (SV), the special cassettes having metal guide rollers and cut-out lugs to tell the VCR that the tape is of the SV type. Novel features of the SV4004 VCR are a ten-day digital clock and a control which alters the crispness of the displayed picture.

G8 Chassis VCR Modification

A Philips colour set fitted with the G8 chassis had been in use as a VCR monitor for a considerable while without any problems occurring, but it was noticed that when the VCR was switched to the still frame position all the colours were washed out with green. In the play position everything was normal, but those green faces on still frame.... Though not important for everyday use, we decided to delve into the G8. After some thought we decided that the problem was due to the signal phase relationships being distorted in the still mode. The following modification solved the problem, giving us nice pink frozen faces. R7190 in the feed from the ident stage to the TBA520Q i.c. was increased in value to 5·6kΩ (from 2·7kΩ), and a 5·6kΩ resistor was added between the junction of R7190 and the capacitor (C7206) in series with it and chassis. The ident coil L7205 was then adjusted for optimum effect.

Philips VCRs: Models and Derivatives

I've received several requests for details on the similarities and differences between the various VCRs that have been produced using the Philips' standards. It seems an appropriate time to clarify the position.

The basic specification of the original Philips system (CCIR-PAL) was as follows:

Tape speed: 14·29cm/sec.
Tape width: 12·5mm.
Video bandwidth: 3MHz colour, 3·2MHz monochrome, −26dB.
Video signal-to-noise ratio: 40dB.
Audio bandwidth: 80Hz−12·5kHz ±4dB.
Audio signal-to-noise ratio: 40dB.
Colour system: Heterodyned.

N1500: This was the designation of the first Philips machine designed to the above specification. It first appeared in the UK in 1973. Suffixes indicate which national TV system the machine is designed for, and this arrangement has been continued with all following VCRs. The suffixes are as follows:

/00 47-88, 174-230 and 470-870MHz, PAL B and G, Europe (not OIRT).
/15 47-88, 174-230, 470-870MHz, PAL I, UK.
/29 470-870MHz, SECAM L, France.
/43 174-254, 470-862MHz, PAL I, S. Africa.
/45 v.h.f. and u.h.f., PAL B and G.
/65 As/15 but 220V instead of 240V.

In addition to the u.h.f. input and output sockets the machine had two DIN sockets, one for audio input/output and the other for supplying separate chrominance, luminance and a 12V d.c. output to connect to certain television sets.

The N1500 was the original off-air, aerial input machine, incorporating a cooker type mechanical time switch. There were several variants, including the following two, most being designed for video inputs/outputs as well as u.h.f. inputs/outputs.

N1500M: An official variant designed to operate with video as well as u.h.f. signals. Depressing channel selector number six changed from off-air to video input. There were separate, buffered sound and vision outputs.

Various dealers and individuals carried out their own modifications to provide similar features, especially as the N1500M was often in short supply. Many of these modifications can cope with only monochrome video input, though a colour video output would be provided from a colour tape. The reason for this is related to the manner in which Philips process the chrominance and luminance signals separately, necessitating a complex arrangement of chokes and inductors.

N1500CM: A version of the N1500M, produced in small numbers, intended as a master machine for use in copying suites.

European equivalents: Various other European firms produced machines to the original Philips standard, including Telefunken and Skantic. The Skantic 5631 was imported in small quantities when other machines were in short supply. The Telefunken and Skantic VCRs had identical chassis to the N1500.

The Grundig BK2000 and BK2500 were imported for a time and were rather more sophisticated than the basic N1500. The de-luxe BK2500 had video input/output facilities. Both sound tracks were used in the two machines, which had mechanical digital clocks of the falling letter-type.

Radio Rentals 8200 and 8201: These machines are based on the N1500 and were produced in quite large numbers. They were intended mainly for schools' use in conjunction with a suitable RR (Thorn) colour receiver such as the 22in. Model 1714. They differ from the N1500 in having a camera input socket but no off-air tuner unit or timer. There are DIN and multipole connectors for the video signals and separate audio input/output sockets. The multipole video connector was intended to couple the VCR to a suitable TV set, carrying the audio signal as well. The differences between the two machines are small but significant. The original 8200 was designed to give and receive video signals with separate chrominance and luminance components. The 8201 operates with a conventional composite 1V peak-to-peak signal. An adaptor was produced to enable the 8200 to be used with a composite signal. Inside, the 8201 is almost pure N1500, though Thorn use paxolin instead of fibreglass PCBs.

To make these VCRs more versatile, Thorn produced an off-air tuner-timer unit which fits on top of the VCR and is connected via a multiway plug. The timer can be battery operated to provide a back-up against mains failure.

N1501: The second Philips VCR was essentially a reboxed and slightly modified version of the N1500. Modifications include the provision of a stop-motion facility, tracking meter indication on playback, and some other minor alterations. Most spares are common to the N1500.

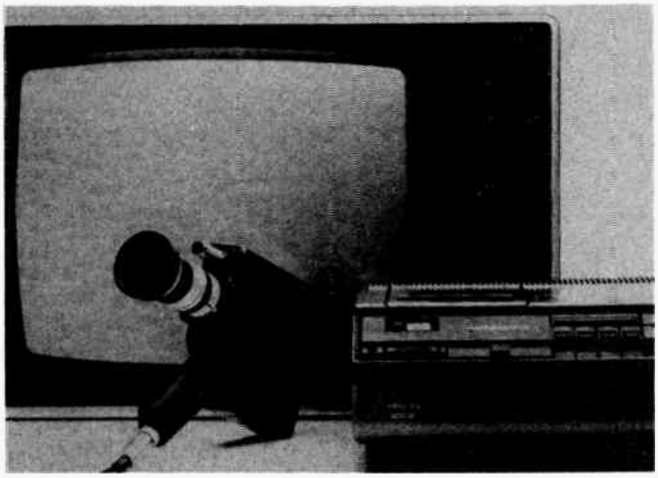
N1501M: The video input/output version of the N1501, similar in many ways to the N1500M.

LDL6269/01: Very similar to the N1501M, with in addition a video crispener circuit. Supplied by Pye Business Communications. Uses a Philips designed colour capable circuit, though of different design to the Austrian produced Philips machines.

N1460: A playback only machine produced by Philips for about six months. Ideal for use in libraries, lecture rooms etc. Many of the boards and mechanical parts are common with the N1501. The standard version had output at u.h.f., though again several dealers modified the machines to give separate sound and video outputs. An interesting feature is the P65 panel which suppresses the white flyback dots sometimes apparent during playback of recordings on some sets (see *Television* May 1977).

N1520: One of two electronic editing VCRs produced by Philips, mechanically very similar to the original N1500. Much of the electronics differ since they have to cope with the pulse counting and servo adjustment for editing. No off-air tuner or timer is provided, but there are video input/output and u.h.f. output facilities. The sound can be fed in or extracted as either a 600Ω balanced line or a high-impedance signal.

There were several official modifications, some quite major. The audio record and playback track selector PCB was replaced for example, to enable one track to be monitored whilst dubbing new sound on to the other: the



The Philips V100/15 monochrome camera.

two PCBs are quite dissimilar! The N1520 is the only VCR in the Philips range to make use of both sound tracks. In view of the complexities of this machine, the cost of the manual and its supplement is well worthwhile.

N1502: Built to the original specification but very different from the N1500 derived machines, both in style and design. Incorporates an off-air tuner, timer, etc. Most of the electronics are contained in modules which plug into a mother board. This main PCB is linked to the other bits of the VCR by means of plugs and sockets. This makes maintenance on a module swapping basis very easy, but even the Philips manual gives no clues about the innards of the modules, which are supposed to be returned to Philips for servicing. This means that true fault-finding is not at all easy. The main PCB remains of discrete component design, as are the three-day digital timer and a few other small PCBs. The standard version has u.h.f. input/output and audio input/output sockets.

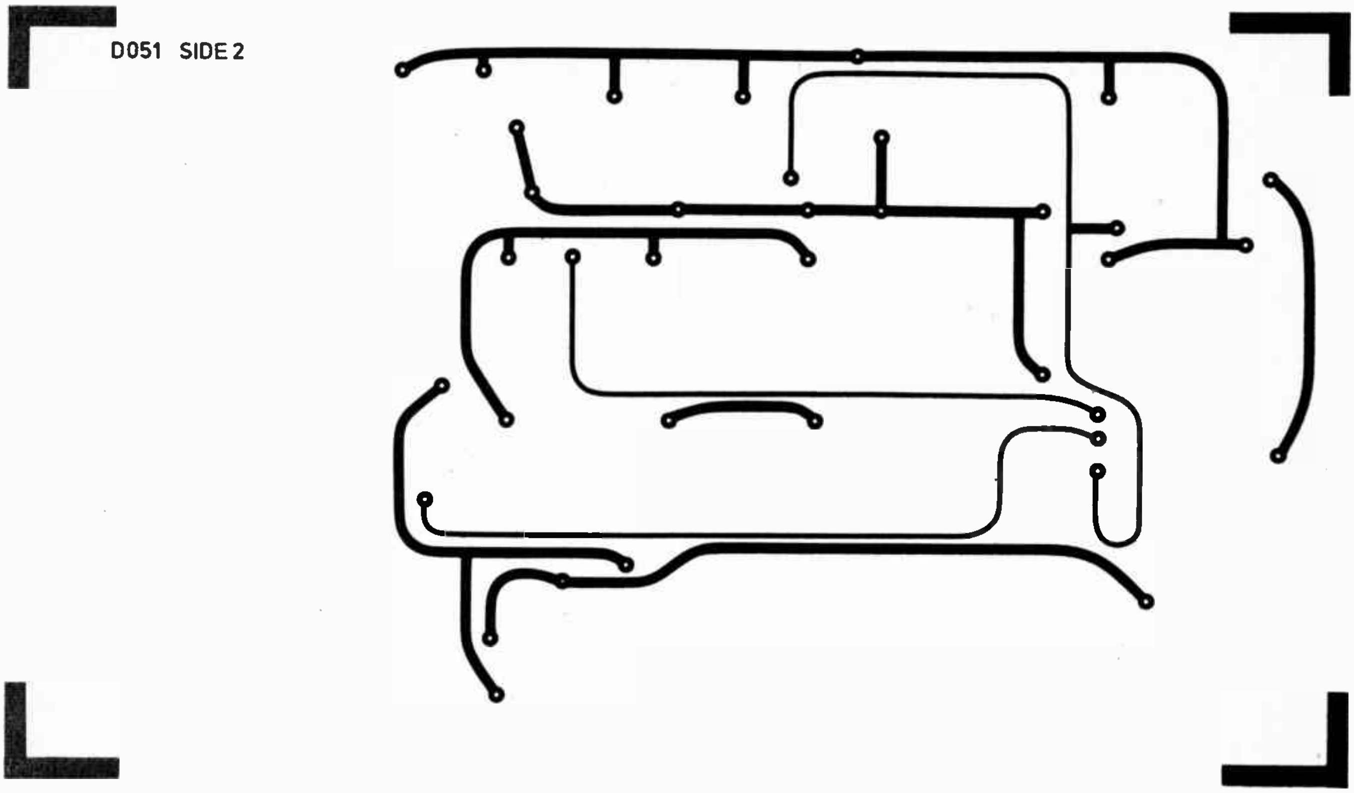
N1512: A video input/output version of the N1502. The difference consists of one plug-in PCB which copes with all the input/output functions. The additional PCB should be available for around £25 for those who want to modify an N1502, but at the time of writing there are no spare boards in the UK. Selection of video input is by selector number eight.

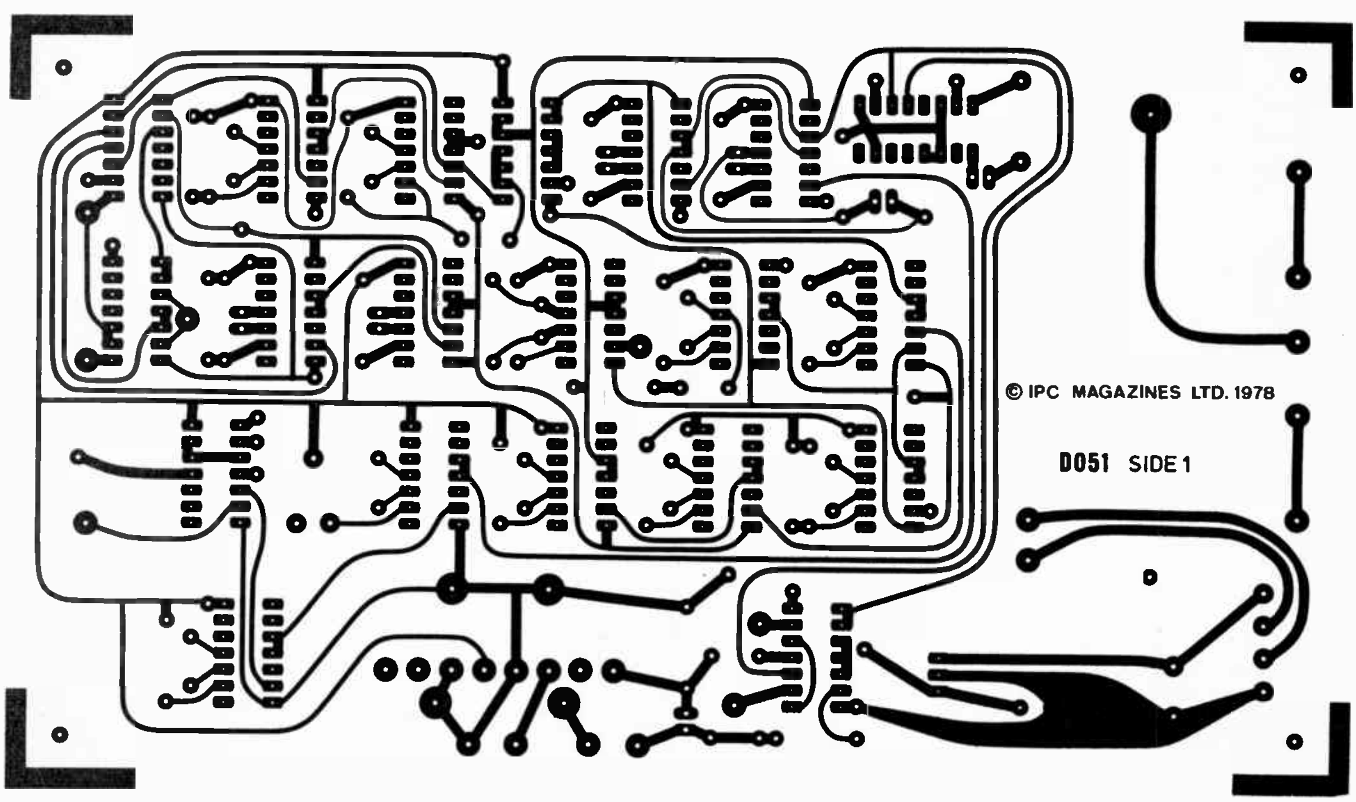
N1700: The latest Philips offering, using the LP (long play) format which gives up to two and a half hours' playing time. Similar externally to the N1502, but quite different internally. Instead of TTL i.c.s, the logic circuits employ CMOS technology. This helps keep the current consumption down. The VCR is an improvement on the N1502 mechanically, the new motors giving a very rapid rewind and wind time. There's no commercial video input/output version, Philips' policy being to keep the N1700 as a domestic only use machine. A perusal of the manual however indicates that video output and monochrome input could be arranged on similar lines to the N1500. For further details, see *Television* April 1978.

LDL1100: A very sophisticated battery-operated portable VCR available from Philips and Grundig. Designed to the original Philips format but intended for high-quality ENG work. Includes full electronic editing, with an auto-edit facility to ensure clean transitions between camera shots. Other features include an electronic tape timer, solenoid-operated tape transport, remote control, etc. Originally intended for operation with the Hitachi/Philips colour camera, but can also be used with the Grundig ENG camera.

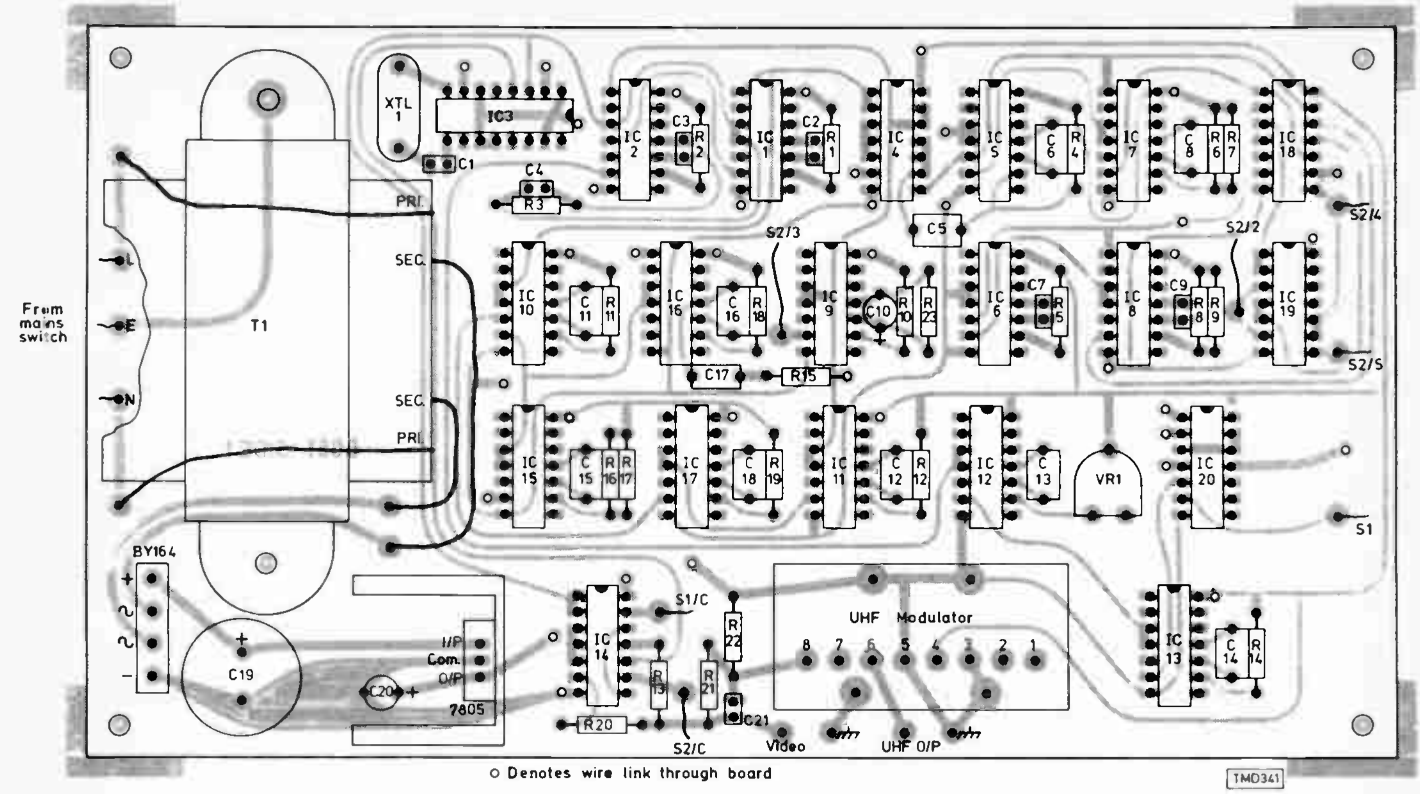
Grundig: Grundig have had a stake in the VCR market for some time, with a large range of machines. Some are similar to the Philips designs but some are unique. The BK3000 and VCR3000 are broadly similar to the N1502 and N1512: the BK4000 and VCR4000 are similar to the N1700 and a video input/output adapted N1700 respectively. The recently announced SVR4004 provides four hours' playing time. The dual-standard VCR5000AV can record and play back both N1500 and N1700 type tapes: playback selection is automatic. See also the earlier comments on the BK2000 and BK2500.

DIAGNOSTIC PATTERN GENERATOR PCB DETAILS





Top and underside print patterns. The actual board size is 8 x 4½ in.



○ Denotes wire link through board

Diagnostic pattern generator PCB component layout.

Notes on the Sanyo CTP370

Hugh Cocks and David Martin

THE phone rang one morning. "Do you mend Japanese TVs?" enquired a voice. "What make?" I asked. "A Sanyo" the voice replied. Relief spread through my mind that it was not a similar sounding Japanese make with four letters. Little did I know what was in store however . . .

Initial Complaint

The set concerned turned out to be a CTP370, which is somewhat unusual in being of hybrid design, with valves in the timebases, audio and video sections and transistors elsewhere. The valves are all familiar types except for the e.h.t. rectifier which is an oriental 3BS2A. The complaint was no sound or picture, and there was an upper expenditure limit as the owner had just bought another set. On removing the back I discovered that the e.h.t. rectifier had been removed by the previous "repairer". This looked ominous to say the least, so I thought it prudent to take the set back to the workshop.

On switching the set on the valve heaters lit up and h.t. was present but there was no l.t. The c.r.t. didn't light up – its heater supply is derived from a secondary winding on the mains autotransformer. This transformer (see Fig. 1) also supplies 120V to the degaussing circuit, with the l.t. supplies being derived from a 71V tap. The h.t. and valve heater supplies are derived from the mains directly – doubtless in countries with 120V mains supplies the transformer is used to step up the voltage for these supplies.

Defective Mains Transformer

To cut the story short, I found that the chassis end of the transformer had been disconnected. Connecting it blew the cutout (no fuses at all in this set!). The last person who had found the transformer defective had left the l.t. rail connected, so that nearly the full mains voltage was applied to the l.t. supply. After removing the chassis to gain access to the power supply components, which are mostly hand-wired on tagstrips on the rear metalwork, I found that the l.t. smoothing resistors had gone open-circuit while the capacitors looked a bit sick. Hooking in a substitute transformer and new resistors and capacitors brought some sound – less picture of course since there was no e.h.t. rectifier.

In view of the expenditure limit I decided to consult the owner – and ended up buying the set for a small sum. Had I known what was to come I'd have asked to be paid to take the set away!

AGC and EHT Variations

Not being very fond of valve e.h.t. rectifiers I decided to instal a Thorn e.h.t. stick rectifier of the type used in the 8000 chassis. The screen then lit up, but I found that the set would overload on even the weakest of signals regardless of the setting of the a.g.c. control on the rear panel, where a multitude of presets live. Prodding this panel would produce proper a.g.c. action – and wild e.h.t. variations. Access to the print side of the panel is poor to say the least, and becoming exasperated with the set when the e.h.t. stick finally succumbed to panel prodding I passed it to David Martin who felt brave and wanted a cheap colour set. In between prodding the rear panel I'd replaced the "burst amplifier-2" transistor Q405 (2SC65Y) in the non-PAL decoder, because of unlocked colour picture V components (there are separate V and U reference oscillators). A BF178 gives a good account of itself in this position. Miraculously this was the only casualty when the l.t. line had experienced the onslaught.

Boost Circuit Short

Before handing over to David Martin to continue the story, some notes on another CTP370 that came my way while preparing the original draft of this article. On switching on, the PY500A boost diode glowed fiercely accompanied by violent arcing on the deflection board which carries the PCL805 field timebase valve, the ECC82 line oscillator/a.f.c. valve and the PCL86 audio valve. The feed from the boost rail to the triode section of the PCL805 comes via the height control VR710 (see Fig. 2) which is mounted on the rear panel: it's then taken via a long length of wire to a large 1MΩ resistor (R322) just below the PCL805. This resistor is very close to the earthing print, and a conductive path had formed between the supply end of the resistor and the earthing print. This short-circuit had lowered the value of R706 (100kΩ) in series with and adjacent to the height control to a few ohms, while R910 near the PY500A had also fallen in value, thus presenting a low-impedance path from the boost rail to chassis.

As the print on the deflection panel at the point of arcing was beyond repair I made a wire junction between C320 and R322 above the board. If R706 is left in position with reduced value incidentally the result is full scan with very weak field sync and field frequency variations with brightness. The height control VR710 appeared to have survived due to having been set at minimum resistance: had it been set midway, doubtless it too would have needed changing.

This set gave me an opportunity to inspect the official e.h.t. rectifier. Suffice it to say that the noise coming out of the X-ray can is reminiscent of dual-standard sets – i.e. arcing and corona discharge. Thank heavens there's no PD500 lurking in the can. Now over to David who takes up the story of the original set.

More EHT Problems

After taking the set over from Hugh I installed two 20kV rectifier sticks in series and set about mending the earthing crack on the rear panel. By this time the line output transformer voiced its disapproval and gave the job up. A new transformer was fitted – and a nasty 33kV was obtained. I switched off quickly and completed repair of the crack – towards the bottom of the board, on the left-hand side looking from the rear. On switching on again there was

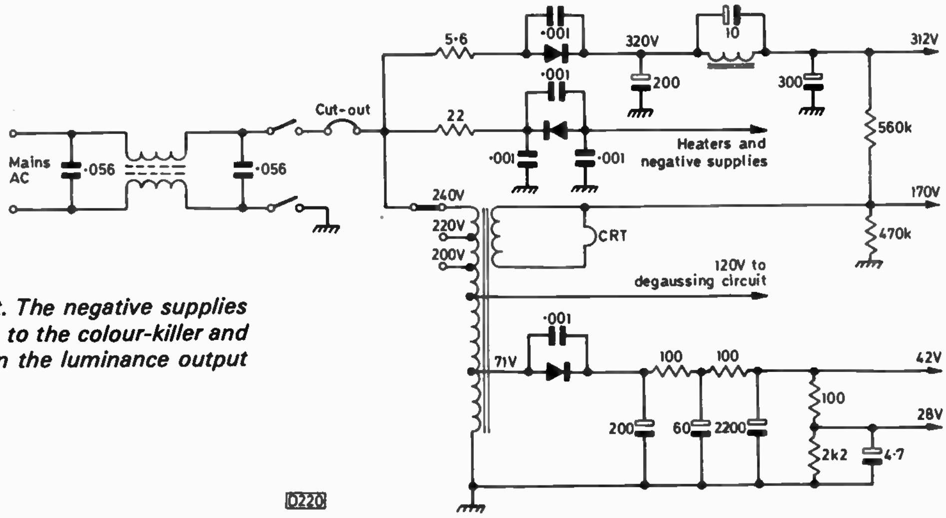


Fig. 1: The basic power supply circuit. The negative supplies consist of a −10V rail and other feeds to the colour-killer and brightness controls. The latter acts on the luminance output pentode's control grid.

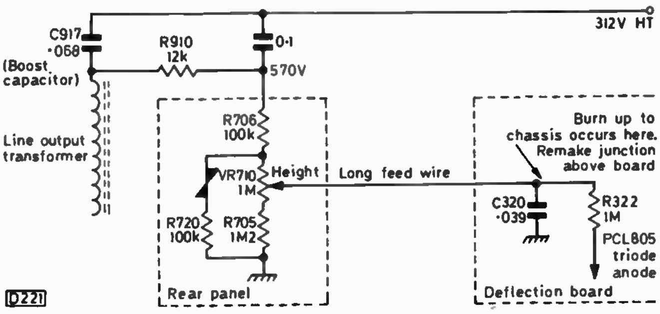


Fig. 2: Simplified circuit showing where the burn-up which shorts the boost rail occurs.

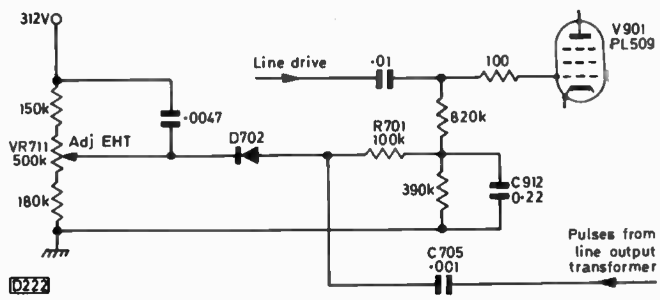


Fig. 3: The width/e.h.t. stabilising circuit. A diode (D702) is used instead of the more common v.d.r. D702 is normally cut off by the positive bias applied to its cathode from the preset VR711. A positive-going line flyback pulse switches it on at the end of each line however. When D702 switches off, a negative charge proportional to the flyback pulse amplitude is left on C705. This is filtered by R701/C912 and is used to bias the control grid of the PL509 line output valve. The same basic system is used for feedback clamp circuits in a.c. coupled RGB channels. VR711 adjusts the point at which D702 conducts during the flyback pulse and thus the e.h.t. obtained from the line output stage.

good a.g.c. action and "nice" e.h.t. O.K. so far then.

Width Circuit Fault

D702 in the width/e.h.t. stabilisation circuit (see Fig. 3) was then found to be short-circuit and was replaced with a BY127. I shudder to think of the X-rays that would have been present with the original e.h.t. rectifier fitted. Moral: when servicing one of these sets, check the e.h.t. and buy a Geiger counter... The e.h.t. rectifier sticks were not very satisfactory, so we fitted another Thorn 8000 rectifier stick which has worked well for several months.

Faulty Presets

I found that the presets on the rear panel were prone to poor wiper contact – many of the gremlins in this set live on this panel. I haven't yet encountered the a.g.c. problem mentioned by Peter Murchison in the August 1977 issue (overloading due to R157 or R158 in the a.g.c. circuit being defective), but C914 (47pF) which feeds the gating pulses from the line output transformer to the anode of the PCL84 (triode section) a.g.c. gate gave problems, resulting in intermittent overloading.

Valve Consumption

After dealing with these various faults and setting up the receiver a good picture was obtained. I've had a lot of valve problems however – doubtless due to the high working temperature inside the small cabinet. Amongst the problems have been brightness drift due to the two PCL84 video amplifiers, horrible colours due to the ECC82 colour-difference output valves, and the usual PCL805 problems. The PCL86 audio valve hasn't given any trouble however. The latest problem is almost continuous demise of the PCL84 (triode section) sync separator. Roughly once a week sync is more or less lost and a replacement valve provides a cure. All the voltages are correct, so for the moment we're putting it down to a dud batch of valves.

Conclusions

The transistor side of the set has for the most part proved reliable. This is just as well, since access to some of the transistors is quite difficult. The chassis is quite easy to remove from the cabinet, and this is often necesssary when a component needs to be replaced. Be careful not to foul the convergence board on the tube neck when withdrawing the chassis.

When working, the set gives a good picture. I've had it in full domestic use for several months, and the set is also a good one for DX use due to the rotary u.h.f. tuner and the colour-killer threshold control on the rear panel. The latter enables weak colour signals to be resolved. The unusual decoder gives quite good colour – if setting up is necessary, the full manual should be obtained. Many people believe that the model is quite old, but this one is stamped September 1974.

One hopes that no other reader will encounter all these faults on one set. The mind boggles at the repair bills had Hugh's original customer decided to keep the set going! ■

Letters

COMMON FAULTS

Following the article on the Thorn 1590/1/3 series of portables (August issue) I thought you might like to include a note on the following common fault in the line output stage. The reported fault is lack of line scan, which I've normally traced to dry-joints on the line output transformer and flyback tuning capacitor C109. On some sets however a burn mark will be seen around the circumference of the winding when the transformer is examined, and in this case it's necessary to replace the transformer, the line output transistor VT26 and resolder C109, also checking that there are no other dry-joints in the area. I've also found on several occasions that the a.g.c. gating diode W1 has failed when this fault has occurred.

Another fault that's showing up with increasing frequency is intermittent loss of field scan on the earlier Pye hybrid colour chassis (691, 693). If the usual items are checked to no avail look for a dry-joint on smoothing panel B – normally at R313 or a wire which carries the 20V (B) supply to the edge connector.

I hope these tips will be of help to other readers. – **M. Brett, T. Eng. (CEI) AFSERT,** *Sidcup, Kent.*

VCR CONVERSIONS

I would like to thank your contributors who wrote about their successful experiments in converting 1500 series VCRs to the long-play standard, and to confirm their findings using an additional tape servo, 1700 series head and reducing the diameter of the capstan and pulley.

To complete the conversion I found that it was possible to modify the clock-timer to extend the switching period. This can be done as follows. Dismantle the front section of the clock mechanism by removing the hands and releasing the four split spring washer clips, also removing the front timing disc. The modification involves carefully elongating the three radial slots in the plastic time setting gear – I used a small Swiss file to do this – extending the cutout on the periphery of the period setting gear wheel, and extending the timing cutout on the front timing disc (see Fig. 1). The amount of elongation was determined using dividers to measure the chordal length of the remainder of each slot after inserting the mating trip plate, with trips against the runout position. – **S. J. Humphrys, C.Eng., M.I.Mech.E.,** *Welwyn, Herts.*

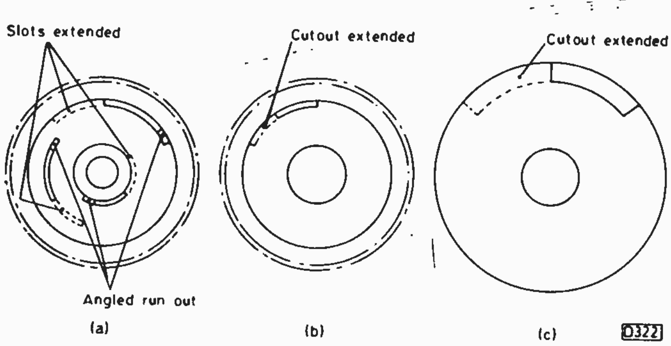


Fig. 1: Modifications to the Philips N1500 series VCR clock-timer to extend the switching period to convert to the N1700 standard. (a) Time setting gear. (b) Period setting gear. (c) Front timing disc plate.

PHILIPS COLOUR RECEIVERS

I'd like to correct an error which occurred in the final instalment (Part 3) of my article on the Philips G8 chassis. This was in the instructions given on page 543 of the August issue for setting up the decoder. In the second paragraph, it's L7007 that should be adjusted for minimum hanover bars on R – Y, not L7003. The third paragraph "L7007, the burst phase detector transformer, is best left undisturbed" should be deleted. I hope this hasn't caused anyone any difficulty.

In the same issue Andy Denham mentions a tricky problem on this chassis, intermittent no sound or raster. I've had this one a few times and the cause has always been a dry-joint, either on one of the 1Ω wirewound resistors in the base circuits of the pair of line output transistors or on one of the four tags carrying the connections from the two secondary windings on the driver transformer to the top panel. It's impossible to provoke the fault once the set is operating normally, presumably because it's due to the line oscillator running from a slightly reduced supply before the line output stage starts up, not enough drive being produced to "bridge that gap".

The weak raster on the Philips G6 chassis *(Your Problems Solved,* page 551) is presumably a case of excessive brightness. A common cause of this is the zener diode (X2154) in the cathode circuit of the PFL200 luminance output pentode going short-circuit. Replace it with a BZX61/C4V7. – **Mike Phelan,** *Holmfirth Yorkshire.*

TRIPLER CONVERSION

While digging through an ever growing pile of faulty old TV sets I came across a Bush TV161 which didn't look too bad. After replacing the dropper resistor and h.t. rectifier the set came to life, so it was left on for an hour or so to see what would happen. On checking, sound o.k., no raster, due to the overwinding on the line output transformer having gone. Before scrapping the set I decided to experiment with an e.h.t. tripler, as outlined in a previous issue of *Television* (see March 1976) in connection with the Decca CTV25 colour receiver.

I removed the overwinding completely, connecting the top cap of the PL504 to the input of a tripler for the 24in. Thorn 1500 chassis. I then fitted a 220pF, 12kV capacitor from the cathode of the PY88 to chassis to adjust the tuning. Being a coward, I next persuaded the wife to switch the set on while I hid . . . Not hearing any strange noises, I came out of hiding and found a good picture with perfect sound. The width was a bit excessive, so the value of the capacitor added was reduced to 180pF. This corrected the width on this particular set.

I'm now trying to fit the tripler in the space vacated by the redundant DY802 e.h.t. rectifier and its base. When completed, this will have been a very good and cheap repair. Perhaps the idea may be of use to other readers as an alternative to buying a new line output transformer for an elderly set. – **P. Naylor,** *Aston, Birmingham 6.*

CONVERGENCE MODIFICATION

Mention was made in the August *Your Problems Solved* of repeated failure of the R/G parabola control R1934 on the convergence board of the Philips G8 chassis. There's an official modification I thought you'd like to know to overcome this problem on earlier convergence boards – by fitting up-rated controls and adding a resistor. The details are as follows: change R1934 to part no. 103-17042 (10Ω) and R1933 to part no. 103-17091 (20Ω), and add a 15Ω resistor (part no. 113-87201) from the junction of R1933/4 to the junction of R1919 and the R/G tilt control L1917, i.e. in parallel with R1934 and R1919. This modification seems to be fairly reliable using the Philips approved parts. – **P. Cole,** *St. Austell, Cornwall.*

HEATER CHAIN ORDER

I read with interest B.C. Alabaster's letter in the August issue on the order of the heater chain. This problem of 50Hz hum was new to me and I've been unable to find any reference to it in the usual textbooks. Anyway, I decided to try out an experiment to see what would happen. I got an old Bush set (Model TV135U) which was displaying a good, clean picture and reversed the order of the heater chain so that the tube heater was first in line and the line output valve last. Once the picture came on, a lovely 50Hz hum bar was found travelling up the picture! Having satisfied myself on that point, I then short-circuited the boost diode's heater and cathode (the boost diode is second in the chain in these sets, after the line output valve). As a result the boost diode glowed brilliantly while all the other valves, except for the line output valve which was now down at the earthy end of the chain, appeared to be near normal. The fuse didn't blow, even after a couple of minutes. What did happen was that the boost diode blew up, it's heater going open-circuit. I can't say that this would be the case on other chassis of course. – **Robin D. Smith,** *Knebworth, Herts.*

SERVICING ACROSS THE CHANNEL

I've been reading with interest the correspondence on TV cowboys in *Televisi n.* The situation here seems to be worse still from the cust ner's point of view. According to the Federal Union of Consumers' magazine *Que Choisir?* you're sure to run the risk of being swindled if you 'phone the first servicing company whose number comes to your attention when your set goes wrong. The magazine explains that servicing companies are interested in doing as much servicing as possible rather than maintaining sets in working order, so jobs are done as quickly as possible with the greatest possible number of parts being involved. The magazine conducted a small test, calling in seven firms to repair a set with an open-circuit fuse. Components in perfect condition were changed, sometimes being replaced by secondhand ones... when the fuse was not simply shorted with wire! Though the cost of the correct fuse was not more than one franc the prices invoiced ranged from 47F to 304·77F, with the total cost of the repair varying between 190F and 414·20F (from about £20 to nearly £50). *Que Choisir?* concludes that it's better to call the setmaker or retailer. – **Thierry Weber,** *Paris, France.*

RECOMMENDATION FOR RECONDITIONING

Keith Cummins may have a couple of Thorn 2000 chassis still giving good results but, as someone who spends most of his time reconditioning colour sets for sale, I'm happier with hybrids. In common with J. Pierce (June letters) I've found that the best chassis for this purpose is the GEC one. I sell both the dual-standard (modified for single-standard operation) and single-standard versions and obtain reasonable periods of operation from both. I've had the dual-standard version working for over a year after reconditioning and then with only minor faults. I'm quite sure I'd rather face a line output stage fault in a hybrid set than one in a solid-state chassis. Valves are obtainable much more cheaply, with nearly all sets using the same type, and one always has that second chance not available with a solid-state line output stage. – **J. Broadhead,** *Leeds, Yorkshire.*

CRT REACTIVATOR

Other readers may be interested in the c.r.t. reactivator design shown in Fig. 2. Before I built this I had been using the one published in the February 1973 issue of *Television.* That one fed the c.r.t. heater from the mains via a 100W bulb, and had just a 15W bulb in the grid-cathode emission circuit. I felt that it was probably limited to monochrome tubes, and had insufficient kick to clear some monochrome tubes. The design shown in Fig. 2 clears both colour and monochrome tubes. It uses a transformer with 6V/2A and 240V/40mA outputs. To get an extra kick for clearing the grid-cathode path, a 15μF capacitor is added across the output. I first tried this after having no luck with a 23in. monochrome tube: it came up like new after adding the capacitor! The connectors are similar to those used for pickup cartridges: they were made from a small piece of tin can by squeezing around a needle the size of a c.r.t. pin, finally covering with tape.

In use, connect the heater leads to each side of the c.r.t. key, then the red lead to the grid and the black lead to the cathode, with SW2 closed. For slow tubes it may be best to start with SW2 open for about ten seconds to allow the 15μF output capacitor to charge. For colour tubes the heater leads are again connected to each side of the key, then each gun is cleared by connecting the red and black leads to pins 2/3, 6/7 and 11/12. Switching the mains on and off several times clears much better. – **G. T. Jones,** *Pwllheli, Gwynedd.*

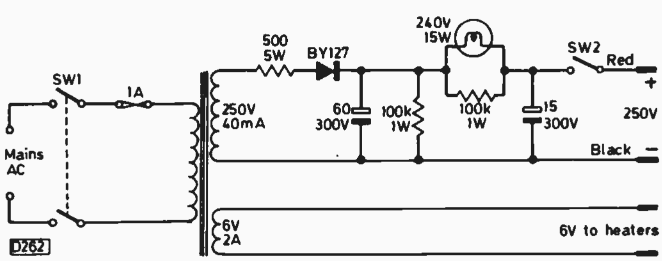


Fig. 2: Colour and monochrome c.r.t. reactivator suggested by G. T. Jones.

TV Servicing: Beginners Start Here . . .

Part 13

S. Simon

As we've seen, the line timebase deflects the c.r.t.'s beam from side to side of the screen while the field timebase deflects the beam downwards so that successive lines fall below each other. As a result, a complete picture is built up on the screen, and due to the speed at which these processes occur and the persistence of human vision the eye sees this complete picture rather than the scanning spot. A vital aspect of television is synchronisation, i.e. ensuring that the television receiver's horizontal and vertical scanning are kept in synchronism with the original signal source, be this a camera or whatever (VCR, TV games unit or pattern generator maybe). Without synchronisation, the display would be a jumble; with weak synchronisation, the result is ragged verticals with unreliable field hold, i.e. a tendency for the picture to roll upwards or downwards.

Synchronisation is effected by adding sync pulses to the video signal at the signal source, i.e. studio, outside broadcast unit, etc. The line sync pulse occurs at the end of each line, to start the c.r.t. beam flying back to the left-hand side of the screen before the beginning of the next line. Likewise field sync is effected at the end of each field, to get the beam to return from the bottom to the top of the screen. This is a longer period than the line flyback time, the field scanning being relatively slow (at 50Hz while, with 625 lines, the line frequency is 15,625Hz). During the time allotted for the field flyback, a group of pulses is transmitted: these are integrated to give a single, large pulse which is used to lock the field oscillator.

Since the beam has to return to the left-hand side of the screen at the end of each line, and from the bottom to the top of the screen at the end of each field, these processes taking a certain finite time, there's plenty of time available for the necessary synchronising pulses (it's the leading edge of the pulses that initiates the actual flyback). We can set arbitrary points for the black and white levels of our video waveform – provided we keep to them. As Fig. 1(a) shows, with a standard 1V video signal 0·7V is taken as the extreme from black to white. This leaves us with 0·3V which is "blacker than black" and can be used for the sync pulses. We want the screen to be blanked out anyway while the line and field flyback are occurring, so this is a convenient arrangement.

The waveform in Fig. 1(a) is a typical line waveform. The signal rests at black level for a short period before and after the actual sync pulse – the front and back porch respectively. Otherwise the signal might have to drop from peak white to zero and back again instantaneously, which is impossible. The relatively long back porch gives us a convenient point at which to add a colour sync signal, but we must leave that aside until we come to colour later.

Field synchronisation is a more complex business since with 625 lines each complete picture consists of two interleaved fields of 312½ lines each. Interleaving, or interlacing as it's called, is used to reduce picture flicker and save bandwidth, but we don't need to go into the theory of that. From the practical aspect those half lines mean that successive fields begin and end at different points along a line. This results in a rather complex field sync signal, while if precise field sync is not maintained the complementary fields will not interleave exactly and the spacing between lines will alter, giving loss of vertical definition.

The video signal is generally used to drive the cathode of the c.r.t. It must be negative-going for peak white therefore, i.e. inverted as shown in Fig. 1(b). This is equivalent to driving the grid positively. Now suppose that we apply the signal shown in Fig. 1(b) to a stage which is so biased that it does not conduct until the input signal rises above 70% of its maximum amplitude. It will pass the sync signals only of course. This is the simple principle of the sync separator. Ah, you might say, but how do we distinguish between the line and field sync pulses? This is again a simple matter. Since the line pulse frequency is much higher than the field pulse frequency, simple time-conscious filter networks can be used to separate the pulses and send them on their separate ways to synchronise the line and field timebases.

Flywheel Line Sync

We're rather fortunate in the UK in that TV reception conditions are generally good. This is reflected in the comparative simplicity of the sync separator circuits used. Many imported sets use quite elaborate sync separator circuits in order to guard against the effects of noise and so on. But even in the UK the line sync pulses are not used directly to synchronise the line timebase. Instead, they are fed to a circuit which compares their timing with that of the flyback pulses produced by the line output stage. Any disparity results in a control voltage which is used to adjust the line oscillator frequency. This system is called flywheel line sync, and was mentioned in some detail in an earlier instalment.

Sync Separator Circuits

First however the sync pulses have to be separated from the rest of the video signal. It's essential that the sync separator does not pass any picture information – otherwise the picture information will also be present at the output of the sync separator and will confuse the timebases. The biasing of the sync separator is quite an important point therefore in maintaining good sync performance.

Let's start with valve sync separator circuits. We've already made the point that a valve can be biased towards cut-off by applying a positive voltage to its cathode – positive with respect to the control grid voltage that is – or alternatively by doing things the other way round, i.e. applying a negative voltage to its control grid, with the

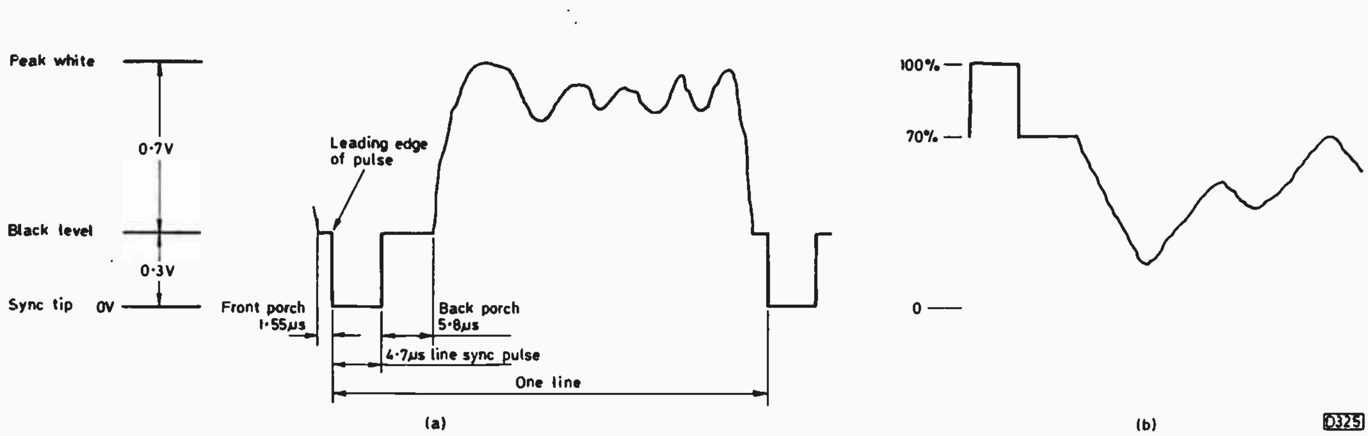


Fig. 1: (a) Position of the line sync pulse in the video waveform. (b) Positive-going sync pulses are applied to the sync separator and to the c.r.t. cathode (with cathode c.r.t. drive).

cathode taken directly to chassis say. In considering valve audio circuits last month we saw how the control grid can be negatively biased by applying the signal via a capacitor and using a high-value resistor between the control grid and chassis. The high-value resistor ensures that the plate of the capacitor connected to the valve's control grid retains an average negative charge, thus providing the required bias. This is the approach used with valve sync separator stages. A typical example is shown in Fig. 2, where it will be seen that the charge developed by the coupling capacitor C70 is −26V.

Consider again the waveform shown in Fig. 1(b). The valve is biased off until the input rises above 70%, signifying that there is a sync pulse present. Note however that once the waveform rises above 70% it moves rapidly to 100% and stays there until the end of the pulse. This means that the valve is being switched into heavy conduction for brief periods. When a valve conducts heavily current will flow in the control grid circuit, i.e. the control grid and cathode will act as a rectifier diode, and in consequence the grid coupling capacitor will receive a negative charge. This is exactly what we want: we use a high-value resistor in the grid circuit so that this charge remains, holding the valve cut off between sync pulses.

Since the negative charge acquired by the capacitor is proportional to signal strength, we also have a simple measure of the signal strength. The voltage can be used therefore to provide the a.g.c. action.

We can use the same biasing technique to operate a transistor as a sync separator. A.G.C. doesn't come in here however. With the 625-line system the sync pulse tip represents maximum signal modulation (it represents zero modulation with the 405-line system). Thus on 625 lines a simple peak detector can be used to measure the sync pulse amplitude for a.g.c. purposes. The use of the 625-line system and transistors as sync separators started at much the same time, making it unnecessary to complicate

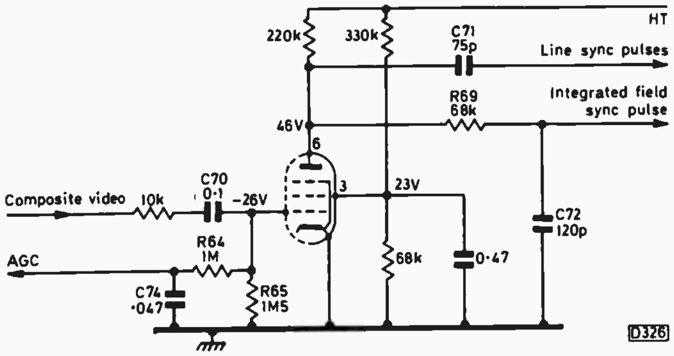


Fig. 2: A typical valve sync separator circuit – from the ITT/STC series of monochrome dual-standard chassis.

transistor sync separator circuits by linking them to the a.g.c. system.

As we've said, time-conscious filters are used to separate the field and line sync pulses. The series of field sync pulses usually charge a capacitor through a resistor (integration). The components involved in Fig. 2 are R69 and C72. The important things here are that the correct component values are chosen and that the components keep to their original value. There are occasions when they don't and the signals get mixed up. This is usually due to a capacitor failing to do its job.

Recognising Sync Faults

It's easy to confuse timebase faults with sync trouble, and whilst it's a simple matter to trace the sync signal from the video amplifier through to the output of the sync separator etc. with an oscilloscope we have to assume that the reader does not have this advantage. Some practical tips can be of more value therefore than nice pictures of waveforms, however useful these are to those who have more elaborate equipment. Those possessing such items, plus the knowledge to use them (correctly), will hardly be reading these articles anyway.

Poor Sync

There are one or two points to remember before we start. Most line timebases work in conjunction with a flywheel sync circuit which tends to keep the line steady even when the sync signals are weak. Therefore weak sync will most often be seen by the inability to lock the field timebase firmly. By this we mean that the picture tends to roll up or down, with no positive lock. The ideal is to use the field (frame) hold control so that the picture starts to roll downward, then adjust it so that the picture rolls up and almost "clicks" into lock, with a degree of further rotation of the control having no effect. With this happy state of affairs established, the control should be returned to the setting where it just caused the picture to roll up and lock, this being the point where the timebase is being triggered at the most sensitive part of the oscillator's cycle (slightly slow).

An interlace diode is often included in the sync feed to the field oscillator, and this can give rise to weak field hold, the sync separator itself being perfectly in order. It's helpful therefore to note the effect of the line hold control before jumping to conclusions. The writer is and always has been an expert at jumping to conclusions. Many hours have been wasted in the pursuit of this sport, when careful observation and checking could have wrapped the job up in no time.

The average type of line oscillator circuit is quite tolerant of the line hold control setting. Adjusting this control should result in the picture moving sideways before hold is completely lost. Weak sync will result in a more critical setting, thus giving an indication that the reason for the poor field lock is in the sync stage or perhaps before this (in the video stage or a.g.c. circuit in some cases). It will have been noted that the sync pulses are at one extreme of the signal waveform (in the "blacker than black" part). Thus if the video amplifier is not biased to operate at the mean centre of its characteristic curve, the sync pulses could be considerably impaired or crushed. The same effect occurs if the input to the video stage is excessive, and can also occur in the i.f. strip if the a.g.c. bias is incorrect. Thus it's prudent to reduce the setting of the contrast control to see if this improves the sync performance.

A quick check on the video output stage voltages and those of the sync separator can be very revealing if one knows the approximate readings to expect. For example, to return to our Thorn 1500 chassis for a moment, poor sync is nearly always the result of R44 increasing in value (47kΩ to pin 7 of the 30FL2, see Fig. 3): a voltage check here will show whether or not this is so. If the reading is much below 60V, suspicion should fall on the resistor. The sync will hold when the voltage starts to fall below 60V as the resistor goes higher in value, implying that 47kΩ is not a critical value. Once the resistor's value starts to rise however it will certainly not stop (or obligingly fall), and the resistor should be changed for one of higher wattage as a matter of routine.

If all is well at this point one should check over the video stage generally. The electrolytic capacitor C38 should not be above suspicion, as when this dries up and no longer functions a further 8·2kΩ resistor enters the signal circuit in the shape of R126 and the designed operating conditions are drastically changed. Likewise C37 can leak, thus altering the video transistor's base voltage (strictly speaking base current) and pushing the sync pulse response "into the red" as it were.

Thus there are many factors to take into consideration, and each chassis (or series of models) has its own habits or traits which when enough have been serviced enable the repairer to pounce quickly upon the most likely component. What's sauce for one model is not necessarily sauce for another. Only experience provides the quick remedy, or a close study of the experiences of others if this valuable knowledge is available.

The alternative is a good working knowledge of the factors involved and a methodical approach whatever the basic design. We offer below some practical examples of our own experience over the last few years.

Faults in Valve Circuits

Whilst the valve in a valve sync separator circuit may well be at fault, resistors are the primary cause of poor sync performance. We've already mentioned the 1500 chassis. A similar case occurs with the GEC Series One chassis. Here a PFL200 valve performs the functions of video amplifier and sync separator. Although the valve may well be responsible for weak sync, in the majority of cases R141 (again 47kΩ) in the screen grid circuit will be found high.

In an earlier series of models (many still in use), namely the ITT/KB VC1 to VC52 chassis, a PCF80 valve was used with the pentode section as the sync separator (see Fig. 2). Whilst this valve can give trouble, again the resistors are more likely to be responsible, the likely ones having values of 330kΩ and 220kΩ (the screen grid and anode resistors). Both tend to go high in value. They can easily be

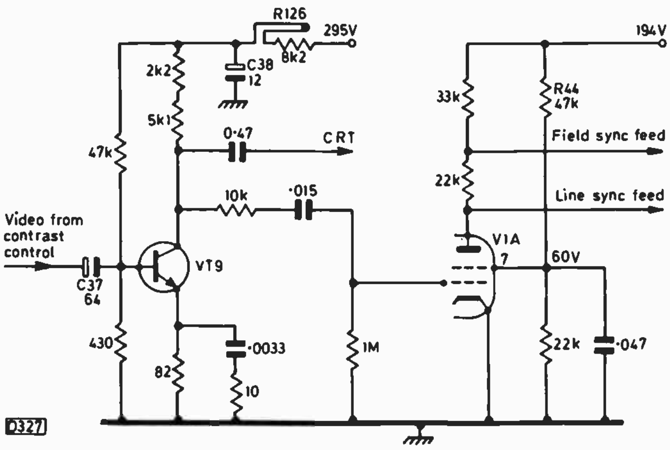


Fig. 3: The video output and sync separator circuits used in the Thorn 1500 chassis.

found by tracing the leads back from valve pins 3 and 6 to the tag panel. 330kΩ (orange, orange, yellow), 220kΩ (red, red, yellow).

In some chassis the sync circuit itself is rarely at fault. In the Bush TV161 series of receivers for example the cause of poor sync is more likely to be found in the a.g.c. circuit, where the setting of the contrast control is quite critical. This is also the case with some Philips receivers. As far as the Bush series is concerned however a likely culprit is indeed in the sync stage and is C48 (8μF) – especially if this is a white component! We have referred to this item in a previous article (capacitors and their habits) so there is no point in labouring the point here. Suffice it to say that the capacitor is below the PFL200 valve.

Transistor Sync Separators

Transistor sync separator circuits can be complicated, but not necessarily so. In the popular Pye dual-standard and single-standard colour sets (Dynatron, Ekco, Invicta etc.) for example there's a fairly simple and easy to check stage (VT7, see Fig. 4). The transistor is a BC147 which can be checked in moments with an ohmmeter switched to the low ohms range (remember the drill, check an npn transistor with the black probe to the base, low reading of about 30Ω with the red probe to the collector or emitter, high reading with any other connection). In fact the transistor will usually be found to be in order, the main suspect being the 4·7MΩ resistor R33 which "turns on" the base current. The diode D3 is easy to check with the black probe to the emitter of VT7 and the red probe to chassis to produce some sort of deflection on the low ohms range, but not with the probes the other way round.

In most other receivers with transistor sync circuits if the trouble is known to be in the sync separator stage(s) the transistors are the main suspect(s), but the associated resistors and capacitors may need to be separately checked. In some Philips colour sets of Swedish origin for example a multi-transistor circuit which it is not easy to follow is used. The collector of one of the transistors is fed from the h.t. line via two resistors in series, and our experience here is that these resistors are the items likely to give trouble. So,

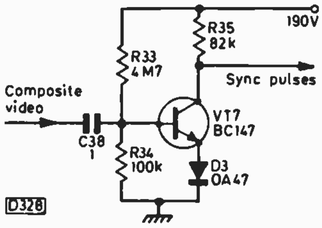


Fig. 4: The simple transistor sync separator circuit used in the Pye hybrid colour chassis.

coupling this up with what has been related before we can expound Simon's Second Law: if there are small sized resistors connected between the h.t. line and a fairly low voltage point, check them.

Misleading Symptoms

Quite often the symptoms presented on the screen suggest that there's a fault in the sync or even the video stage when the fault is not in these circuits at all. There are usually clues however which the more experienced (or clued up) will observe – but this series is not intended for them anyway.

A common condition is where the picture cannot be locked horizontally, i.e. it will bend or drift one way or the other but will not lock. The line hold control may or may not affect the condition, depending on the circuit. If the field (vertical) lock is solid the fault is unlikely to be in the sync separator circuit.

If a PCF802 valve is used in the line oscillator circuit, this must be the first suspect. If replacing the valve fails to improve matters the trouble is probably in the flywheel sync circuit, which we've already described (see Part 5 and the letter in the April issue). One tends to think in terms of the original sync pulses being lost on route to the flywheel sync circuit (this could be the case) but all too often, and it's most important to remember this, the feedback pulse from the line output stage has gone astray instead. The feedback path normally consists of a capacitor and a resistor in series between a winding on the line output transformer and "one side" of the discriminator diodes. In the 1500 chassis the resistor is R51 (220kΩ) and the capacitor C45 (0·001μF) – see Fig. 1, page 190, February. While these components don't give much trouble in the 1500 chassis, in some other chassis the resistor is very often at fault. This seems to be because the pulse is derived from a high-energy point in the line output stage. The capacitor usually puts up with this sort of stress but the resistor (usually carbon) deteriorates. If it increases in value to become well nigh open-circuit the result is that the picture falls about horizontally or is just a mass of lines. All too often however the resistor is not so obliging in its manner of deteriorating.

In the Pye group hybrid colour chassis for example the resistor has an original value of 47kΩ but in the process of deteriorating it falls to a very low value (discolouring in the process). The high energy is then transferred to the discriminator diodes, which are totally unable to cope and thus also end up on the funeral pyre. So the lesson here is to suspect the PCF802 but first check on the condition of R203. If it's discoloured, change it and check the diodes D40 and D41 if the line hold is lost. If R203 is not discoloured check R210 which is in series with the line hold control and also tends to change value.

The little Indesit portable Model T12 also tends to have line sync troubles. Here the reference pulse feedback resistors are R913 and R915 (Model T12LGB, see Fig. 5). These and the 2·2MΩ resistors R412-R413 on either side of the discriminator balance preset R414 are suspect if TR404 etc. read right.

Use of Integrated Circuits

Many receivers don't use discrete components in the video processing and sync stages. Chips are used instead and these are the main suspect if the sync is poor or is lost.

A commonly used video/sync i.c. is the TBA550, and this often has to be replaced before sync can be restored. Since this chip performs several functions however it can give rise to many and varied symptoms. Loss of sync is only one of them. Others include a picture with a "washed out" appearance (poor video response), tending to lead the uninitiated to think that the tube has lost emission.

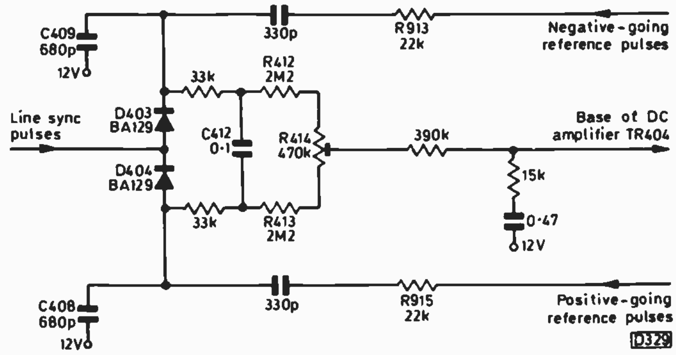


Fig. 5: The flywheel line sync discriminator circuit used in the Indesit T12LGB monochrome portable. A similar circuit is used in the ITT CVC5-CVC9 series of colour chassis. This is an example of a circuit in which both positive- and negative-going flyback pulses are fed back to the discriminator from the line output stage. This particular circuit has a wider than normal locking range due to the action of C412 which is connected between the voltage summing points that determine the output fed to TR404. The designer uses the 12V rail as a signal "earth" in this area.

On some occasions (certainly not all) some local heating and rapid cooling can help to identify the faulty item. To this end a small hairdrier with a narrow nozzle is often an immense help, along with one of the several freezing aerosols available.

Before condemning an integrated circuit verify the voltages at the various pins.

Where these are absent or low, check any associated electrolytic capacitor for leakage.

Long-Distance Television

Roger Bunney

JULY was an active month, with both Sporadic E and F2/TE reception abounding. High-pressure systems gave improved tropospheric conditions during part of the month, though there was nothing very spectacular. An extremely large sunspot group at the centre of the Sun produced a giant flare and radio blackout on the 14th, but there have been no reports of Aurora or other associated phenomena unfortunately. Most strange!

Month's Log

My own log shows that the month was an active one, but the only important event was reception of Rhodesia ch. E2 on July the 8th at 1800. There was a good Sp.E opening that day, and it was interesting to see DR (Denmark) ch. E3 over a short skip distance carrying the PM5544 test pattern (at 1842). There were Sp.E openings here at Romsey on the following days:

1/7/78 ORF (Austria); TVP (Poland); RTVE (Spain); also unidentified signals.
2/7/78 Mostly unidentified programmes from Eastern Europe.
3/7/78 TSS (USSR); SR (Sweden).
5/7/78 DFF (East Germany); RTVE.
8/7/78 RAI (Italy); TVP; DR; JRT (Yugoslavia); RTVE. Also Rhodesia via TE.
9/7/78 Unidentified programmes.
10/7/78 TSS; JRT; RAI; CST (Czechoslovakia); Switzerland.
11/7/78 TSS (up to ch. R4); TVP; DR; DFF; WG (West Germany); JRT; RAI.
12/7/78 RTVE; very weak unidentified ch. E2 signals from the south at 1852.
14/7/78 Improved trops – several Band III French 625-line signals (PM5544 test pattern) carrying the Paris studio identification "BUTTES CH".
15/7/78 RTVE; RAI; SR; TSS; MTV (Hungary).
16/7/78 SR; NRK (Norway).
17/7/78 TSS; NRK.
18/7/78 RTVE; unidentified programmes from Eastern Europe.
20/7/78 Unidentified programmes from E. Europe; CST ch. R1 noted with EZO test pattern and the identification "PRG-1" (Prague 1 or Programme 1?).
25/7/78 TSS; TVP; NRK; SR.
26/7/78 RTVE; RTP (Portugal).

Readers' Reports

On June 28th Clive Athowe (Norwich) received Gwelo ch. E2 between 1650-1715, with a lady announcer and a clear identification slide (this was also seen by Hugh Cocks in S. Devon) with signals at "fair strength". July 1st brought John Lees (Cirencester) a mystery signal on ch. E2 – from 1930 onwards – a very blurred southerly signal showing African people in a news programme with an obvious military content: at 2012 the sound channel broke through – in French! Any ideas? The only possible southerly countries that use French and system B transmissions are Chad and the Central African Republic. If any readers can help please do so. This isn't the first time that French ch. E2 sound has been received.

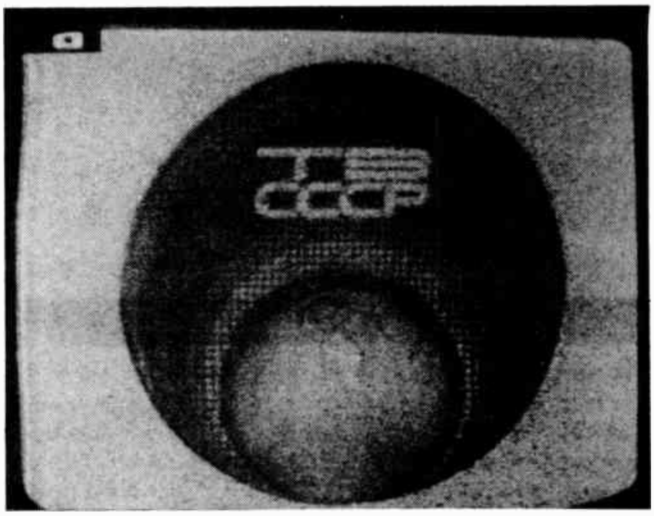
Mike Allmark (Leeds) reports a good Aurora on the 4th, giving all the BBC-1 Band 1 Scottish stations plus NRK ch. E4 at good strengths, also Sandale ch. B6 and NRK Stoord ch. E5. Kevin Jackson (Leeds) received RAI ch. ID (E5) via Sp.E on the same day.

The 7th produced Amman, Jordan ch. E3 via multiple-hop Sp.E in Devon at 1900, with single-hop JRT. A few minutes earlier CLT (Lebanon) ch. E4 was received. It's interesting to note Hugh's comment about a characteristic rumble on the Amman signal – broad thick bars on vision. Gwelo ch. E2 appeared again "very ghostly" the same day, with an accompaniment of Arabic harmonics throughout Band I.

Clive Athowe reports Gwelo ch. E2 again on the 8th, between 1754-1830 via F2/TE, with the usual spiral crest identification slide – a very strong signal this time!

Following an improvement in southerly trops on the 9th the scene changed, with the Canary Islands ch. E3 on the 10th, a clear "RTVE IZANA CANAL 3" being seen by several observers at 1300 and again at 1720. With the propagation path open to the south Gwelo, Rhodesia strangely didn't appear but NTV (Nigeria) Sokoto ch. E3 did! – at fair strength, using the globe slide as shown before in these pages. Only David Martin (Shaftesbury) noted this slide, but Hugh logged programmes a little later. Back to Clive Athowe who logged Gwelo on the 9th, RAI ch. D on the 10th and signs of F2 reception at 1800-1900 on the 11th with in addition local Italian f.m. stations at 103MHz as late as 2230.

After a four day pause Clive wrote again on 15th to



TSS (USSR) news caption received by Steve Birkhill (Sheffield) at 4GHz from the Statsionar-2 satellite.

report a ch. E2 signal with coloured gentleman (white hair and glasses) – a very strong signal at 1845, suspected to be Nigeria. Gwelo was received again at Norwich on the 17th (1827-1831) and 18th (1839-1855), this time with a second co-channel signal! Both Hugh and Clive received Rhodesia on the 21st between 1630-1830, with English language sound and commercials. RTVE ch. E2 fought with the signal and eventually swamped it at 1830.

At a tangent, we have received a number of reports of test patterns, colour bars etc. being seen during the evenings at times when programmes are normally on the air. These ch. E3, 4 signals are most likely to have originated from the now numerous transmitters being operated in Italy under the "free station" umbrella.

This long list indicates improving conditions.

News Items

Holland: A report from Brian Fitch suggests that the ch. E4 (and u.h.f.) transmitters at present sited at Lopik will be moved to central Holland, due mainly to four new 500kW short-wave transmitters being constructed.

Eire: RTE is manufacturing special u.h.f. filters to enable viewers to continue to view the relatively weak UK u.h.f. signals alongside the new high-powered RTE-2 transmitters as and when they come into service. We are hoping to include further information on these low-loss filters shortly.

WARC 1979: At the World Administrative Radio Conference in 1979, which will deal with the revision and allocation of radio frequencies, the EBU will ask for an increase in the spectrum avilable for broadcasting. The 26MHz band, at present an international short-wave broadcasting band, is to be suggested as a potential satellite broadcasting band. Of greater importance however is the demand for retention of Band I 47-68MHz and Band III 174-223MHz (with a 7MHz extention). An extention of Band II (currently f.m. radio) to 108MHz is suggested. The conference will be held at Geneva.

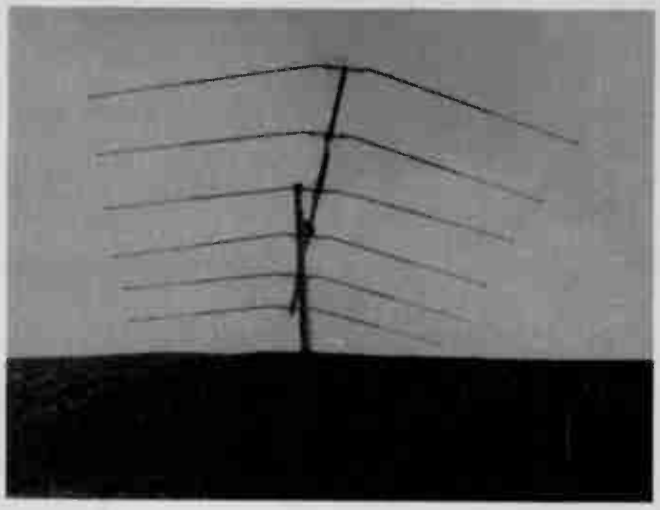
Satellites: The Japanese BSE satellite is now in operation. The 12GHz television tests involve two colour channels.

Publications

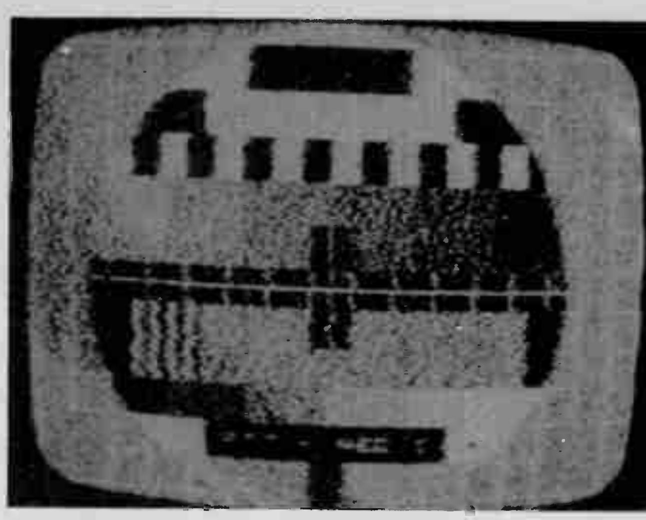
Two new books published by the IBA are strongly recommended. *A Broadcasting Engineer's Vade Mecum* is an invaluable compendium of reference information ranging from basic measurements through decibels, light, propagation, channel allocations, TV systems in various countries to aerial and noise measurements and much more. Even more exciting is *Satellites for Broadcasting*. This is a must for all enthusiasts and includes many articles on both transmitting and receiving systems and associated information. The article on "Low-Cost Satellite Receiving Techniques" by Pat Hawker is particularly worthy of close study. Copies of these publications can be obtained at £1.50 each from the Chief Accountant, IBA, Crawley Court, Winchester, Hants SO21 2QA (make crossed cheques/POs payable to the Independent Broadcasting Authority).

From Our Correspondents . . .

Whilst watching Southern ITV on June 19th Francis Jimenez (St. Mary's College, Twickenham) noticed an announcement that the u.h.f. service was suffering from tropospheric interference. On tuning to the v.h.f. Band I spectrum Francis was able to watch the Norwegian weather forecast followed by the Icelandic test card "RUV

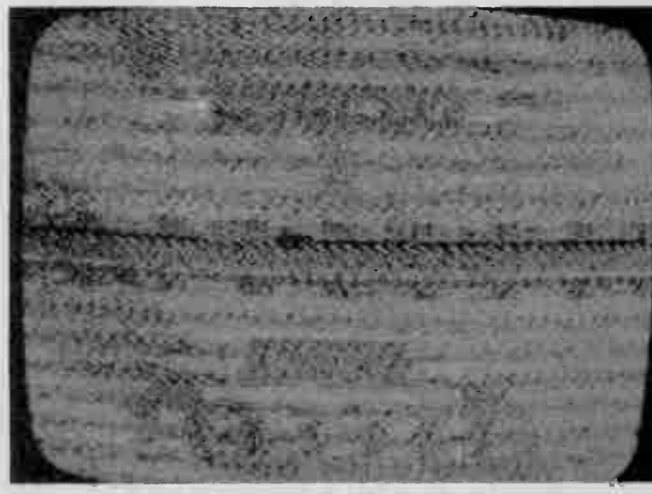


Chris Wilson's ch. E3-4 log-periodic array. Note the angled elements to reduce the beamwidth and increase the gain.



Lopik (Holland) ch. E4 picked up via Chris Wilson's log-periodic aerial with the aerial on beam.

Much reduced signal pick-up from Lopik (ch. E4) with Chris Wilson's log-periodic 30° off-beam.



Lopik ch. E4 with the aerial 45° off-beam: with increasing off-beam rotation the signal disappears into the noise.

ISLAND" on ch. E4. He later noted Budapest and Yugoslavia (test card with identification "JRT BGRG1").

Frank Lumen and his friend Don have been conducting Sporadic E reception experiments. On June 19th Don received CST ch. R2 whilst Frank was receiving JRT ch. E4. On comparing notes it was found that neither could receive the other's signal despite being only five miles apart! John Cowan at Ayr, some 30 miles distant, received Italian and Yugoslav signals on the 1st and 2nd respectively, but neither of these two signals were seen at Frank's or Don's (Glasgow) locations despite the same channel being tuned in. This selective reception has been noted before: any suggestions from readers as to why?

Kevin Jackson (Leeds) has been in touch with the RSGB Propagation Study Committee following his reception of certain Scandinavian signals via Aurora. The committee is anxious to obtain information on signal reflection for a close study of auroral ionisation drift. To this end if any enthusiast receives an Auroral signal from a *definite* transmitter the RSGB would appreciate a note on the reception. Information needed is of the station/country, time, duration of signal and if possible the aerial beam heading. Send observations to the I.A.R.U. Auroral Co-ordinator, RSGB Propagation Committee, Mr. C. Newton, 61 Merriman Road, Blackheath, London SE3 8SB. If there is any query enclose an SAE but important questions only please.

Robert Copeman's friend in Dunedin, NZ, quite unintentionally received CBN-8 TV Orange NSW, Australia on her TV ch. 6 position (this corresponds to the Australian ch. 8), indicating more Band III Sp.E. You may recall that Robert Copeman received Samoa ch. A2 (KVZK-TV 2) on Christmas Day 1976!

Log-periodic Aerial Design

Chris Wilson has constructed a Band I log-periodic array with certain modifications that depart from convention. The elements are bent forwards to increase the forward gain (by restricting the forward beamwidth and side lobe radiation). His design (see Fig. 1) is for chs. E3-4 inclusive, but a seventh element can be included to improve ch. E2/R1 performance. The photos show the performance on a ch. E4 Lopik signal.

Infra-red Link

A development of increasing importance in broadcasting is ENG, electronic news gathering, which was the subject of an article in the August 1976 issue of *Television*. Numerous US TV companies now use this technique which has only recently come to be accepted by UK broadcasters. Basically, ENG is the use of a small TV camera instead of a film camera for news coverage, the camera's output being recorded on to videotape or transmitted back to base via a microwave link (in the 13GHz band). The advantage of course is speed, since film has to be developed.

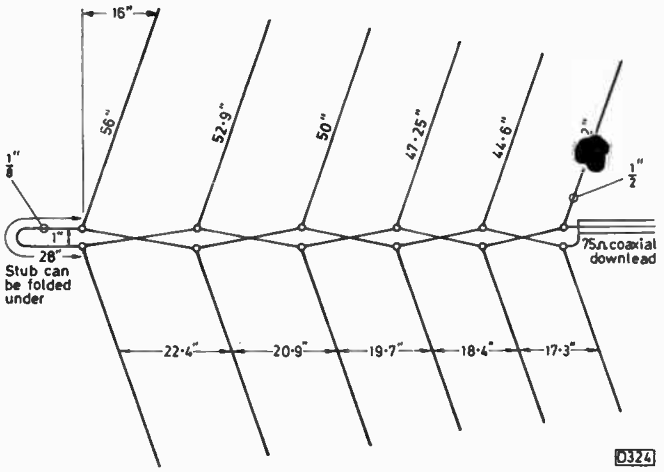


Fig. 1: Six-element log-periodic aerial array designed by Chris Wilson for reception of channels E3-4. A seventh element could be added to extend the coverage to channel E2/R1: this would have 59in. sections with a spacing of 24in. and the stub increased to 30in. Note that the design does not follow strict log-periodic calculations.

An interesting development of this technique was required at KSL-TV, Salt Lake City. A conventional microwave link licence couldn't be obtained for a 780ft. part of the proposed link, whilst renting a coaxial cable link was prohibitively expensive. The solution adopted was to use an infra-red light beam for which no licence was required. The system gives a flat bandwith of over 10MHz, while the transient response is improved because no bandwidth limiting filters are required. A couple of problems have been experienced however. The inclination of the receiver at 35° facing west means that for a short period during a week or so in the summer the sun passes across the receiver's field of view, giving an increase in the noise level. A winter problem, again degrading the signal, results from snow build up in front of the receiver's lens.

The infra-red source transmits the modulated light via an optical filter to give a narrow beam. The beam in practice spreads to a diameter of approximately 10ft. at a distance of 2,000ft. At the receiver, a lens assembly focuses the light through a bandpass filter on to a silicon avalanche photodetector – the bandpass filter resembles a piece of flat black glass and is basically an optical resonator designed to pass only the infra-red information, suppressing interference from other light sources such as the sun, street lighting, etc. The silicon avalanche detector both amplifies and recovers the video signal along with the sound subcarriers (there are two 15kHz f.m. sound channels on 10MHz subcarriers on the same infra-red beam). Further processing and clamping are then used to remove propagation fluctuations.

Circular Polarisation

Another development, circular polarisation, was the subject of an article in the October 1976 issue of *Television*. This is gaining popularity in N. America for both TV and f.m. radio broadcasting, the advantages being felt in metropolitan areas where high buildings cause severe ghosting. A circularly polarised transmission has either left- or right-hand polarisation, but the important point is that the polarisation sense of a reflected signal is reversed. This means that a correctly polarised receiving aerial will give minimum output from reflected signals. A recent article in the *RCA Broadcast News* suggests that circularly polarised TV "is here to stay", some off-screen shots demonstrating the dramatic improvement in reception achieved in difficult areas by using circular polarisation.

Service Notebook

G. R. Wilding

Checking Transistor Stages

While substitution is a common way of checking suspect transistors, nevertheless the need to obtain and fit a replacement takes time so that it's best to check first to make sure that the suspect is faulty.

As a general rule, if the voltages are correct, particularly at the base and emitter, a transistor can be considered to be operational. With a normal silicon amplifier transistor – as distinct from a sync separator, pulse amplifier, oscillator or a.g.c. stage – the base voltage should be about 0·6-0·7V above the emitter voltage, the latter voltage depending on the value of the emitter resistor and the current flowing through it. To confirm that a transistor's emitter voltage is the result of its current flowing through the emitter resistor, short-circuit the base-emitter connections. The result should be to reduce the emitter voltage to zero – unless there's a stabilising resistor between the emitter and one of the supply lines. In this case a small emitter voltage should still be present, but noticeably less than the normal, correct value.

On occasions you may find that the base voltage is nearly normal but that the emitter voltage is only slight, with the collector voltage at the supply rail potential. In this case the collector-base junction is probably open-circuit. The small emitter voltage is due to the base-emitter current flowing through the emitter resistor. If the base-collector junction is short-circuit, the collector, base and emitter voltages will all be much the same.

With the base-emitter junction open-circuit there'll be zero emitter voltage and the collector will be at the rail potential. The latter will also be the case with a short-circuit base-emitter junction, but this time the base and emitter voltages will be the same.

If you have an i.f. strip or chrominance channel giving zero or negligible output and all the voltages are correct, then you've a coupling, tuning or load problem. If the interstage coupling is capacitive, there could be an open-circuit or dry-jointed capacitor. With the coils or transformers capacitively tuned, there could be an open-circuit or changed value capacitor thus mistuning the stage, or a short-circuit capacitor thus removing the load altogether.

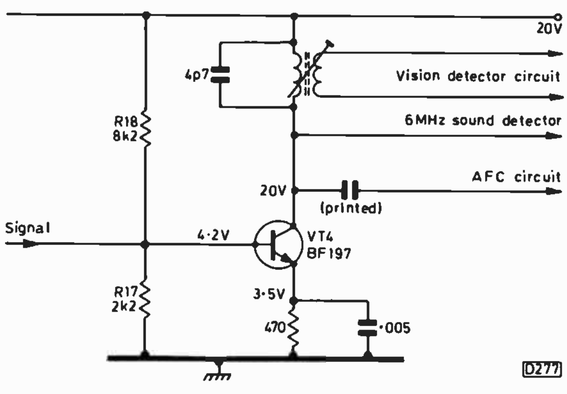


Fig. 1: Final i.f. stage, Pye hybrid colour chassis.

Incorrect voltages in gain-controlled i.f. stages are often due to a fault in the a.g.c. circuit. Excessive forward bias will result in the controlled stage(s) being driven into saturation where it/they will be unable to respond to the signal voltage. Under this condition all three voltages will be about the same, as occurs when there's a collector-base short-circuit or heavy leak, though if you measure carefully you will usually find that the base voltage is a fraction of a volt above the emitter and collector voltages, due to both junctions being forward biased.

Occasions sometimes arise when one or more transistors are simply under or over biased, resulting in either case in markedly reduced gain. For example, a Pye colour receiver fitted with the 697 chassis recently came our way, the complaint being weak contrast and lack of saturation even with the controls fully advanced. Absence of grain on the picture indicated that the fault was after the tuner, while the low colour strength suggested that there was reduced signal amplitude at the chrominance signal take-off point, i.e. at the emitter of the first video phase splitter transistor VT5. Naturally the first thing to check was the preceding detector diode, but this was found to be in order. VT5's voltages were all normal, but on working back to the final i.f. amplifier transistor VT4 (see Fig. 1) we found the base and emitter voltages both markedly above the correct figures. The collector voltage was correct, but since the load consists of the low d.c. resistance of the final i.f. transformer's primary winding no change was to be expected. The base bias for this transistor is provided by a potential divider, R18 (8·2kΩ) to the 20V supply line and R17 (2·2kΩ) to chassis, so it seemed that either the former resistor had fallen in value or the latter increased in value or gone open-circuit. Since only very small currents flow in such resistors, value change is very rare. What had actually happened was that the lower resistor R17 had become dry-jointed. As a result, the transistor's base voltage had increased, raising its forward bias but reducing its gain. On resoldering R17, normal voltages and correct contrast and saturation were restored.

No Results: Thorn 3000 Chassis

The complaint with a Thorn colour set fitted with the 3000 chassis was no sound or picture, though we found that sound was present for a fraction of a second after switching on. Tests on the power supply panel revealed that there was no chopper rail, though the 2·5A fuse was intact. On checking the three-section dropper resistor R605/6/7 the first section, which acts as a surge limiter, was found to be open-circuit. In most receivers an open-circuit section of a multiple dropper resistor can be shunted by a replacement, but in these sets there's no safe way in which this can be done. So although sections of this dropper don't break down very often, a complete replacement component is a must for the spares stock.

Severe Line Tearing

The trouble with a hybrid, single-standard GEC colour set was two-inch wide bands of severe line tearing which moved slowly up the screen, tripping the field timebase when they reached the top. Poor heater-cathode insulation in the PCF802 line oscillator valve was the first suspect, but a replacement valve brought no improvement. Inadequate h.t.

smoothing was ruled out since there was no hum from the speaker while the only raster disturbance was the bands of tearing. Attention was turned to the smoothing of the l.t. supply therefore, and it was found that on contacting a 64μF test capacitor across the 2,000μF smoothing capacitor C58 the line tearing was greatly reduced. Clearly the capacitance of this electrolytic had greatly decreased, and although the accompanying reservoir section of the can appeared to be good the complete unit was replaced. Apart from anything else, it's usually awkward to wire replacement capacitors and mount them securely on compact colour chassis.

Top Cramping

The raster on a Thorn portable fitted with the 1590 chassis was cramped, mainly in the top half of the screen. This suggested that one of the field output transistors was faulty, but voltage checks back through the complementary symmetry driver stage to the preceding "linearity amplifier" transistor VT16 showed that the incorrect voltages started in this stage – all three stages are direct coupled. The two diodes associated with VT16 both proved to be in order, so as all nearby resistors looked and tested normal the transistor was changed. This restored correct voltages and a normal raster, though the defective transistor was found to give acceptable forward and reverse readings across its two junctions. In all d.c. coupled transistor circuits, concentrate on the first stage where incorrect voltages are found.

Field Collapse

The trouble with a hybrid single-standard GEC colour receiver was field collapse, and on inspection we found that the 560kΩ resistor (R526) feeding the height control had burnt out. The resistor forms part of an *RC* filter with C519 (0·01μF), and suspicion naturally fell on this capacitor. An ohms test showed that the capacitor was o.k. however, but as the panel was badly charred where R526 had been we gave it a thorough clean up – charred paxolin can become conductive. On fitting a new resistor to the cleaned up panel a raster of only about half the normal height was obtained, while the resistor soon began to overheat. Although it looked perfect, the only conclusion we could come to was that the associated height stabilising v.d.r. (VDR500) was faulty, falling to a very low resistance. Removing the v.d.r. produced grossly excessive height – as one would expect since R526 and the v.d.r. form a potential divider. The point was proved however, and a replacement v.d.r. produced a normal raster.

Intermittent Field Failure

Now and then we all come across a printed board on which a fault either appears or clears when the board is tapped or pressure is applied to it in a particular area. Where there's no visual indication as to where the fault lies, the temptation is to resolder all connections in the suspect area. All too often however this produces no improvement, while there's always the risk of inadvertently connecting adjacent tracks with a blob of solder. Far better, wherever possible, to keep a meter connected to relevant points in the circuit in order to see where voltage changes occur when the board is tapped or pressure is applied.

This was brought home to us the other day when we had a case of intermittent field collapse on a set fitted with the Thorn 1500 chassis. Naturally the first move was to try a new PCL805, but the fault remained. We then found that the fault could be instigated by rocking the valve to one side, suggesting either a defective valveholder or a dry-jointed pin connection on the board. Inspection of the valveholder sockets showed that they were all in order however, while the pin soldering was equally faultless.

Next move therefore was to check voltages around the valveholder connections, noting the effect produced by valve displacement. There was a distinct fall in the voltage at pin 1 (triode anode) when the fault was present, indicating that the valve was then failing to oscillate – the absence of negative bias generated at the grid during oscillation would result in increased anode current. So the fault could lie in either part of the circuit, the two sections of the PCL805 being connected as a cross-coupled multivibrator. Failure of the pentode would also result in failure to oscillate therefore. Moving the test prod to pin 2 (triode grid) confirmed the absence of negative bias when the valve was pushed to one side, and on moving to pin 6 (pentode anode) it was found that there was zero voltage under the fault condition.

Had a short-circuit been responsible, the resulting very heavy current, limited only by the d.c. resistance of the output transformer's primary winding and the smoothing circuit, would have blown the fuse. Absence of h.t. had to be due to a break in the feed therefore. Checking on the panel revealed that while there was always h.t. at one of the output transformer's primary winding connection tags, the voltage at the other one fell to zero when the valve was pushed over. Closer inspection revealed the inadequacy of the soldering at this tag. The surprising thing about this fault is that although the transformer is mounted at one corner of the board, the field collapse could be instigated only by pressure on the valve which is mounted well away.

Faults Encountered

– continued from page 639

Perhaps the most difficult portable set fault we've had of late however concerned a Bush Model TV300. The set would work perfectly for hours on end, after which the peak whites would begin to smear, the symptom becoming progressively worse until the set gave an excellent imitation of a faulty tube. One clue that presented itself however was that the collector voltage of the video output transistor TR10 was very low when the fault condition was present. The supply for the video output transistor comes from a rectifier which is fed from the line output transformer. There are two electrolytics involved in this supply, the reservoir capacitor C519 and the smoothing capacitor C520, both 1μF. Replacing them cured the fault. I've since discovered that this trouble is not so rare, so before condemning the tube in these sets check these two capacitors first.

Indesit T24EGB

Finally, large screen monochrome sets. We've a number of Indesit Model T24EGB receivers out on rental. By and large they've turned out to be reliable, the only major weakness being the line output transformer. One set gave us a very poor picture however, of muddy appearance with pronounced vision hum. The sound was unaffected. Electrolytic trouble again, this time C914 (500μF). It's the reservoir capacitor in the 24V supply, which is derived from the earthy end of the heater chain.

The Language of Logic

Part 1

E. A. Parr, B.Sc., C.Eng., M.I.E.E.

IN THE past few years many TV engineers have been casting nervous glances over their shoulders at the quiet intrusion of digital techniques into television systems. These digital circuits call for a certain change of attitude, but worse is the large number of specialised terms that digital engineers use. An engineer I know (brought up like me on ECC83s) summed it up by saying "I understand the words, I just don't understand them when they are put together to make a sentence."

This article is intended as a newcomer's primer to logical circuits, and is arranged in two basic sections. The first is a description of basic electronic logic ideas, the second being a dictionary of common terms.

It's interesting to note that communications engineering is returning to digital circuits after a gap of several decades: early forms of communications (from the heliograph through the telegraph to morse code) were all digital.

What does "digital" mean?

In most electronic circuits, information (such as speech) is represented by voltages. In a standard 1V peak-to-peak CCTV signal for example, a voltage span of 0·7V covers the entire range from black to white. In theory at least any shade of grey can be represented and there is infinite resolution.

In a digital system, only two voltages are present. These are called "0" and "1". One of the most common digital systems used is the so called TTL (transistor-transistor logic) family. This uses voltages of 0·2V for the 0 state and 3·5V for the 1 state. Digital circuits are therefore very similar to switches and relays which both have two states: on/off; energised/de-energised.

At first sight, a circuit using only two voltages would seem a bit useless (like the hovercraft steamroller). After all, who wants a TV that could display only black or white? This is valid, but there are areas where digital systems come into their own: control, number crunching and information transmission.

Control engineering is the design of systems that originally used relays. There are many industrial control devices that have two states – relays, contactors, valves (hydraulic and steam), switches etc. These can in turn be controlled by digital circuits built round statements like "If signal A is present, and signal B, but not signal C then energise output X".

Number crunching is the use of digital systems to represent numbers. At the simplest level we can display the channel number on a TV set. At the complex end we have calculators and computers.

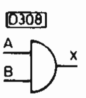


Fig. 1.

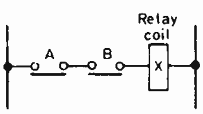


Fig. 2.

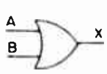


Fig. 3.

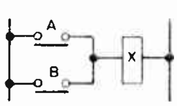


Fig. 4.

Finally we have information transmission. The information to be transmitted (which can be anything from a TV signal from Mars to the water level in the local reservoir) is converted into a sequence of digital on/off signals representing numbers. These digital signals are sent down the transmission path and at the receiving end they are converted back to voltages to produce the TV picture or drive the level gauge in the distant control room. Note that this implies two limitations. First the signal can change only in fixed steps, i.e. it's not continuously variable. Secondly the signal is sampled only at intervals. In the design of a system, the minimum step size (accuracy) and sample rate (frequency response) first need to be defined.

Most digital systems combine the three digital techniques. In Teletext for example, we have control, number crunching and information transmission all at once.

Logic Gates

Control systems are the easiest to understand, following, as they do, the basic concepts of relay design. Control systems are built round circuits called "gates". These have one or more inputs and one output. The relationship between the input and output is defined for all possible circumstances. Surprisingly, there are only a few types of gates. These will now be described.

First the and gate, whose symbol is shown in Fig. 1. The inputs can be in only the 0 or 1 state. The output is at 1 when all the inputs are at 1. We can thus draw a chart of all the possible conditions – this is called a truth table:

Input A	*Input B*	*Output X*
0	0	0
1	0	0
0	1	0
1	1	1

In many ways the and gate is similar to the relay chain shown in Fig. 2.

Occasionally you may see "logical equations". These express the logical operation being performed in mathematical form. The symbol for the and operation is a dot (·) and our gate can be expressed as: $X = A \cdot B$. And gates are available with up to eight inputs.

In the case of an or gate the output is at 1 when any input is at 1. The symbol is shown in Fig. 3 and the truth table is:

A	*B*	*X*
0	0	0
0	1	1
1	0	1
1	1	1

The or operation is represented by a plus sign (+) and the logic equation is: $X = A + B$. As before, this has an analogy in relay designs. Fig. 4 shows the relay analogy. Or gates are available with up to eight inputs.

Inverters have one input and one output. The output is the opposite binary state to the input. The symbol for an inverter is shown in Fig. 5, the small circle on the output denoting inversion. Inversion is sometimes called negation. The truth table is simple:

A	*X*
1	0
0	1

In a logical equation, inversion is denoted by a line above the letter concerned, thus $\overline{A}$. This is said "bar A". The logic equation is: $X = \overline{A}$. Inversion is similar to a relay normally-closed contact. By definition, there can be only one input to an inverter.

The nand gate is an and gate followed by an inverter. Its symbol is shown on Fig. 6, the circle on the output showing inversion. The truth table is:

A	*B*	*X*
0	0	1
0	1	1
1	0	1
1	1	0

This might appear a rather useless gate, but in fact it's the most common type of gate. The reason for this lies in its flexibility. It can be used as an and gate, an or gate or as an inverter by being clever with the logic design. We'll return to this when we come to positive and negative logic.

The logic equation is: $X = \overline{(A \cdot B)}$. Nand gates are available with up to eight inputs.

The nor gate is an or gate followed by an inverter. Its symbol is shown in Fig. 7. As before, the circle shows inversion. The truth table is:

A	*B*	*X*
0	0	1
0	1	0
1	0	0
1	1	0

The logic equation is: $X = \overline{(A + B)}$. Nor gates are available with up to eight inputs but are rarely used in logic designs.

The exclusive-or gate has only two inputs. The output is at 1 when the two inputs are in different states, at 0 when the two inputs are the same. The symbol is shown in Fig. 8. The truth table is:

A	*B*	*X*
0	0	0
0	1	1
1	0	1
1	1	0

The logic equation symbol for exclusive or is $\oplus$, hence the equation is: $X = A \oplus B$.

The exclusive-or gate is made by the logic combination shown in Fig. 9. This has the logic equation:

$$X = \overline{(A \cdot B) + (A \cdot B)}.$$

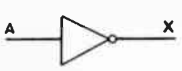


Fig. 5.

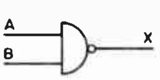


Fig. 6.

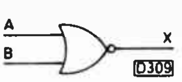


Fig. 7.

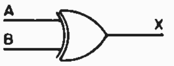


Fig. 8: Exclusive-or gate symbol.

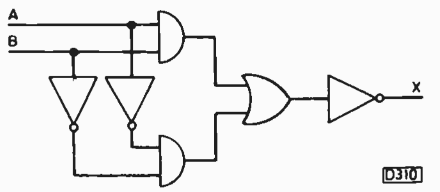


Fig. 9: Internal arrangement of an exclusive-or gate.

It will be left to the reader to convince himself that this is the same logic and equation as the exclusive-or.

If this seems complicated, take heart. Exclusive-or gates are normally encountered only in fairly complex number crunching systems.

By definition, an exclusive-or gate is available only with two inputs.

That completes the basic family of logical gates.

Positive and Negative Logic

Manufacturers define the voltage for logic levels. For TTL a 1 is 3·5V and a 0 is 0·2V. If the 1 is more positive than 0 the logic is described as positive logic. If the 1 is more negative it is described as negative logic. TTL is therefore positive logic. A logic system I once worked with which had a 1 of −3V and a 0 of +3V was negative logic.

In theory, negative logic should have a small circle at the corresponding inputs and outputs. The logic symbols for a negative logic or gate and nand gate are shown on Fig. 10.

The small circle at the output of a conventional positive nand gate means, in effect, that the state at the output when the input conditions are satisfied is the more negative.

As the vast majority of logic systems use positive logic (TTL, RTL, DTL, ECL, CMOS) you probably think this is academic. Consider however the circuit shown in Fig. 11. This has the truth table:

A	*B*	*C*	*D*	*X*
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1
0	0	0	0	0

which means it has performed

$$X = (A \cdot B) + (C \cdot D).$$

In some odd way, gate three has performed like an or gate. To see why, let us take the operation a step at a time. The output of a nand gate in terms of voltage is:

A	*B*	*X*
0·2	0·2	3·5
0·2	3·5	3·5
3·5	0·2	3·5
3·5	3·5	0·2

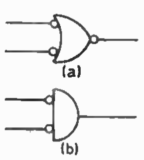


Fig. 10: Negative or (a) and nand (b) Gates.

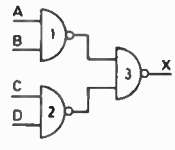


Fig. 11.

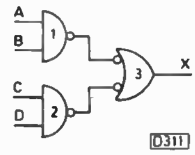


Fig. 12.

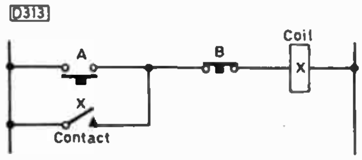


Fig. 14.

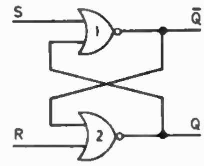


Fig. 15.

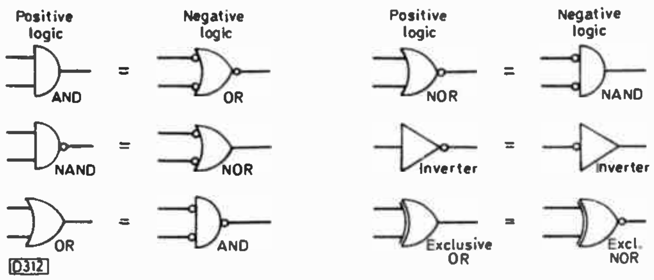
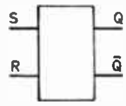
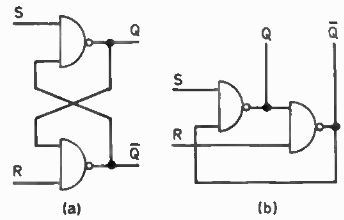


Fig. 13: Demonstrating the interchangeability of positive and negative logic.





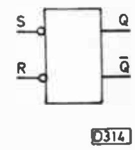


Fig. 16 (left): SR flip-flop symbol.

Fig. 17 (centre): Nand gate flip-flop (a). This is sometimes drawn as shown in (b).

Fig. 18 (right): Active low SR flip-flop symbol.

If we define 1 as 0·2V and 0 as 3·5V we get:

A	*B*	*X*
1	1	0
1	0	0
0	1	0
0	0	1

which is a nor gate in negative logic. In Fig. 11 gates one and two give a 0 out for A·B and C·D. Gate three then acts as a negative logic nor gate on the signals from gates one and two.

In theory, Fig. 11 should be drawn as Fig. 12.

It's only honest to say that very few people bother, least of all the author, and it's usual to find logic drawings done entirely with positive logic symbols even though negative logic might be performed at places inside it.

This flexibility is the reason for the common usage of nand gates rather than and gates.

As might be expected, there is a similar interchangeability between other gates. The positive logic gates above when used as negative logic change as below:

Positive logic	*Negative logic*
and	or
or	and
nand	nor
nor	nand
inverter	inverter
exclusive-or	exclusive-nor (an exclusive-or followed by an inverter)

Non trusting readers should draw up the truth table for each gate, replace it with voltages, then replace the voltages with 1 = 0·2V and 0 = 3·5V.

The interchangeability of positive and negative logic gates is summarised in Fig. 13.

Memories

In logic it's often necessary to remember that something has happened. This is equivalent to the latching relay network shown in Fig. 14. Relay X is energised when button A is momentarily pressed, and stays energised until button B is pressed.

The simplest way of making an electronic memory is to use two nor gates as shown in Fig. 15.

We have two inputs labelled S and R and two outputs labelled Q and $\bar{Q}$ (pronounced bar Q remember). Let us assume that S is at 1 and R at 0. Because S = 1, $\bar{Q}$ = 0. At the input of gate two we have R = 0 and $\bar{Q}$ = 0. The output of gate two is thus Q = 1. This has no effect on gate one.

Let us now take S to 0. We have S = R = 0. On gate one we have S = 0 and Q = 1 so the output of gate two stays $\bar{Q}$ = 0. On gate two we have R = Q = 0, so the output of gate two stays Q = 1. With Q = 1, gate two is unaffected. The circuit remains with its outputs: Q = 1, $\bar{Q}$ = 0.

Let us now take R to 1. The output of gate two, Q, goes to a 0. At the input of gate one we have Q = 0, S = 0. The output of gate one, $\bar{Q}$, goes to 1. At gate two's input we now have $\bar{Q}$ = 1 and R = 1. The output of gate two stays Q = 0.

If we now take R = S = 0, as before, nothing will change and we are left with: Q = 0, $\bar{Q}$ = 1.

The circuit thus has two stable states. The first is Q = 1, $\bar{Q}$ = 0, when the S input was last at 1. The second state is Q = 0 and $\bar{Q}$ = 1, when the R input was last at 1.

The first state is known as the "set" state and the second

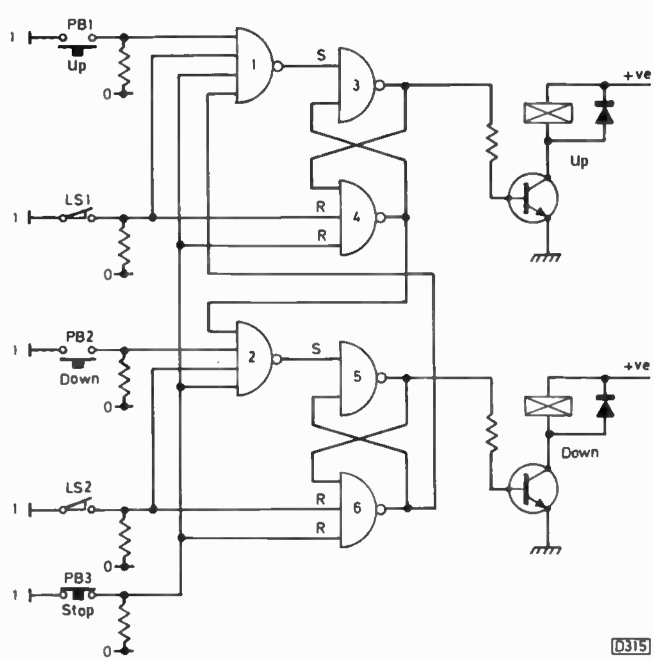


Fig. 19: Control system for a car lift.

as the "reset" state. Not surprisingly the S input stands for set and the R input for reset. (The reasons for the use of Q are lost in the mists of time.)

This circuit is known as an RS memory. It's also called an RS flip-flop or an RS statisciser (or stat for short). Often the RS label is omitted and it's simply called a flip-flop or stat. It has it's own circuit symbol, shown in Fig. 16.

It's possible to construct an RS memory from nand gates as shown in Fig. 17. This is set and reset by 0 at the inputs (rather than 1 in the nor constructed memory shown in Fig. 15.) We thus have:

a 0 on the S input sets Q to 1 and $\bar{Q}$ to 0;
a 0 on the R input resets Q to 0 and $\bar{Q}$ to 1.

The nand constructed RS memory has the symbol shown in Fig. 18.

As with the gates, the circles show that the set and reset are active for a low signal.

An RS flip-flop is not the only type of memory. Other common types are the D type, toggle and JK flip-flops. These will be dealt with in the dictionary part of the article.

These then are the basic elements of digital control. Other more complex devices (such as monostables) will be dealt with in the dictionary.

Typical Control Scheme

A typical (but somewhat trivial) example of a control scheme is shown in Fig. 19. The device being controlled is a garage car hoist. There are three push buttons: PB1 up; PB2 down; and PB3 stop. Once the up button is pressed the lift goes up until limit switch LS1 opens or the stop button is pressed.

The operation is obvious, but there are a few points to note. Gates three and four form an RS flip-flop, activated by 0 at the S input. The flip-flop can be reset by a 0 at either of the two R inputs of gate four. Setting the flip-flop energises the up relay.

Gate one inhibits the setting of the up flip-flop if LS1 is open, the stop button is pressed or we are already going down (the latter being the purpose of the link from gate six, the $\bar{Q}$ output of the down memory).

Gates two, five and six behave in a similar manner to energise the down relay.

Both flip-flops are reset if the stop button is pressed.

Most television control schemes tend to be more complex than a car hoist, but the same basic gate functions apply. In addition, most TV logic systems operate at far higher speeds than the average relay system!

Number Crunching (or One Ten Buckle My Shoe)

Number crunching is the use of digital techniques to handle numbers. Before we can deal with the actual circuits we must, I'm sorry to say, indulge in a little mathematics.

We are used to counting in units, tens, hundreds etc., so the number 4057 means "four thousands plus no hundreds plus five tens plus seven units". This is counting to the base of ten.

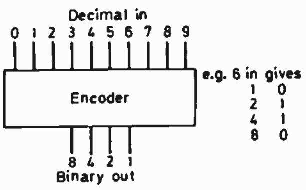


Fig. 20: Encoder.

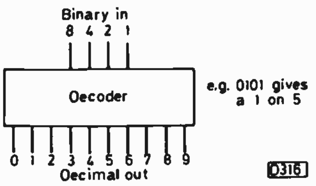


Fig. 21: Decoder.

It's possible to make a number system to any base. The only reason we use ten is simply because we have ten fingers. If the inhabitants of a planet round Alpha Centurai had six fingers they would probably count:

Base 6 0 1 2 3 4 5 10 11 12 13 14 15 or
Base 10 0 1 2 3 4 5 6 7 8 9 10 11.

In Alpha Centuria, 14 means "one six plus 4 units"; 351 would mean "3 times 36 plus 5 sixes plus one unit."

Suppose we now want a number system based on two (don't ask awkward questions like why, all will suddenly come like day). This peculiar number system could only have two symbols 0 and 1. The columns (units, tens, hundreds and thousands in decimal) would be 1,2,4,8,16 etc. and we would count

0	0
1	1
2	10
3	11
4	100
5	101 etc.

This number system is called binary. Remembering that each column stands for 1, 2, 4, 8 etc., we can look at the binary number 1011011.

We start taking units at the right (as usual) and say that this is:

one unit	1
plus one 2	2
plus no 4	0
plus one 8	8
plus one 16	16
plus no 32	0
plus one 64	64
Total	91 in decimal

All this may seem academic and laborious. After all, it's easy to write 91: 1011011 is laborious and a bit meaningless – imagine what 4057 would be like in binary (111111011001 actually).

But because we have only two symbols with this system, 0 and 1, it's very easy for electronic digital circuits to handle numbers in binary form. The large numbers of gates necessary to handle large numbers is no problem, since gates and flip-flops are cheap. The circuits won't get confused, like we would, with the binary numbers. The only restriction is that inputs to the system should be decimal, and outputs decimal, so that they are intelligible to us.

Decimal inputs are converted into binary form by a chip called an encoder. This takes in a 1 on one of the input lines and produces the correct binary pattern on the output (see Fig. 20).

Note that the binary output will be in the range 0000 to 1001. Incidentally, it's usual to draw diagrams with the smallest column to the right and the largest (in this case the column representing 8) to the left.

A binary digit is known in the jargon as a bit.

Readers might like to try to work out what goes on inside an encoder – it's just a load of or gates.

The opposite chip is called a decoder. This takes in a four bit binary number (as the jargon says) in the range 0000 to 1001 and puts a 1 on the corresponding output line (see Fig. 21).

Readers might again like to work out its innards. You will need a collection of and gates and inverters. As a start, the circuit for the 6 decode is shown in Fig. 22.

We can easily design an adder using gates. This is not

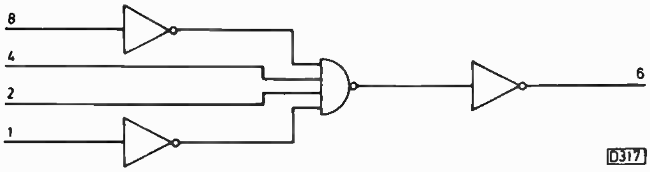


Fig. 22: Internal logic for decoding "6".

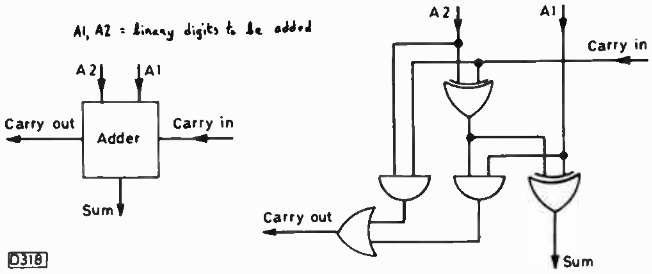


Fig. 23 (left): One-bit binary adder.

Fig. 24 (right): Internal logic of a one-bit binary adder.

really the place to go into the intricacies of binary arithmetic circuits, but to add two binary digits (i.e. two bits) we need three inputs: the two bits to be added, and the carry bit from the lower column. We produce the answer bit plus a carry bit to the next highest column (see Fig. 23). The truth table for this is:

X	*Y*	*Carry in*	*Sum*	*Carry out*
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

The logic required to do this is relatively simple (see Fig. 24), but chips are available to do this. These are usually four bit adders, with carry into the bottom bit and carry out from the top so that 8, 12 bit adders can be made.

With an encoder, a decoder and an adder we can make a very simple adding machine. We have two decade switches SW1 and SW2, the outputs of which are encoded into binary form by IC1 and IC2. The two four-bit numbers are

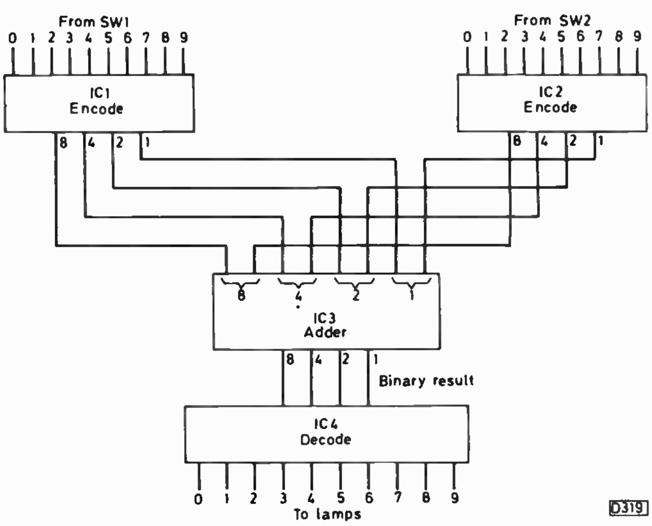


Fig. 25: Simple adding machine.

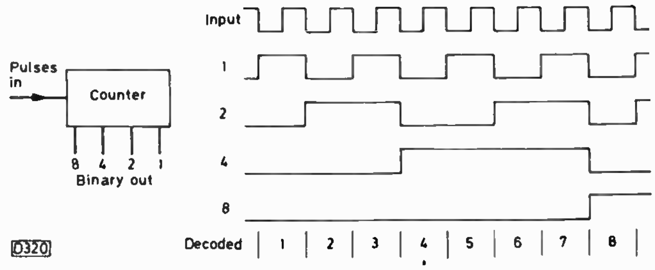


Fig. 26: Binary counter.

added by IC3 and the result (again in four bits) is decoded by IC4 to light one of the ten output lamps. Note that the result must be in the range 0-9. The adder will work with 7 + 2 but not 7 + 5 (see Fig. 25).

One final component of number crunching systems is a counter. This is constructed around the toggle flip-flop (described in the dictionary) but for our purpose here it's a box with one input and four outputs (see Fig. 26).

This counts pulses at its input, giving the answer in binary form at the output.

There are many variations on counters. They usually have a reset pin so that they can be reset to zero (0000). Counters are also available that can be preset to a given number before counting commences. Finally counters are available for counting up or down.

It's hard to believe, but even the largest computers in the world are just a collection of the control and arithmetic elements described so far.

Data Transmission

Finally we have the use of digital techniques to transmit analogue signals (e.g. conventional video or audio waveforms) by digital methods. All data transmission systems have a common block diagram (see Fig. 27). The input

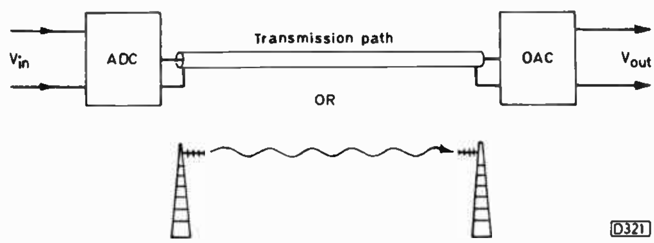


Fig. 27: Block diagram of a digital transmission system.

voltage is converted into a digital signal by a device called an ADC (see dictionary for further details). The digital signal is sent along the transmission path and at the receiver a DAC converts the digital signal back to an analogue one.

A somewhat pointless exercise you might think. The system does have some great advantages however. For example, a digital system cannot produce distortion due to differential phase and non linearities. Because the signal is simply on or off, it has excellent noise rejection. And with error correcting codes the transmission can be made almost error free.

Digital transmission has been used by the GPO for telephone links for some time, and TV pictures are linked to some IBA and BBC transmitters by digital links.

An interesting mixture of data transmission and number crunching techniques is the digital standards converter, where a 525-line TV signal is digitised, processed then reassembled as a 625-line signal.

TO FOLLOW: DICTIONARY OF LOGIC TERMS

Your PROBLEMS solved

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PYE HYBRID COLOUR CHASSIS

The contrast on this set is very weak, the picture being neither as crisp nor as bright as it was. The screen is fully illuminated, with little grain in the picture, which improves somewhat with time. The sound is perfect and the colour seems to be o.k. though perhaps it could be improved with more contrast.

First check the PL802 luminance output valve on the left side, and the voltages in this stage to see whether the circuit is otherwise fault-free. If everything seems to be in order here transfer attention to the i.f. panel, where VT6 which drives the contrast control, and its input coupling capacitor C36 (50μF), are suspect. If necessary check the final i.f. transistor VT4.

ITT VC200 CHASSIS

When the set was first bought some years ago it was noticed that the brightness control had to be advanced beyond three-quarters of full rotation before the picture appeared, and usually had to be set at maximum for good contrast. The picture was very good though, so we left things alone. Faces are now a little too dark for pleasant viewing with artificial lighting however. The screen is well lit without a signal.

Component tolerances can combine to give an inadequate brightness range on this chassis – this seems to be borne out by the variations in the brightness control resistor network found in production. Try reducing by half the value of the resistor (R169, 47kΩ) connected between the brightness control and chassis; if necessary, increase the value of the resistor (R165, 4·7kΩ) between the HT4 rail and the brightness control by one or two preferred values.

PYE 169 CHASSIS

There's sound and a full-sized picture, but it's very dim. The contrast control works, and the brightness control has some effect. The line timebase valves have all been renewed and the h.t. lines are present – slightly high.

The voltage-dependent resistor between the brightness control and chassis sometimes changes value to cause this trouble. It's type E299/DD/P352. A check is to raise the normal voltage range of the brightness control by connecting a 100kΩ resistor in parallel with R35 which is between the HT3 rail and the other end of the brightness control. If this doesn't do the trick, check the voltages in the video output stage.

PYE 731 CHASSIS

The picture suffers from a high-frequency flicker, taking about two hours to settle down after switch on.

The trouble is very often due to the over-voltage protection circuit preset control RV879 being incorrectly set. Adjust it and RV916/7 (fine and coarse h.t. setting respectively) as set out in the manual. If the trouble persists, R924 (8·2MΩ), the trigger diac D892 and the thyristor rectifier D888 (type 2N4444 with heatsink now the recommended type) are suspect.

HITACHI CNP192

This set gives a reasonable picture though there are some minor faults. First there's a slightly shaded band down the left-hand side of the screen. The verticals tend to bend to the right, and there's a slight purple patch at the top right-hand corner, noticeable mainly on monochrome.

The purple patch is likely to be due to tube magnetisation, which should be removed by repeated use of the set's degaussing circuit. If not, it can be cured by using an external degaussing coil. If the verticals tend to quiver as well as bending to the right, check the setting of the line oscillator coil T701 (line hold) and the flywheel sync discriminator diodes CR32/33. When adjusting T701, earth terminal B2 (input to the flywheel sync phase splitter) with an 0·1μF capacitor. If the bending increases towards the edge of the screen and there's a tendency to pincushion distortion there could be a fault on the small side pincushion correction board. Correction adjustment is provided by R627 and L601 which are mounted just above the board. Unless you're sure that the vertical bending is associated with pincushion distortion however these controls should be left alone. The narrow band down the left-hand side could be due to a fault in the line output stage, but can sometimes be caused by a weak aerial input signal, especially if the lead is trailing close across the back of the set.

PYE 693 CHASSIS

There's a good picture on BBC-1 and -2, but on ITV the field slips and rolls rapidly. The fault is not due to the appearance of advertisements but occurs mainly when the picture contains a large white horizontal patch. Switching to either BBC programme will restore a steady picture and may restore ITV on switching back, but the picture will roll again as soon as the critical picture content occurs on ITV. The signal strength is good, and adjusting the field timebase controls has no effect on the fault.

This problem can be caused by the preset contrast control RV3 on the i.f. panel being over-advanced. It's more likely however that the trouble is in the sync separator stage. The most likely culprit here is the base bias resistor R33 (4·7MΩ) which tends to increase in value. If necessary, also check the load resistor R35 (82kΩ), the transistor itself (VT7, BC147) and the two diodes D3 and D4. All these are on the right-hand side of the panel.

ITT/STC VC4 CHASSIS

The trouble with this set is excessive buzz on 625 lines.

Replace the ratio detector diodes D1 and D2, using OA90s or OA91s, and the reservoir capacitor C103 (6·4μF, 4·7μF will do). Then carefully adjust the balance control R111 and the cores of the 6MHz tuned coils L56, L58 and L55 for minimum buzz. L56 and L58 are in the large rear can, while L55 is the top core in the can nearest the mains switch – of which beware!

THORN 8800 CHASSIS

After about six hours the touch-tuned channels start to flash from 1 to 6 in short bursts. The overload cut-out then operates. If this is reset, the same thing happens after about a quarter of an hour. Resetting the cut-out will then result in it opening each time the set is switched on again.

If there's no sign of sparking or arcing around the c.r.t. base, anode connector or the line output stage, it's likely that the e.h.t. rectifier is faulty. First make sure that the c.r.t. aquadag is well bonded to the spark gap on the tube base however.

PHILIPS 11TG190AT

There's no raster on this set, the c.r.t. first anode voltage being 12V instead of 315V. The line output transformer and the diode and capacitor which produce the c.r.t. first anode supply have been replaced – with the capacitor removed the voltage rises to about 80V and a dim raster with vertical bars appears. The line output transistor voltages seem to be correct.

You don't say whether the voltage regulator is working normally. Check the current through the 2A fuse – should be about 1·5A. If this is low, check the three transistors in the regulator circuit – the AC128 is the most likely culprit. Make sure that the output is 11V (set by R4043) – measure between the collector of T1513 (AD149) and chassis. Also ensure that the replacement line output transformer has the same colour coding for the wiring – different suppliers are not too careful about this. Check the diodes in the line output stage – X2013/4/5/6. Is the sound section working? If not, there could be a heavy current drain here. Another suspect is the boost capacitor C2096. The system switching could be in need of cleaning of course.

DECCA 30 CHASSIS

There's colour loss on this set. The picture appears in full colour when the set is first switched on, but once the set's got warm the colour fades out, leaving a good monochrome picture. During the course of the evening the colour may return for a short period, but will then fade out again. Another decoder panel was tried, but the trouble remains.

This sort of trouble is usually due to intermittent failure of the second chrominance amplifier TR206, the delay line driver TR207 or the crystal. TR206's emitter is decoupled by an electrolytic C224 (33μF) which can sometimes play tricks. Another electrolytic worth checking is the colour-killer reservoir capacitor C232 which is also 33μF. If your're sure that the replacement panel is o.k. however check whether the 25V supply line is correct during the fault, and ensure that the leads to the colour control are making good contact. If these points are in order, concentrate on the pulse feed to the decoder via PD10: if the pulses are mistimed, distorted or absent the result will be no colour.

THORN 1590 CHASSIS

There are five dark vertical bars, each an inch wide and an inch apart, superimposed on the picture. They are still present with no signal.

If there's no damping resistor across the line linearity coil L15 try adding one (560Ω). If this doesn't do the trick, check the 95V supply reservoir capacitor C111 (1μF) which is a non-electrolytic type in later production sets. Further possibilities are the flyback blanking clipper diode W15 and the 300V supply reservoir capacitor C110 (10μF).

GRUNDIG 1500GB

When the set is first switched on a weak, negative monochrome display appears, with weak field and line hold. A strong colour picture with good field and line lock comes on after a couple of minutes.

This problem is usually traceable to poor joints in the early vision i.f. stages. If you are lucky, you'll find the cause of the trouble on the luminance delay line or one of the small post-detector chokes – L351 or those in the i.f. can. The fault might be buried in the rather inaccessible i.f. strip however. Careful tapping and probing should tie it down.

GEC C2110 SERIES

The set behaves perfectly for long periods, with a good colour picture, then it flicks and a greenish tinge appears. It then flicks back to normal colour. These flicks between normal and greenish colour seem to be more prevalent when the set has thoroughly warmed up, but can occur at any time.

The fault could be due to several different things, but we've usually found it to be due to the small 2·2kΩ preset control P303 (set G – Y level) which feeds pin 11 of the chrominance demodulator i.c. (IC301, TBA990) on panel PC457. Moving the body of the control with a finger is generally sufficient to establish its guilt, although a dry-joint to the panel could be the cause.

THORN 1590 CHASSIS

There's brightness trouble on this set, sometimes an intermittent change in brightness level, more often a slow change in the brightness, leaving the picture over bright. The brilliance and contrast controls are o.k., and there's no detectable change in the voltage fed to the brightness control. The voltage at the collector of the video output transistor is on the high side, while the d.c. voltage at the cathode of the c.r.t can be seen to be changing very slowly. The board has been checked for cracks and dry-joints and the 95V supply reservoir capacitor has been replaced.

The fact that the voltage change can be measured at the c.r.t. cathode suggests that the trouble is in the video circuit. We suggest you replace the output transistor's collector load resistor R51 (6·8kΩ) and if necessary check by substitution the video output transistor VT9 and the preceding, d.c.-coupled emitter-follower VT6. Other possibilities are C36 (4·7μF) which smooths the bias applied to VT6 and C51 (100μF) which is in series with the slider of the contrast control. Use of a hairdryer and freezer aerosol may help locate the culprit. If you are unlucky, the c.r.t. could be faulty with a grid-cathode leak.

ITT CVC5 CHASSIS

The trouble with this set is intermittent poor focus. On one recent occasion the focus was so bad that the picture seemed to be broken up. I've checked the high-value (4·7MΩ) resistors in series with the focus VDR and the 2·2MΩ resistor in series with the c.r.t.'s focus electrode visually and for dry-joints, but they seem to be in order.

It's still worth changing these three resistors since they can be responsible for this trouble. The symptom is often due to invisible corona discharge and leakage at the two spark gaps associated with pin 9 on the c.r.t. base panel however. Clean them with methylated spirit, and slightly enlarge them with a small file. Make sure that pin 9 is making good contact with its socket.

ITT VC200 CHASSIS

It takes anything up to an hour for the picture to reach the correct brightness. It's very dull, and out of focus around the edges. The line output stage has been checked thoroughly, and new valves have been fitted. Valve voltages seem to be correct but the c.r.t. first anode voltage is about 450V instead of the 660V quoted on the circuit. The brightness control has to be fully advanced. The focus control measures about 1·5MΩ instead of 2MΩ.

The focus potentiometer often does fall in value, reducing the c.r.t.'s first anode voltage. Under normal circumstances however we find that the c.r.t. first anode voltage rarely attains the 660V claimed. The symptoms you quote suggest that the c.r.t. is almost certainly low emission. Reactivation may improve it for a while, but a regunned tube would be a lasting cure.

THORN 8500 CHASSIS

The trouble with this set is that there are horizontal shadows, varying in width, across the picture.

If the bars are not "lined up" with the picture features (smearing), check the a.g.c. smoothing capacitor C111 (10μF). If the effect is heavy, picture-dependent smearing, check the luminance coupling capacitor C174 (3·3μF).

TEST CASE

190

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

A Thorn monochrome mains/battery portable, Model 3845 (1690 chassis), would work for hours on end on its loop aerial without trouble. Sound and vision sensitivity were both remarkably high, and the picture was of good quality in all but difficult areas. Every now and again however the screen would gradually brighten, and the contrast would decrease until eventually the picture was only vaguely discernible below the high screen brightness.

Sometimes the effect would clear on its own, either gradually as it started, or suddenly, the screen then clearing and the contrast reverting to normal. The fault condition sometimes occurred a short period after switch-on, or during a programme sequence after the set had been working for several hours.

After operating normally on the test bench for most of a morning the symptom suddenly occurred. Quick adjustments were made to the controls in an endeavour to gain some idea of the whereabouts of the fault. It was found that the range of brightness control was curtailed when the fault was present, and that the contrast control had hardly any influence at all on the "brightened-out" picture in the background. Before further tests could be made the fault cleared!

The fault lasted a little longer the next time, allowing measurements to be made at the tube base connector. It was found that both the cathode and grid potentials were on the low side, particularly the cathode potential, which tended to fluctuate with brightness change more than would be expected as a result of picture signal brightness changes. At this stage a test prod was unwittingly knocked against the tube neck and the fault cleared.

It was found that the fault could be cleared by switching the set off and then on again quickly. Various video output stage components, including the BF391 transistor, were replaced but the fault would still occur. The components and the printed circuit board in this area were subjected to heat and freezing liquid, but the fault could not be encouraged to develop in this way.

What was the most likely cause of the trouble, and what significant clue, if any, was overlooked by the service technician? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 189
— Page 608 last month —

Receivers using an ECC82 multivibrator field generator are very susceptible to small changes in value of the anode load resistors, particularly the resistors connected to the anode of the second triode section, i.e. in the field charging circuit. This is one reason why a VDR is used to stabilise the supply against load variations. It's not possible to determine whether a resistor is subject to such value variations merely by measuring it with an ohmmeter; neither is it possible to achieve a sensible reading by measuring the anode potential with a 1,000Ω/V meter!

The symptom described is very often caused by slight electrical inconsistency in one of the resistors in series with the height control. The only way to prove this is to extract the suspect component and solder in a replacement.

It was discovered that the 560kΩ resistor (R526) connected to the top of the height control was causing the trouble, a good quality replacement completely curing the effect. It was not possible to detect any fault in the extracted resistor by making an ordinary ohmmeter test: a fair current has to flow through the resistor before the fault occurs.

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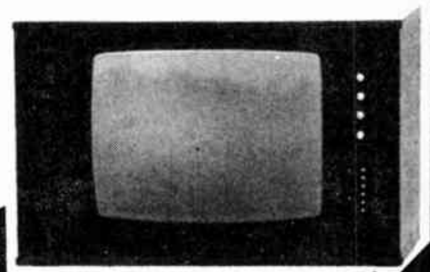

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5Z3	1.40	6GH8A	0.80	30PL13	1.30	ECH81	0.55	KT88	6.75	QQV03/10	2.00
5Z4G	0.75	6GK5	0.75	30PL14	1.50	ECH84	0.75	P61	0.60	QV06/20	4.70
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6AM8A	0.70	6JU8A	0.90	AZ41	0.50	EF40	1.00	PCC84	0.39	UBC81	0.55
6AN8	0.78	6K7G	0.50	DY51	2.00	EF41	1.00	PCC85	0.47	UBF80	0.50
6AQ5	0.75	6K8G	0.50	DY86/7	0.52	EF80	0.40	PCC89	0.49	UBF89	0.39
6AR5	1.05	6L7(M)	1.50	DY802	0.50	EF83	1.70	PCC189	0.60	UC92	0.50
6AT6	0.60	6Q7G	0.75	E80CF	6.00	EF85	0.45	PCF80	0.80	UCC85	0.50
6AU6	0.55	6SA7	0.70	E88CC	1.20	EF86	0.52	PCF82	0.45	UCF80	0.80
6AV6	0.65	6SG7	0.70	E80F	5.50	EF89	0.55	PCF86	0.57	UCH42	1.00
6AW8A	1.15	6SJ7	0.70	E188CC	5.0(	EF91	0.70	PCF200	1.55	UCH81	0.60
6AX4	0.75	6U4GT	1.00	E280F	12.50	EF92	0.70	PCF201	1.45	UCL82	0.75
6BA6	0.65	6V6G	0.50	EA50	0.40	EF183	0.50	PCF801	0.49	UCL83	1.00
6BC8	0.90	6X4	0.95	EABC80	0.48	EF184	0.50	PCF802	0.80	UF41	0.70
6BE6	0.70	6X5GT	0.50	EAF42	1.00	EH90	0.75	PCF805	2.25	UF42	1.00
6BH6	1.10	9D7	0.70	EAF801	1.50	EL34	2.50	PCF806	0.70	UF80	0.40
6BJ6	0.75	10C2	0.70	EB91	0.25	EL41	1.00	PCH200	1.20	UF85	0.50
6BK7A	0.85	10DE7	0.80	EBC41	1.00	EL81	1.00	PCL82	0.62	UF89	0.52
6BN8	1.50	10F1	1.00	EBC81	1.00	EL84	0.48	PCL83	1.20	UL41	0.90
6BQ7A	1.40	10F18	0.65	EBF80	1.00	EL95	0.95	PCL84	0.65	UL84	0.90
6BR7	1.00	10P13	0.80	EBF89	0.40	EL360	2.50	PCL86	0.85	UM80	1.00
6BR8	1.25	10P14	2.50	EC86	0.84	EL506	2.00	PCL805	0.85	UY41	0.70
6BW6	3.75	12AT6	0.45	EC88	0.84	EL509	2.50	PFL200	1.35	UY85	0.70
6BW7	0.65	12AU6	0.50	EC92	1.00	EM80	1.00	PL33	1.00	U19	4.00
6BZ6	1.50	12AV6	0.60	EC97	0.75	EM81	1.00	PL36	0.80	U25	1.00
6C4	0.50	12BA6	0.50	ECC33	2.00	EM84	1.00	PL81	0.49	U26	0.90
6C9	2.00	12BE6	0.85	ECC35	2.00	EM87	1.45	PL81A	0.75	U191	0.50
6CB6A	0.65	12BH7	0.68	ECC40	1.00	EY51	0.80	PL82	0.50	U301	1.00
6CD6G	4.00	13D8	2.00	ECC81	0.52	EY81	1.50	PL83	0.50	U404	0.75
6CG8A	0.90	19AQ5	0.65	ECC82	0.62	EY83	1.50	PL84	0.50	U801	1.00
6CL6	0.75	19G6	6.50	ECC83	0.62	EY87/6	0.45	PL95	1.00	X41	1.00
6CL8A	0.95	19H1	4.00	ECC84	0.50	EY88	1.00	PL504	1.05		
6CM7	1.00	20P1	1.00	ECC85	0.50	EY500	1.45	PL508	1.85		
6CU5	0.90	20P4	0.84	ECC86	2.00	EZ40	1.00	PL509	3.10		
6DE7	0.90	30C15	1.00			EZ41	1.00	PL519	3.75		

All goods are unused and boxed, and subject to the standard guarantee. Terms of business: Cash or cheque with order only. Despatch charges: Orders below £25, add 50p extra per order. Orders over £25 post free. Same day despatch. Terms of business available on request. Any parcel insured against damage in transit for only 5p extra per parcel. Many other types in stock. Please enclose S.A.E. with any enquiries. Special offer of EF50 VALVES, SOILED, BUT NEW AND TESTED £1 EACH.

SUMMER SALE!!!

Due to a special bulk-contract purchase we have thousands of sets that must be cleared regardless of cost! Many, many bargains too numerous to list, with extra discounts for callers – e.g. Bulk lots (30 or more) mixed MONO @ £1.50 ea. (Sell out at over £15 ea after service). We don't mind our customers making 1000% profit on a £50 investment, it keeps them coming back for more! Most types of COLOUR TV available for HOME and EXPORT markets at discount prices.

Send stamp, or phone for 1978 Catalogue.

West Midlands TV Trade Sales,
92 High Street, Kings Heath, Birmingham B14 7JZ.
021-444 6464

SOUTHERN IRELAND DEALERS

We are the largest stockists in the south of Ireland of clean used T.V. sets.

BUSH – PHILIPS – FERGUSON – KORTING DECCA ETC.

Mono D/S from **£15.00** each
Colour from **£120**
All Sets Tested & Cabinets Polished.
Over 2,000 sets in stock.
Visit our warehouse and see for yourself.
Fresh Stocks Weekly.
Delivery can be arranged.

T.V. WHOLESALE DISTRIBUTORS LTD.
E.D.I. HOUSE,
Kylemore Park West Industrial Estate,
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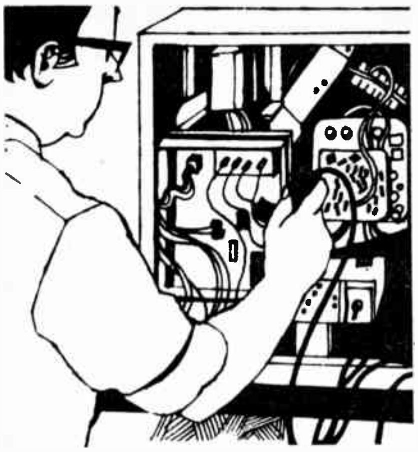

SETS & COMPONENTS

VALVE BARGAINS

ANY 1–20p, 5–80p, 10–£1.25, 50–£5.50

ECC82, ECH84, EH90, DY86/7, EF80, EF183, EF184, PC86, PC88, PCF80, PCF802, PCL82, PCL84, PCL85/805, PCL86, PY81, PY800, PY88, PL36, PL504, 6F28, 30PL14.

COLOUR VALVES 50p EACH

PY500/A, PL508, PL509, PL519.

Postage & Packing 30p, no VAT

VELCO ELECTRONICS

9 Mandeville Terrace, Hawkshaw, Via Bury, Lancs.

PL802/T Top Quality

Solid State Replacement Valve

£2.50 each C.W.O.

Lloyd Electronics, 63 North Parade, Grantham, Lincs.

TELEVISIONS to the Trade. Large quantities of Mono from £4, square screen from £8. Colour TVs working from £65. R.B.M. GEC, Pye, Thorn, etc. Phone Scarborough (0723 68087 65451. Scarborough TV Trading, Ridings House, Depot Lane, Seamer Road, (A64), Scarborough.

EX RENTAL TV

19″	UHF 625	£4.50
23″	UHF 625	£6.00
Colour	from	£40.00

EDWARDS & SONS

103 Goldhawk Road, London W12

Tel: 01-743 6996

MAINS DROPPERS

Philips G8 47Ω	40p
Philips G8 2-2-68Ω	60p
Philips 210 118-148-LoopΩ	60p
Philips 210 30-125-2K85Ω	70p
Philips GT23 6-124-84Ω	70p
Thorn 3500 6-1-100Ω	70p
Thorn 1500 350-20-148-1500-317Ω	85p
Thorn 8000 56-1K-47-12Ω	85p
Pye 725 27-56Ω	60p
R.B.M. TV161 250-14-156Ω	65p
GEC 2010 8-15-17-70-63-188Ω	85p

2010 Covers 2013 2014 2017 & Sobell 1010 10A 13 & 1014

Bush TV165-166-171-175-176-178 65p

Murphy V1910-1913-1914-2014-2310-2311-2312 2314 65p

TV Condensers:	200 + 200 ± 100 mfd 300V	42p each
	150–100–100–100–150M 325V	£1.90
	150–150–100M 300V	£1.50
	175M 400V 100–100M 350V	£1.95
	400–400M 350V	£2.50

Post Free, Cash with order, VAT paid.

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TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact Coles-Harding & Co., 103 South Brink, Wisbech, Cambs. 0945 4188. Immediate settlement.

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SETS & COMPONENTS

INGERTONE

For ex-rental colour and mono televisions

De-controlled sets suitable for re-rent or sale.
A good selection always available, many working.
Good testing conditions.
Trade only.

LONDON
24 Dames Road
London E7
01-555-5569 01-555-2200

BRISTOL
28 St. Thomas Street
Bristol 1
0272-211179

American Dynascan Tube Restorer & Analizer,

Now available in this country.

For full details write or telephone:–

T.V. WHOLESALE,

12 Front Street, Whitley Bay.

Tel: 532561 or 512276.

BREAKING TV's

Over 200 TV's to be disposed of, for Spares or Complete. Almost any Mono spare available (Tested). Any Mono Tube £5 + £1.25 p & p.

SPECIAL OFFER:– BRC 1400 Chassis, complete, working order. incl. valves, less tuner, £6 + £2 p & p. Many colour spares available. S.A.E. please with enquiries.

KNAVESMIRE T.V.,

74, Albemarle Road, York.
Tel: York 31237.

VALVE LIST

ALL VALVES FULLY TESTED

Five valves or over postage paid
Under five valves postage 6p each

DY86/87	15p	PC900	8p	PCL85/805	20p
EB91	12p	PCC84	8p	PL36	20p
ECC82	10p	PCC85	20p	PL504	25p
ECL80	8p	PCC89	8p	PY32/33	15p
EF80	8p	PCC189	8p	PY81/800	15p
EF85	8p	PCC805	15p	PY801	20p
EF183	10p	PCF80	8p	U191	15p
EF184	10p	PCF86	15p	6F23	15p
EH90	13p	PCF805	20p	6/30L2	15p
EY86/87	13p	PCL82	15p	30F5	10p
PC86	15p	PCL83	15p	30FL1	20p
PC88	15p	PCL84	15p	30PL14	15p

AND MANY MORE AVAILABLE

S. W. ELECTRONICS

114 Burnley Road, Rawtenstall, Rossendale, Lancs.

BRC 2000, 3000, 8000, 9000.
Philips G8, Pye 691, 697, 713
Bush Murphy 802, 823.
G.E.C. 2100 Single Standard Hybrid

Panel Repair/Exchange Singles or Bulk.

MODULAR ELECTRONICS

160 Brabazon Road, Hounslow, TW5 9LP.
Telephone 01-897 0976.

TIRRO ELECTRONICS the mail order division of RITRO ELECTRONICS UK offers a wide range of components for the amateur enthusiast. Large SAE or 20p brings list. GRENFELL PLACE, MAIDENHEAD, BERKS. SL6 1HL.

Colour T.V. Spares

Brand New Top Quality Components

E.H.T. Triplers

Philips G8 **£6.50**; Pye 691 **£6.00**; Thorn 3000 **£6.50**; 3500 **£6.50**; 8000 **£4.00**; Thorn 8500 **£7.00**; 9000 **£7.00**; Korting Hybrid **£6.80**; Grundig Hybrid **£9.00**.

Mains Capacitors

Philips G8, RRI. GEC. 600MFD. 300V **£2.25**; Pye 691 200-300MFD. 350V **£3.00**; Thorn 3000/3500 175-100-100 **£3.00**; Thorn 1000MFD. 70V **80p**; RRI. 2500+2500 30V **£1.25**.

Semiconductors

BT119 **£4.00**; BT120 **£4.00**; TV106 **£1.70**; BU208 **£2.80**.

All prices inclusive. Please add 30p for p. & p. Thousands of parts in stock for British and Foreign TVs.

Terry Gallagher,
TV Spares Specialist
20 Oakworth Green, Beechwood, Middlesbrough, Cleveland TS4 3ES.

Office Only, No Callers, Thank You.

EDUCATIONAL

FOR SALE

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ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Television for ....

insertions. I enclose Cheque/P.O. for £ ....

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd and made payable to Television)

NAME ....

ADDRESS ....

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Send to: Classified Advertisement Manager,
TELEVISION,
GMG, Classified Advertisement Dept., Rm. 2337,
King's Reach Tower, Stamford Street,
London SE1 9LS. **Telephone 01-261 5846.**
Rate
18p per word, minimum 12 words, Box No. 60p extra.

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PHILIP H. BEARMAN (VALVE SPECIALISTS)

SUPPLIERS TO H.M. GOVT. Etc.

NEW valves by Mullard, Mazda, Telefunken, Tungsram, etc.

"QUALITY" BRANDED VALVES ONLY CARRY THE 90 DAY GUARANTEE, SEE OUR LISTS.

IMMEDIATE POSTAL DESPATCH — **LISTS S.A.E.** — **QUOTED PRICES INCLUDING 6% ALLOWANCE IN LIEU OF GUARANTEE**

PRICES FROM JUNE 1978 INCL. 12½% VAT

DY86/7	75p	GY501	£1.60	PCF802	£1.00	PL36	£1.20	U25	60p	30P12	70p
DY802	80p	PC86	95p	PCF805	£1.60	PL84	70p	U26	60p	30PL1	£1.45
ECC81	75p	PC88	95p	PCF808	£1.70	PL504	£1.50	6F23	60p	30PL13	£1.00
ECC82/3	75p	PC97	80p	PCH200	£1.25	PL508	£1.55	6F28	£1.05	30PL14	£1.20
ECL80	70p	PCC84	35p	PCL82	£1.00	PL509	£3.00	20P4	70p	30PL15	£1.10
EF80	65p	PCC89	75p	PCL83	90p	PL802	£2.85	30C1	90p	Etc., Etc.	
EF183	80p	PCC189	75p	PCL84	£1.00	PY81/83	90p	30C17	80p		
EF184	80p	PCF80	95p	PCL85 }	£1.20	PY800	90p	30FL1 }	£1.20		
EH90	80p	PCF86	95p	PCL805 }		PY801	90p	30FL2 }			
EY51	85p	PCF200	£1.60	PD500	£3.60	PY500 }	£1.75	30L15	75p		
EY86/7	50p	PCF801	90p	PFL200	£1.35	PY500A }		30L17	75p		

BY 100/127 etc. all 21p each with 10W resistor.

(Correct at time of going to press ONLY.)

MINIMUM ORDER 80p!

ENQUIRIES WELCOMED ON OUR VAST RANGE

HUNDREDS OF OTHER TYPES AVAILABLE, VAST STOCKS.

SEND SAE FOR COLOUR & MONO TRIPLER LIST (BRC) ALSO LATEST COMPONENTS LIST.

See separate Component, CRT and Transistor List. Many obsolete types available. I.R.C. or S.A.E. with enquiries please. Please verify current prices due to inflation etc. Overseas Post @ Cost. U.K. Post 14p per valve under £20.00 (max. 80p) but 2p extra larger valves/ADDITIONAL VALVES 7p).

*Short supply.

TELEPHONE INQUIRIES WELCOMED

(Adjacent to Post Office) 6 & 8 POTTERS RD., NEW BARNET HERTS. Tel: 449/1934-5 (Robophone on 449/1934)

STOP PRESS PC92/96, PCL200, PL95, PL519 available! Also EY500A, EL509 etc.

(CLOSED 12.30–2 p.m. DAILY. OPEN SAT. A.M. ONLY)

NOTE Any excess paid will be refunded.

TELEVISION TUBE SHOP

NEW TUBES AT CUT PRICES

A28-14W	£18.95
A31-19/A31-20W	£19.95
A31-410W	£17.95
CME1220/A31-120W	£17.95
CME1420/A34-100W	£17.50
CME1520/A38-160W	£17.50
CME1906/A47-13W	£12.50
CME2013/A50-120	£17.95
CME2313A59-23W	£18.95
CME2413/A61-120W	£18.95

SPECIAL OFFER
FOR K.B. FEATHERLITE VC11
TSD 282/217 .... £8.50

JAPANESE etc. TUBES

9AGP4	£17.50
190AB4	£15.00
190CB4	£15.00
230ADB4	£18.95
230DB4/CT468	£20.00
CT507	£17.95
240AB4A	£17.95
310DMB4/DGB4	£19.50
310DWB4/DJB4	£19.50
310EDB4	£18.75
310EUB4	£19.50
310EYB4	£16.50
310FDB4	£19.95
310GNB4A Equivalent	£19.95
310HCB4	£19.95
340AB4	£19.50
340AYB4	£23.00
340CB4	£23.00
340RB4	£23.00
340AHB4	£24.50

Some Rebuilt Japanese Tubes Now Available at £14 + V.A.T.

COLOUR TUBES

12VARP22	£62.50
330AB22	£67.50
470FUB22B	£85.00
A44-271X	£65.00
A47-342X	£69.50
A49-191X/120X	£52.00
A51-220X/510DJB22	£64.00
A56-120X	£69.50
A56-140X/410X	£62.00
A66-120X	£75.00
A63-11X/120X	£69.50
A67-120X	£82.00
A67-150X	£69.00
A66-140X/410X	£70.50

ALL TUBES GUARANTEED 12 MONTHS

CARRIAGE:
Mono £2.00 Colour £3.00
N. Ireland £4.00

ADD 12½% VAT TO ALL PRICES

TELEVISION TUBE SHOP
52 BATTERSEA BRIDGE RD., LONDON, SW11.
Tel. 228 6859/223 5088

TELE-PART

REBUILT TUBES — TWO YEAR GUARANTEE

17″ 18″ 19″ £32
20″ £33 22″ £35 25″ £38 26″ £42

CASH OR CHEQUE + 12½% VAT
AND OLD CRT WITH ORDER
ADD £3.50 CARRIAGE

ENQUIRIES FOR OTHER SIZES WELCOME
ACCESS AND BARCLAYCARD ACCEPTED

TELE-PART (WTON) THE TELECENTRE, WORCESTER ST., WOLVERHAMPTON (0902) 772293

SOUTHERN VALVE COMPANY

Second Floor, 8 Potters Road, New Barnet, Herts.

Telephone 01-440/8641
MAIL ORDER ONLY
MINIMUM ORDER 80p

ALL NEW & BOXED. "QUALITY" BRANDED VALVES GUARANTEED 3 MONTHS. BVA ETC. HAVE 6% ALLOWED IN LIEU OF GUARANTEE! ALREADY DEDUCTED FROM OUR PRICES!

NOTE: PLEASE VERIFY CURRENT PRICES.

Correct only at time of going to press.

Some leading makes available.
VAT invoices issued on request.

DY86/7	53p	EF86	54p	GY501	£1.40	PCF802	80p	PL36	90p	PY500A	£1.75
DY802	53p	EF89	55p	PC86	75p	PCF805	£1.60	PL81A	65p	UBF89	41p
ECC81	54p	EF183	55p	PC88	75p	PCF806	75p	PL82	30p	UCC85	50p
ECC82	60p	EF184	55p	PC97	72p	PCF808	£1.70	PL83	46p	UCH81	58p
ECC83	54p	EH90	60p	PC900	65p	PCL82	63p	PL84	50p	UCL82	70p
ECC85	52p	EL41	90p	PCC84	35p	PCL83	80p	PL500 }	£1.10	UCL83	90p
ECH81	55p	EL509	£2.90	PCC85	52p	PCL84	65p	PL504 }		UF89	52p
ECH84	85p	EM84	90p	PCC89	50p	PCL85 }	70p	PL508	£1.50	UL41	85p
ECL80	52p	EY86/7	46p	PCC189	55p	PCL805 }		PL509	£3.00	UL84	70p
ECL82	62p	EY500A	£1.50	PCF80	80p	PCL86	80p	PL802	£2.90	UY41	55p
ECL86	70p	EZ80	42p	PCF86	60p	PCL200	£1.40	PY88	75p	UY85	60p
EF80	41p	EZ81	44p	PCF200	£1.50	PD500	£3.60	PY800	60p	U25	60p
EF85	45p			PCF801	55p	PFL200	£1.35	PY801	60p	U26	60p

We offer return of post service.

CWO ONLY. No C.O.D.

Post free over £20.
£6 to £20 – 80p (max.)

Items in stock at time of going to press but subject to possible market fluctuations if unavoidable.

One valve post 13p, each extra valve 6p. Large valves 2p. each extra.

MAX 80p LISTS & ENQUIRIES, S.A.E. PLEASE!

ALL PRICES INCLUDE VAT @ 12½%.

ENQUIRIES WELCOMED FROM TRADE & RETAIL (same prices)

PHILIP H. BEARMAN

6 & 8 POTTERS ROAD, NEW BARNET, HERTS. Tel: 01-449 1934/5

NEW MONO TUBES, Usually 2 Year Guarantee. Tested prior sale.

A31/410W Mullard }	£18.00 (A31/300)
A31/120 – CME1220 }	
A34/100 – CME1420	£19.50*
A38/160 – CME1520	£21.00*
A44/120WR – CME1713	£21.00
A50/120WR – CME2013	£18.00*
A61/120WR – CME2413	£21.00*

Note* less £1 for 1 year guarantee.
PRICES INCLUDE 12½% VAT.
MAKES INCLUDE TOSHIBA, MAZDA, BRIMAR & MULLARD.
CARRIAGE £1.50 (Mainland);
£1.25 Extra Short Sea Journey.
Eire Extra

COLOUR TUBES. Prices on application. SAE all enquiries please!
Prices correct at time of going to press but subject to alteration without notice.
Telephone enquiries welcomed. 19″, 20″ **£60; 22″ £68.00 £5** allowance old CRT.

EMO – EUROSONIC – GRUNDIG – TELETON + ALL BRITISH MAKES
IETC, ETC, ● ALL SPARES READILY AVAILABLE ● PANEL REPAIR SERVICE

NEW– COMBI/ANTUR LOPTX NOW AVAILABLE

SURPLUS STOCK

Colour CRT base	0.40
Mono CRT base	0.05
Mono EHT lead/cap	0.10
Mono Scan coil Bush etc.	£2.50
Mono aerial skt Decca	0.15
7 x 4 12R speaker Pye	0.85
10 Mxd T.V. control/switches	£1.00
50 Mxd presets	£1.00
10 IN60 (OA90 DA91 AA119)	£1.00
50 Mxd PF Capacitors	£1.00
10 BC109	0.70

All plus 12½% VAT + 25p P & P
Send s.a.e. for full lists.

ALMOST ANY T.V. COMPONENT SUPPLIED
By return "off the shelf" e.g. LOPTX – EHT trays – droppers – DSC coils – switches – cans – smoothers – transistors – diodes – I.C.'s, etc. etc.

IF YOU REQUIRE ANY T.V. COMPONENT YOU CAN BE 95% SURE WE CAN SUPPLY BY RETURN.
IF YOU'RE WAITING FOR SPARES – RING NOW!

FREE SERVICE CATALOGUE EMO CIRCUIT
Send 25p to cover post & packing
ACCESS AND BARCLAYCARD ACCEPTED

TELE-PART (WTON) THE TELECENTRE, WORCESTER ST., WOLVERHAMPTON (0902) 772293

FOR YOUR GUIDANCE

VALUE ADDED TAX

Unless otherwise shown, all prices in advertisements are inclusive of VAT. Where prices are exclusive, readers should ensure that they have added the correct amount of VAT before ordering.

Export orders are not subject to the addition of Value Added Tax.

40V, 2A O.P. Trans NPN PNP BD375-6	Pair 20p
AD161 – 162	Pair 60p
For Varicap 7 Push Button Units with Variable Resistance, Fascia Plate & Lamps	£2.00
6 Push Button Units with Variable Resistance for Varicap with Fascia Plate	£2.00
For Varicap 4 Push Button without Fascia Plate 20K	75p
Transistor BF180-1 UHF Tuner Unit with AE Socket & Leads. G.E.C. Rotary Type	£1.35 New
New VHF/UHF Varicap Units AEG	£3.00

10 Watts Mullard Modules LP1173	£3 Each
	£3 New
BF258	20p
BC303	20p
BD207	30p
BF157	15p
BC238A	10p
BC148B	10p
TIP31A	20p
TIP2955	50p
BF195	10p
8A 800V Thyristors 2N6399A	35p
7A/Thyristors 400V S2600D	35p
16172 RCA BT119 Type	£1.00
AT1025/08 Blue Lateral Ass.	25p
E1222	15p
BSY95A	7½p
2N930	7½p
4·7NF 5kV	10p

Convergence Panel for GEC 2040 11 Pots 5 Coils & Resistors etc	£2.00
220 MFD 450V	50p
MODULES	
Reject Units VHF ELC1042	50p
10 Watt LP1173	£1.00
I.F. LP1170	50p
AM/FM LP1179	50p
IN2069A	5p
Triple LP1174 Mullard	£3.00
TIP 29A	25p
TIP 32	25p

BT106 Special Type	60p
Y827 Diodes	30p
SN76227	50p
TBA 510	£1.00
TBA 540	£1.00
TBA 396	50p
Bridge Rectifiers	
B30C600A6	15p
B30C500P	15p
RCA Line Output Transistor for use in Low Impedance Line Output Circuits	75p
BT119	£3.00
BT109	60p
BT146	60p
RCA 536 O/P IC	

SENDZ COMPONENTS

2 WOOD GRANGE CLOSE, THORPE BAY, ESSEX.

Reg. Office only –
Callers by appointment only. Thank you.
Free Postage applies in U.K. only.

PLEASE ADD 12½% VAT

TV LINE OUTPUT TRANSFORMERS

All items new and guaranteed

MONO TRANSFORMER £7·45
(No Extra for Carriage)
VAT @ 12½% ·93
TOTAL £8·38

DISCOUNT FOR TRADE.

BUSH

TV102C	TV128	TV183 or D
TV103 or D	TV134	TV183S
TV105 or D	TV135 or R	TV183SS
TV105R	TV138 or R	TV185S
TV106	TV139	TV186 or D
TV107	TV141	TV186S
TV108	TV145	TV186SS
TV109	TV148	TV191D
TV112C	TV161	TV191S
TV113	TV165	TV193D
TV115 or C	TV166	TV193S
TV115R	TV171	TV198
TV118	TV175	TV307
TV123	TV176	TV313
TV124	TV178	TV315
TV125 or U	TV181 or S	

BUSH A816 CHASSIS **£11.00**

BAIRD — PLEASE QUOTE PART NO. NORMALLY FOUND ON TX. BASE PLATE 4133, 4123, 4140 OR 00062.

COLOUR TRANSFORMERS
ITT CVC1 TO CVC20 CHASSIS
PHILIPS G8 CHASSIS
DECCA CS1730 GS1830
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