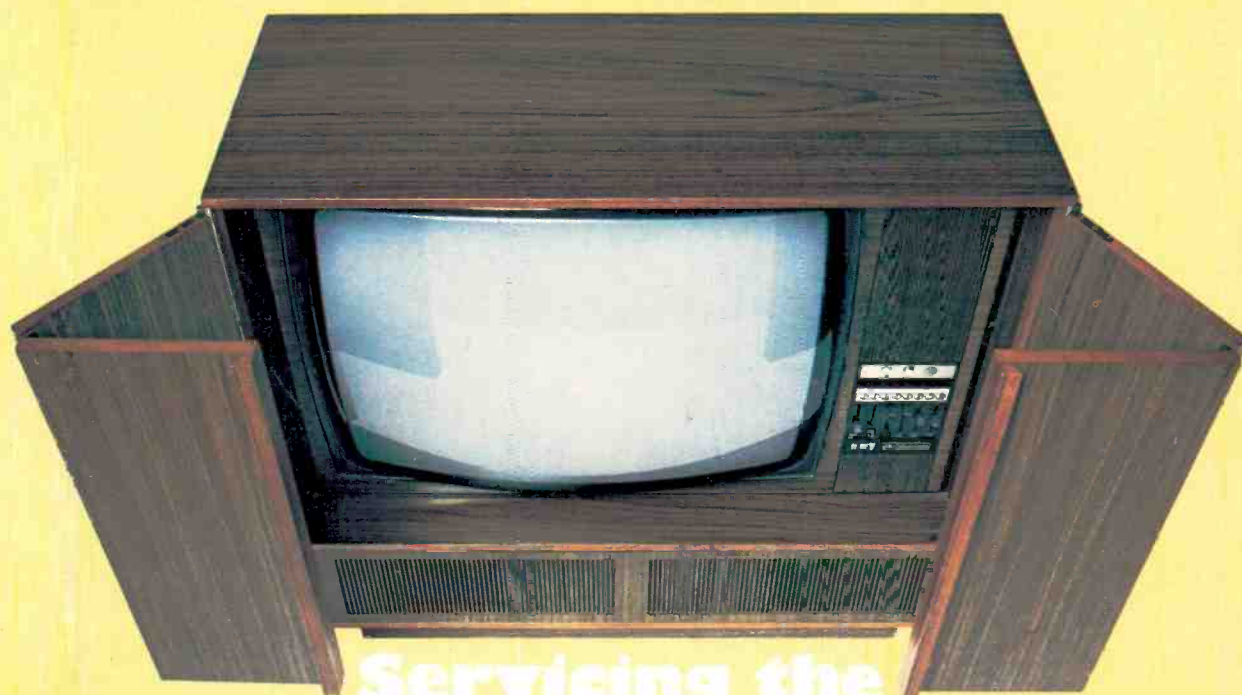


MARCH 1981

70p

# TELEVISION

SERVICING-VIDEO-CONSTRUCTION-DEVELOPMENTS

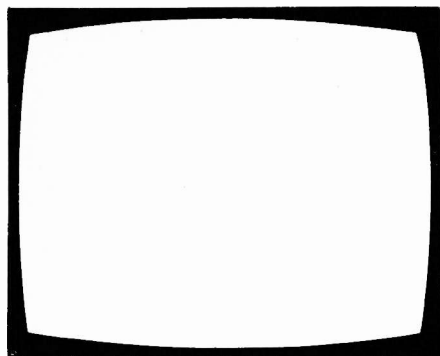


Servicing the  
THORN 4000  
Chassis



**UHF PREAMPLIFIER • PUB GAMES  
IN-CIRCUIT TRANSISTOR TESTER**





# TELEVISION

March  
1981

Vol. 31, No. 5  
Issue 365

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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., Lavington House, Lavington Street, London SE1 0PF.

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## QUERIES

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.

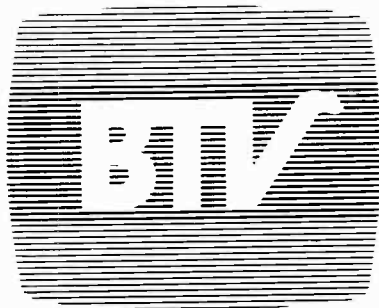
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

## this month

- 233 **Leader**
- 234 **Teletopics**  
News, comment and developments.
- 236 **Simple UHF Preamplifier** *by Roger Bunney*  
A wideband, single-transistor circuit featuring high gain with a very low noise figure.
- 239 **I Wish I Had Your Job** *by Les Lawry-Johns*  
A series of decidedly awkward faults this time, with a look at the power supply arrangements used in the Thorn 9800 chassis.
- 241 **Test Report** *by Eugene Trundle*  
An assessment of the NLS LM353 digital multimeter.
- 242 **Fun and Games** *by Malcolm Burrell*  
What goes on inside Space Invaders, Galaxian, Asteroids etc., and a note on faults.
- 244 **Service Notebook** *by George Wilding*  
Faults of various types and how to deal with them.
- 246 **Long-distance Television** *by Roger Bunney*  
DX reception and conditions, news from abroad, and details of a multi-position notch filter.
- 249 **Servicing the Thorn 4000 Chassis, Part 1** *by David Robinson*  
Thorn's chassis for driving 110° delta-gun tubes had many interesting technical features. A guide to the chassis and the common faults that have shown up.
- 254 **Video/Audio Input for the Philips N1700 VCR** *by D. K. Matthewson, B.Sc., Ph.D.*  
Arranging to feed video input signals into the N1700 is complicated by the fact that the machine was designed primarily for off-air recording. Video input is possible however, as this article shows. The audio side presents fewer problems.
- 254 **Readers' PCB Service**
- 256 **Practical TV Servicing: Hum and Hum Bar Problems** *by S. Simon*  
Hum is one of the most common problems with TV sets. A practical guide to locating the sources of hum and its elimination.
- 257 **Next Month in Television**
- 259 **A Look at Tuned Circuits** *by S. George*  
A brief summary of the main features of series and parallel resonant circuits.
- 260 **VCR Clinic** *by Steve Beeching, T.Eng. (C.E.I.)*  
This time the troubles have all been on Grundig VCRs of the 2 x 4 type.
- 261 **Vintage TV: The Ekco Model TS105** *by Vivian Capel*  
Another oldie, dating this time from 1949. Amongst the interesting features described are the thyatron field oscillator and Miller-transitron line oscillator circuits.
- 263 **Video Mixer** *by Malcolm Burrell*  
Board details for the project described last month.
- 264 **In-circuit Transistor Tester** *by Mike Phelan*  
This simple device uses only four components plus batteries and a switch, but provides a reliable check on whether a transistor is operational.
- 265 **Letters**
- 267 **Service Bureau**
- 269 **Test Case 219**

OUR NEXT ISSUE DATED APRIL WILL  
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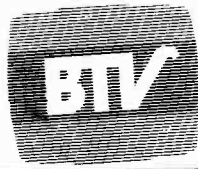
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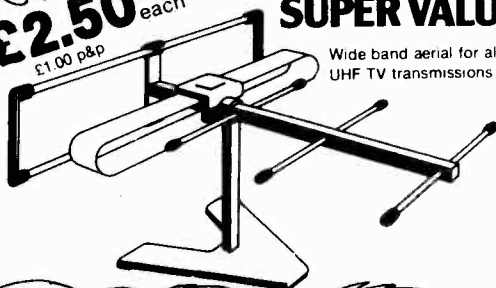
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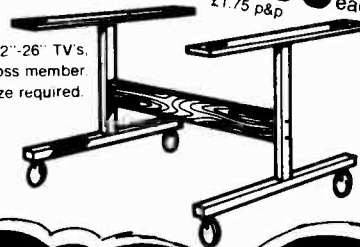


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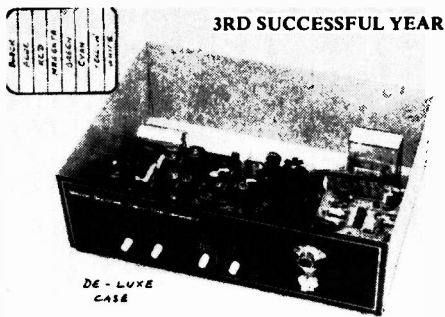
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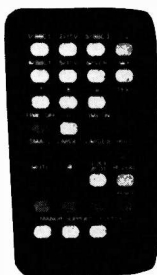
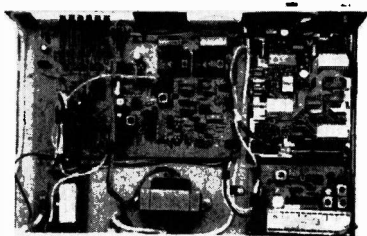
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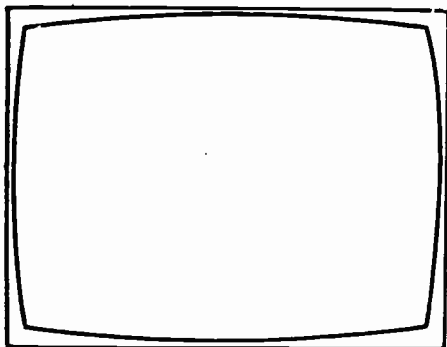
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Table for TELEGEAR (Details of full range on request) and LABEL ADAPTOR 7056.

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# TELEVISION

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## CORRECTIONS

Due to an editorial mistake, the frequency of the New Zealand ch. 1 vision carrier was twice given as 42.25MHz instead of the correct 45.25MHz in Roger Bunney's column last month.

In the December *Teletopics*, the changed value capacitor (burst gate timing modification) in the Rank T22A and T26A chassis was given as 2C50 instead of 2C59.

## An industrial nation?

A recent World in Action programme commented on TV setmaking in the UK, comparing in particular production at Panasonic's S. Wales plant and Thorn's Gosport plant. There was also a passing reference to the Rank/Toshiba events at Plymouth.

Now the problems faced by UK TV manufacturers are quite complex, while their causes lie a fair bit back in time. The policies pursued by the Japanese, UK and European governments are relevant, as is the general world economic climate and the value of the pound. These facts set the overall context of the situation. Within the UK, the abilities, resources and profitability of indigenous manufacturers and the policies pursued by successive governments are relevant. It's a complicated situation, with many contributory influences.

You wouldn't think so from the World in Action programme. They'd found a pat answer and that was that. Apparently the Japanese concentrate on the production floor, and having got conditions right there everything else falls into place. Now getting production right is obviously vital. Equally obviously it's only part of the story. One can't help but feel that if this World in Action programme is the best that TV can come up with, it's not a very suitable medium for investigating anything other than the simplest of matters.

The programme compared Thorn rather unfavourably with Panasonic. What it didn't say, amongst other things, was that the Panasonic plant is producing a set designed and engineered elsewhere, with the development costs already covered, that Panasonic operate on a world wide basis, and have far greater resources than Thorn. So far as a simple comparison between production lines is concerned, there's little difference between Thorn and Panasonic. Both use up-to-date production technology, and both produce first rate sets. In their TX9 and TX10 designs, Thorn products compare favourably with TV chassis produced anywhere in the World.

Japanese manufacturers have justly earned a reputation for reliability. But it's easy to make unfair comparisons. There are vast quantities of old and not very reliable UK made TV sets around. Many date from the time when Japanese sets were almost unknown in the UK. What were the Japanese sets of that time like? A bit better than the UK sets made during the produce-or-bust boom of 1973 perhaps, but they were often crude in comparison to the more recent sets we've come to think of as setting the Japanese standard. They too had valves, and cooked themselves up!

Sets designed and produced in the UK over the past five years may not quite have equalled the reliability standards established by their Japanese contemporaries, but they haven't been far behind. If you want to go into why Japanese manufacturing industry is relatively much more successful than that in the UK however you have to go rather deeper into the social, economic and industrial backgrounds.

We think of ourselves as an industrial country – after all the first industrial revolution occurred in the UK, and there was an awful lot of smoke over Manchester and Birmingham in Victorian times. It's a misleading notion however. Our relative industrial decline dates back to the last century, when industry in Germany and the USA was rapidly expanding. By the time of the first world war we were importing a high proportion of the manufactured goods we required, and to pay for them we exported cotton and coal – hardly high value-added items. The twenties and thirties were times of economic depression in the UK, and the post war period has hardly been one of burgeoning economic activity. The UK has been a minor industrial country throughout the present century in fact.

Now you could argue that this is no bad thing. To rely on trading, agriculture and the provision of services may seem to be a reasonable proposition. But there's little doubt that a sound manufacturing section is essential to the generation of real wealth, and that the general malaise felt in the UK has more than a little to do with our failings in this respect.

The roots of the problem go deep. In an educational system that's never devoted adequate attention to engineering and technology for example. In governments and a civil service that have not understood industry and its needs. In banking and investment strategies that have failed to provide adequate funds for industrial development. The whole depressing scene leading to inadequate productivity and profitability.

Unfortunately the problem today seems to be as far as ever from a solution. The nation's present administration is hell-bent on trying out an economic theory that takes no account of the problems of the "real" economy. At the turn of the century we were paying for our imports with coal. We're now paying for them with oil. Meanwhile the Japanese import oil and export TV sets and things...

# Teletopics

## **Japanese increase VCR production**

Because of the growing export demand for their VCRs, Japanese manufacturers have adopted plans to almost double production this year to around seven million units. About £200 million is being invested in increased production facilities – production in 1980 amounted to some 4.4 million units. By the end of 1981 the ten Japanese VCR manufacturers will have installed enough capacity to produce almost a million VCRs a month (the present capacity is capable of producing 540,000 a month). This takes one's breath away – Japanese colour set production reached a million a month for the first time only last November. In fact the Electronic Industries Association of Japan has forecast that exports of VCRs will soon overtake colour receiver exports.

This implies that the VHS and Betamax formats have by now become firmly established as world wide standards, and casts doubts on the chances of the European V2000 system being able to achieve a substantial share of the market in the foreseeable future. It's interesting to note that ITT in W. Germany have decided to start marketing VHS machines under their Graetz brand name. ITT had previously been concentrating on the V2000 system – which they will continue to handle alongside their VHS machines.

Sales of VCRs in W. Europe are expected to increase from around 1.1 million this year to 1.7 million or so by 1984 (this forecast comes from the 1981 Mackintosh Electronics Year book – see later).

GEC (Radio and Television) Ltd. are planning to add a VCR to their range of models – a VHS Hitachi machine. There are hopes that success with this could lead to a production line being set up at the Hitachi-GEC plant in S. Wales.

Supplies of the new Ferguson Model 3V24 portable VCR are now being distributed to the trade. This "second-generation" lightweight machine is a version of the JVC HR2200 which we mentioned in the January *Teletopics*. As complementary units there are the 3V25 mains power supply/battery charger/tuner/timer and the 3V26 mains power supply/battery charger. The prices are expected to be around £550, £200 and £63 respectively, including VAT.

## **Tatung to take over Decca Radio/TV?**

It seems likely that the Tatung Company will acquire from Racal the Decca radio and television interests. Tatung is Taiwan's largest manufacturer of electronics goods, and was founded in 1939 to manufacture steel products. Tatung, which means "universal harmony" in Chinese, employs over 25,000 people and had sales of over \$514 million in 1980. Monochrome portables produced by Tatung have been available in the UK for several years.

## **McMichael to produce BBC standards converter**

The BBC's new four-field digital TV standards converter is to be commercially produced by McMichael Ltd. The converter, called ACE, was developed by engineers in the BBC Engineering Designs Department, following fundamental work on signal interpolation carried out by engineers in the BBC's Research Department. The converter is particularly noteworthy in its ability to handle

pictures featuring rapid movement. In addition to standards conversion, the equipment provides signal processing for international television programme exchange: it can be used for PAL/SECAM transcoding, as a synchroniser for correcting the timing of one TV signal relative to another, and for repairing out-of-specification TV signals.

In recent years McMichael, which is now part of the GEC group of companies, has concentrated on professional electronic engineering for the military market, using both analogue and digital techniques. McMichael has also provided British Telecom with equipment for coding TV signals, and has produced data collection platforms for users of the Meteosat meteorological satellite. Older readers may however recall the times when McMichael as an independent company produced their own TV sets. They were one of the firms producing sets before the 1939-45 war, and continued to produce their own designs until 1956, when they became part of Radio and Allied Industries (Sobell). The latter subsequently merged with GEC. I wonder whether Vivian or Chas will be the first to come up with a vintage piece on the TM51 series, or maybe the earlier 909/912...?

## **405-line close down**

Details of the initial stages in the run down of the 405-line transmitter network by the BBC and the IBA have now been released. 48 transmitters will be closed down in 1982, and a further 36 transmitters will cease broadcasting in 1983 (see list below). The network will be phased out gradually during the five years 1982-6.

## **405-line transmitter closures, 1982-3**

### **First quarter 1982**

Bude, Okehampton, Bodmin, Isles of Scilly, Ballachulish, Kinlockleven, Carmarthen, Churchdown Hill. (All BBC transmitters.)

### **Second quarter 1982**

**BBC transmitters:** Belmont, Sheffield, Scarborough, Kendal, Dundee Law, Perth, Maddybenny More, Ballycastle, Kilkeel.

**IBA transmitters:** Belmont, Sheffield, Scarborough, Ballycastle.

### **Third quarter 1982**

**BBC transmitters:** Ventnor, Bexhill, Newhaven, Canterbury, Ffestiniog, Abergavenny, Cardigan, Llanelli.

**IBA transmitters:** Newhaven, Ffestiniog, Abergavenny, Brecon.

### **Fourth quarter 1982**

**BBC transmitters:** Marlborough, Swindon, Oxford, Hungerford, Hereford, Northampton, Bedford, Cambridge, Aldeburgh, Ayr, Campbeltown, Girvan, Port Ellen.

**IBA transmitters:** Membury, Lethanhill.

### **1983**

**BBC transmitters:** Bath, Barnstaple, Weymouth, Manningtree, Wensleydale, Douglas, Richmond (N. Yorkshire), Weardale, Whitby, Thrumster, Orkney, Bressay, Ballater, Toward, Lochgilphead, Rosneath, Millburn Muir, Grantown, Kingussie, Pitlochry, Fort William, Llangollen, Ammanford, Kilvey Hill, Llanidloes, Larne, Newry.

**IBA transmitters:** Huntshaw Cross, Bath, Ridge Hill, Richmond Hill, Whitehaven, Rumster Forest, Rothesay, Rosneath, Aviemore.

## **Aerial Catalogue**

South West Aerial Systems have produced a new, expanded catalogue listing a wide range of aerials, amplifiers and

associated equipment. In fact almost anything you might require for TV reception is to be found within it. The catalogue costs 45p, from South West Aerial Systems, 10 Old Boundary Road, Shaftesbury, North Dorset (telephone 0747 4370). The proprietors are Roger Bunney and David Martin.

### Crystal Gazing

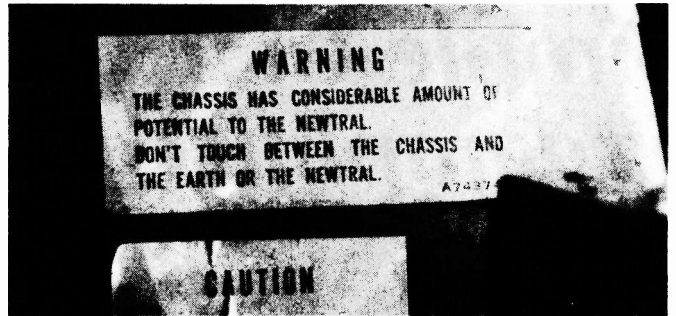
And something more . . . If you've an odd £130 to spare you can buy a copy of the *Mackintosh Yearbook of West European Electronics Data 1981*, which gives production (1978-81) and market (1979-84) estimates for the electronics industry in each of the thirteen W. European countries. It's the eighth successive annual edition. The growth of the total W. European electronics market in 1981 is expected by Mackintosh to match an assumed 1980 increase of 12 per cent. This would take it, in constant US dollar values, to a total of over \$100 billion. There seems to be a bit of double counting here however, since components, though quite rightly listed separately, presumably mostly end up in electronic equipment of one sort or another. Anyway, despite the "gloomy economic outlook" on which the Yearbook's forecasts have been based, Mackintosh say that "the current rate of innovation within the electronics industry is proving strong enough to maintain double digit growth rates". A continuing problem area however is the consumer electronics one, which is expected to remain virtually static between 1981-4 at around \$15 billion per annum. Sales of colour TV sets in W. Europe are expected to remain at an annual level of around eleven million: for VCR sales estimates, see our note earlier. One product likely to continue to increase in volume sales however is electronic watches, with European consumption forecast to rise from some 48 million in 1980 to nearly 68 million in 1984. Better put a showcase alongside those VCRs.

An interesting note on video games. Apparently 1980 is assumed to have been the peak year, at around 4.2 million units sold in Europe, with the UK well ahead of elsewhere, accounting for over 30 per cent of total sales. The novelty is expected to wear off by 1984, when just over half the 1980 volume may be required in the UK, though by then other slower growing national markets could be nearing saturation.

As for overall totals, the W. German electronics market is expected to produce total sales of nearly \$27 billion in 1981, with the French and UK markets being around the \$20 billion mark. While W. Germany had a positive trade balance of around \$1.5 billion in 1979, both France and the UK had deficits of around \$1 billion. Other W. European countries with a positive trade balance in 1979 were Holland, Portugal, Sweden and Switzerland. The Yearbook is published by Mackintosh Publications Ltd., PO Box 28Y, Luton LU1 5DB.

### News in brief

Italy is to become the eighth country to participate in British Telecom's Prestel service. SIP (Societa Italiana Per L'Eservizio Telefonica PA) will acquire a GEC 4082 computer and carry out market research . . . The US Electronics Industry Association has been conducting field trials on three different systems for dual-channel TV sound. If the Association's subcommittee can agree on proposals to put before the FCC, dual-channel TV sound transmissions could start next year. The systems under trial are backed by the Electronics Industries Association of Japan, Zenith and Telesonics . . . Conic Investment is setting up a colour TV assembly plant in Hong Kong, which will join Korea,



Notice inside the back of a set – spotted recently by our ever vigilant photographer/servicing friend Stan Franklin.

Taiwan, Singapore and the Philippines amongst others in the Far East at present producing colour sets.

### Publications

Lastly, since my fingers feel as if they're wearing out, some books of interest to readers. A new edition of Roger Bunney's book "*Long Distance Television Reception (TV-DX) For The Enthusiast*" has been published by Bernard Babani (publishing) Ltd., The Grampians, Shepherd's Bush Road, London W6 7NF, at £1.95. It's an enlarged, revised and updated version with extra circuits and taking in such things as satellite reception.

JVC have published a work entitled "*Video the Better Way – a new art for a new age*", comprising five booklets contained in a holder of the same size and design as a VHS cassette, so that it conveniently fits into a video collection. It's aimed at beginners and experienced video users alike, with illustrations in colour and monochrome, both photographs and diagrams. The books cover basics, production, enhancement, applications and supplements respectively, taking the user step by step from basic video recording and camera work through to advanced techniques. "*Video the Better Way*" is available through JVC dealers and specialist video outlets at around £3.95.

The latest IBA Technical Review is entitled "*Standards for Television and Local Radio Stations*" and is the thirteenth title in a series that started in 1972. The lavishly produced 72 page book is a useful reference source, bringing together the current IBA Technical Codes of Practice relating to television studio centres, ILR studios and OB operations. For TV, detailed descriptions of improved test techniques for checking signal sources are for the first time given. The book is intended for engineers, firms and students directly involved in broadcasting, and is also available to technical libraries and educational centres in the UK and overseas. Enquiries should be sent to the IBA Engineering Information Service, Crawley Court, Winchester, Hants, SO21 2QA.

Newnes-Butterworths have recently published the "*Newnes Book of Video*", at £5.95 from booksellers or from Newnes Technical Books, Borough Green, Sevenoaks, Kent. It follows the pattern established with the "*Newnes Book of Audio*", a number of contributors – several of whom will be familiar to readers of this magazine – describing what current video technology has to offer the user. The coverage is certainly comprehensive, taking in the TV set itself, VCRs, video discs, cameras, aerials, cable distribution, teletext/viewdata, CCTV and TV games, leading to computer-TV link-ups. There's also an interesting chapter devoted to programme making. The presentation is excellent, and we'd say it's a handy book to have around as a reference source on the current domestic video scene – and related matters since security and surveillance for example are also covered.

# Simple UHF Preamplifier

Roger Bunney

FROM time to time there arises the need for an inexpensive, simple but effective u.h.f. preamplifier covering the local group of channels. The circuit to be described meets these requirements, using a very recent, low-noise transistor – the SGS/ATES BFQ85. It's an npn silicon planar epitaxial transistor with high gain and a low noise figure, intended for use at up to 1.5GHz. The quoted noise figures are particularly interesting – 1.6dB at 200MHz, rising to a typical 2.2dB at 1GHz. This is quite an improvement on the previous u.h.f. preamplifier design we featured, in July 1979. That used a BF679 transistor, which has a quoted noise figure of 3.5dB at 800MHz. The maximum power gain figure quoted for the BFQ85 is 21dB at 500MHz, falling to 15dB at 1GHz.

The circuit (see Fig. 1) is simple enough. The input signal is coupled to the base of the transistor via a u.h.f. bandpass circuit consisting of C1, L1 and C2. L2 is a stand-off coil for the base bias, which is applied via R1 and R2 – it's wound using the leadout wire of R1. The transistor is operated in the common-emitter mode – the two emitter leads make for easy mounting. The tuned output circuit consists of the line L3 and the tuning trimmer C3, the output being tapped from the low-impedance end of L3 and taken via C4.

The prototype preamplifier is housed in a diecast box. It's built on a small square of double-sided copper laminate, supported within the box by means of solder tags bolted via the fixing bolts used for the coaxial sockets. The BFQ85 is mounted centrally on the copper laminate, with a copper screen to give isolation between the input and output circuits. The screen has a slot filed at the centre of one edge so that it neatly straddles the transistor. Because of the size of the case used for the prototype, the tuned line was bent to

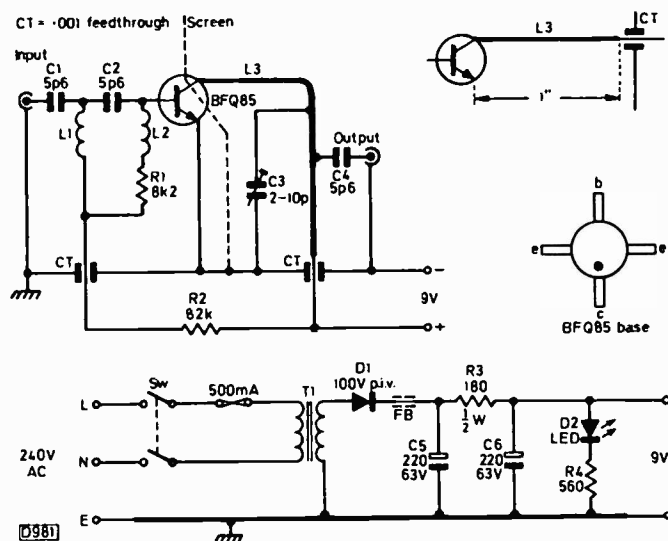
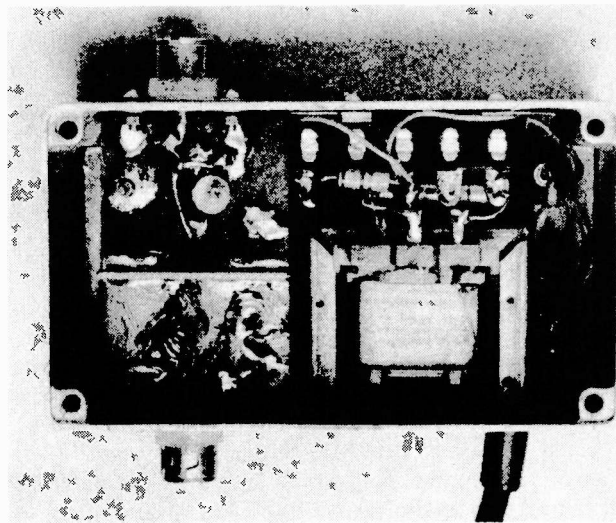


Fig. 1: Preamplifier circuit (above), with suggested power supply circuit (below). R1/2 1/2W metal oxide, C1/2/4 ceramic plate, C3 subminiature foil trimmer. L1/2 two turns closed spaced. C3 tapped at midpoint of L3, C4 tapped a third along from the "dead" end.



fit the available space. If a slightly larger box is used, the line can be straight.

A simple power supply circuit is shown. It can be varied according to the type of transformer available. Aim for a supply of approximately 9V. The value of R3 will need to be changed if a different transformer is used. The transformer used in the prototype was obtained at a component shop in the Edgware Road for 95p: it has an 0-240V primary and 0-12V secondary winding.

For optimum performance at u.h.f., keep all connections and wires carrying the signal very short. The wire used as the centre conductor in low-loss coaxial cable is suitable for use as the tuned line L3. The design could be simplified by excluding C2, L2 and R1.

In common with all circuits and projects using mains-operated power supplies, extreme care should be taken to avoid the possibilities of electrical shock. If the unit is used indoors, precautions must be taken to prevent direct access to any exposed mains connection. Three-core cable must be used, with the earth wire connected to the amplifier's chassis.

Although we cannot measure noise, we found that the performance in comparison with the previous preamplifier using the BF679 transistor was extremely good. The noise improvement on a slightly snowy 120μV input signal from Crystal Palace was quite startling. Allowing for an input mismatch, the noise figure in group A will probably be 2dB.

The measured gain on ch. 23 was 19.8dB and on ch. 45 17.5dB. Trimmer C3 is used for peaking over the given band coverage. The prototype covers chs. 21-55, with L3 the length shown: reducing the length of L3 to 1/4in. should give coverage over chs. 40-70. The "peak" is very broad. If the upper part of the chosen spectrum is peaked, the gain over the bandwidth should have a variation of only about 4dB. If single-channel operation is required, the design shown in the July 1979 issue could be adopted, with the necessary changes in the biasing arrangements.

Components can be obtained from Maplin. Ambit also supply the trimmer. The BFQ85 is available from Hawt Electronics Ltd., Firwood Road, Birmingham B33 0TQ. Please include a stamped, addressed envelope with any written enquiry about prices etc. SGS/ATES tell us that from 1981 the supply of r.f. devices in the UK will be run down. Fortunately present stocks are high, so no difficulty with supply should be experienced, but in the longer term the BFQ85 will become difficult to obtain. Other sources are Compstock Electronics Ltd. at Basildon, Consort Electronics Ltd. at Camberley, Distronic Ltd. at Harlow, Quarndon (Semiconductors) at Derby, and ITT Electronic Services Ltd. at Harlow and Johnstone, Renfrewshire. ■

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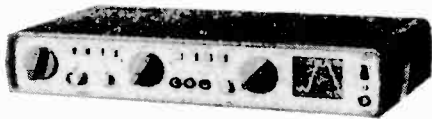
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# I Wish I Had Your Job

Les Lawry-Johns

YOU'VE noticed of course that once one horrific, heartbreaking job has been cleared up another immediately follows. Then, as though Satan himself was directing things, yet another comes along. That's how it's been recently.

"These things are sent to try us" said honey bunch consolingly.

"Try us indeed. What you mean is try me. It's me that's being tried and found wanting, and the chances are that someone up there doesn't like me and never will. I'm fed up with it all. Mix me an overdose and let me be free."

"How you do go on. Just because you're mucking up one job after another we all have to suffer. Now if you'd taken that panel out properly instead of wrenching it out like a maniac it wouldn't be cracked right across."

## Fluctuating Picture

So saying she wandered off and left me trying to think up a suitably cutting reply, something I found difficult since I was still trying to work out why the picture on this Bush Model CTV1122 (A823A chassis), which had come in to have a new tripler fitted, was fluctuating so wildly. They had mentioned that the picture occasionally "jumped on changes of scene", and I'd said it was only a small thing that wouldn't take a minute once the new tripler was in . . .

I examined the picture carefully. On a bright scene, or when the contrast was advanced, some lines appeared horizontally, the picture fluctuated wildly in size, and there was evidence of a hum bar. A meter across the h.t. line showed a corresponding voltage fluctuation before the picture quickly settled down. I pointed an accusing finger at the thyristor, but noticed that it was new - as was the trigger diac. To be sure, I fitted a known good spare panel, but there was no difference.

With the hum bar in mind, I turned my attention to the h.t. smoothing and reservoir capacitors. Both had small bubbles at the end, so out they came. At the same time I noticed that there was some corrosion at the tags of the centre l.t. smoothing capacitor, and one tag fell off when it was touched. So out it came and we ended up with a shining new set of electrolytics. No difference, except that the hum bar, which hadn't been very evident anyway, now wasn't evident at all. But the picture still showed lines and fluctuated from time to time, particularly when the contrast was advanced.

Since the field scan seemed to be affected most, I replaced the right-hand side timebase panel - without much hope of success. It must be the new tripler then. It wasn't. Neither was it anything to do with the line output stage nor the convergence panel. I examined my head carefully in the mirror. Definitely greyer, and there was this kind of glazed look . . .

It must be a poor earth return. The term has a likely ring to it. Crocodile clips and leads all over the place, and whilst wasting all this time I noticed that a new tube had been fitted recently. This was the last place left to check. It just had to be here.

All the earthing connections seemed to be loose, as

though whoever had fitted the tube had been so exhausted by the effort of securing it that they hadn't the strength to finish off the job. The thick sleeved strap really seemed to be the one that was slopping about, and when this and the other contacts were tightened we couldn't make the fault reappear. We still can't quite see how this could have been responsible for such a drastic h.t. voltage variation.

"Did you find out what was giving you so much trouble?"

"There was a screw loose."

"Quite common around here."

No wonder I hate women.

## All that Glistens . . .

A familiar car drew up outside. It had drawn up only yesterday. The nice man with the 26in. Philips G8. We fitted a nice new line output transformer for him, and he'd paid in nice new fivers.

The 800mA fuse on the line timebase panel had failed again however. There were no shorts, and the output transistors appeared to be in order, but when we connected the meter across the fuseholder and switched on we got a reading of well over 1A, while the  $47\Omega$  anti-breathing resistor in the h.t. feed to the line output stage started to overheat. Pop went the fuse on the power supply panel.

Once more my hawk like eyes narrowed. Once more I couldn't see a bloody thing. But I was called upon to make a decision. The glistening new transformer was unsoldered and removed. A dull brown FAT 035 G8 replacement was fitted. The tripler was left disconnected, a new fuse was fitted over on the power supply panel, and the meter was linked across the fuseholder on the line scan panel. Switch on and a reading of some 400mA showed that the right decision had been made, difficult though it had been. Connect the tripler and the reading rose to about 500mA.

"Sorry sir, very sorry. Your new transformer had rather a short life."

"I hope this one fares a bit better."

"It will sir, and a happy new year. Mine's started off interestingly enough."

How fortunate that we keep a good stock of G8 line output transformers.

How prudent that we keep a good stock of . . . if there's a competitor, it must be the Rank T20 chassis. Having said that however I must add that I find the G8 the easiest set to work on. It's caused me few real problems.

## Which Reminds Me

One that raised my eyebrows came in the other day however. It came in because the picture was over large, and because the customer was fed up with the service he'd been getting from a nation-wide group. The over large picture was due to low e.h.t., one of the line output transistors being short-circuit. We also found that the h.t. was 240V instead of 205V. Having replaced the short-circuit transistor, we wound the h.t. preset down and checked again. Still 240V. So we checked the preset in the over-voltage protection

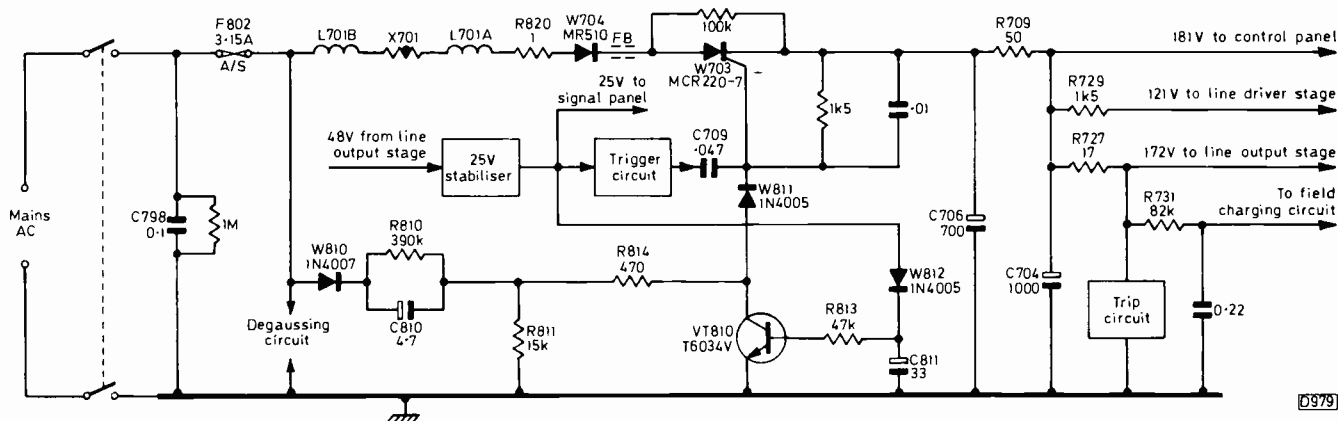


Fig. 1: Simplified circuit showing the power supply arrangements used in the Thorn 9800 chassis. Because the low-voltage supplies are derived from the line output stage, a start-up circuit is required. This consists of W810 and the associated components. When the set is first switched on, mains-derived gate pulses are fed to W703 via W810, C810, R814 and W811. Once the h.t. supplies have been established, the line output stage will come into operation, producing the 48V and stabilised 25V rails. The thyristor will then be triggered in the normal way. When the 25V supply appears, W812 charges C811 and VT810 switches on, shorting out the start-up circuit. Should the over-voltage trip operate, the h.t. and l.t. supplies will decay. W812 will be reverse biased and the time-constant of C811/R813 will hold VT810 on for a while. This prevents the thyristor being triggered until the h.t. supply has been discharged.

circuit. Adjusting this reduced the h.t. all right, but of course the picture was then fluctuating. This suggested that the thyristor was not well. It was new however, as was the BR100 trigger diac. This was presumably why the previous repairer had left the h.t. at 240V, with a steady picture, and had beat a hasty retreat.

I pondered. The protection circuit wasn't operating when the h.t. was high, presumably because it was not set up correctly, but was able to reduce the h.t. voltage when adjusted, the h.t. preset doing nothing at all. It seemed likely that something was wrong with the regulator action. R1368 (470k  $\Omega$ ), which is in series with the h.t. preset, and the feedback resistor R1372 (390k  $\Omega$ ) were both found to be out of tolerance – with R1368 really high. Replacing both resistors restored normal operation, a 205V stabilised h.t. supply and a happy customer.

### The Thorn 9800 Chassis

We've sold quite a few Thorn 9800s – along with 9000s, 9600s and 8800s. While the 9600 is a larger-screen version of the 9000, with the Syclops system but with quite a lot of differences, the 9800 is a descendant of the 8000 series chassis, being a variant of the 8800. This means that it uses a thyristor regulated power supply with an over-voltage trip and, in addition, an inertia start-up circuit. The latter is required because of the subtle changes introduced with the 9800 chassis. Out went the mains transformer, all the low-voltage supplies in the set being obtained from the line output stage, which incidentally employs a diode-split line output transformer. So with only the h.t. supply mains derived, and the thyristor's trigger circuit powered from the scan-derived 48/25V rails, a start-up circuit (see Fig. 1) is necessary. All this is rather complicated and serves to

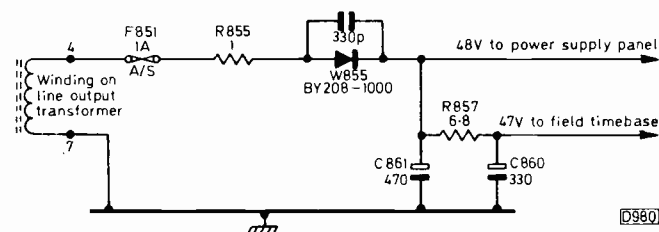


Fig. 2: 48/47V supply circuit, Thorn 9800 chassis.

explain why a simple soul like me gets confused for a little while . . . sometimes longer.

Anyway, the fault reported was intermittent field collapse and hissing, and like a loon I headed straight for the power supply panel, expecting to find a dry-joint in the supply to the field timebase – as you might with the 8000-8800 series. I removed the panel and checked it over thoroughly. Apart from one in another circuit, there were no suspect connections. So I replaced the panel and then found that there was no supply of any sort worth mentioning, except that the power supply was tripping slowly. The slow tick irritated me intensely, since we were now in another ball game and one that always confuses me. Old dogs don't easily learn new tricks.

A meter connected to the 50  $\Omega$  h.t. filter resistor R709 confirmed that the h.t. supply was rising slowly to about 50V, then ticking back to zero. This meant that the start-up circuit at least was functioning. Just then my friend Geoff from Moon Lane popped in to say hello, and asked whether I was in trouble. I explained that the field collapse problem had resulted in me bugging about with the power supply panel, and that I was now in it up to my neck. He said he'd had the same trouble a little while ago and had done much the same thing before realising that the 47V field timebase supply comes from the line output stage. That cheered me up enormously, since now I had a slowly tripping supply and hadn't even started to clear the original faults.

The manual suggested that providing an external 24V supply would help. It didn't seem to make much difference however, so I lost my cool and decided to supply the set with some h.t. whether the set liked it or not. I grabbed a 150  $\Omega$ , 17W resistor and slapped it straight across the thyristor – the thyristor is preceded by an h.t. diode (W704) which can do the rectifying bit. This started the set up with no trouble at all, and on removing the 150  $\Omega$  resistor the set remained on, albeit with a small picture and low h.t. I then noticed that the set h.t. preset control appeared to be at minimum, and on turning it to about midway the h.t. voltage was correct and the picture full size. Switch off and check how the set behaves from cold. Switch on, hear the e.h.t., then find a bright line across the centre of the screen. At least the h.t. was correct.

So I decided to tackle the original problem of field collapse. We now know that the field timebase supply comes from the centre line output stage panel. This can't be

reached from below, so the set had to go off again. Release and slide out panel, then unpend it. The 47/48V supply circuit is shown in Fig. 2, and what we discovered was that the 470  $\mu$ F reservoir capacitor C861 was loose in its solder while the filter resistor R857 (6.8  $\Omega$ ) was dry-jointed. The dry-joint on R857 would explain the field collapse of course, but would the loose reservoir capacitor explain the tripping? All I can report is that no further trouble of this sort has been experienced, but a few minutes after sorting out these connections the hissing initially mentioned put in an

appearance. This turned out to be due to a kink in the e.h.t. cable as it left the top of the line output transformer socket. A new cable with a long-reach nipple was fitted and this trouble was over.

The fact that there was intermittent colour after an hour's use meant that the set came back in again for an i.c. change, but no one had mentioned that so how was I to know?

"I wish I had your job" said Dick as he dealt out the cards. "You never seem to have any worries."

I didn't hear him properly because of the wax in my ears.

# Test Report: The NLS LM353 Digital Multimeter

Eugene Trundle

THERE'S a wide range of digital multimeters on the market at present. Some still use an LED display, but these are now in the minority. The more recent LCD system has many advantages (unless you're working in the dark!), mainly the lower battery consumption. From the many meters available, we chose the NLS manufactured LM353. It's about the smallest DMM we've seen, and is a good example of the current trend towards the miniaturisation of test gear. The instrument is one of a range of several DMMs produced by this manufacturer. They share a common case size, offer a choice of LED or LCD displays, and vary in price from £69 to £195 ex VAT.

The LM353 is about the size of a PP9 radio battery and, being housed in a plastic case, can very often be sat inside the equipment under test. It's a 3½ digit type, which means that "full-scale deflection" is 1.999 and decades thereof. Since a digital display cannot go backwards or "off the end", polarity and overload indicators are required. These take the form of a + or - sign before the readout, and a steady 1 display in the event of overloading. There are a.c. and d.c. voltage and current ranges - four, from 2V to 1kV and 2mA to 1A. The resistance ranges are from 200  $\Omega$  to 10M  $\Omega$ . Power is provided by four AAA size cells, the battery life being quoted as 100 hours. Inside, the instrument consists of four i.c.s and a fair number of discrete components, arranged on three small, parallel-mounted glassfibre boards.

## On the Bench

During the two weeks I had the meter for test, it was being constantly used for TV servicing. I found that the calibration accuracy was within specification on all ranges, and that the a.c. ranges were average-sensing/r.m.s. calibrated for a sinewave input, as is usual with this type of instrument. On the resistance ranges, I found that the kilohms range had the ability to forward bias a semiconductor device (test voltage 2V), whereas the k $\Omega$ /10 range, with applied voltage of 200mV, was not sufficient to switch on a semiconductor junction. This has the advantage that many components mounted around a silicon semiconductor device can be checked in situ - a useful point, and one which may not be immediately apparent. The current ranges require the meter to drop 1V at f.s.d. on all ranges: this seems rather a lot!

I was not so happy with the LM353 mechanically. The front panel is made of wafer thin plastic material which looks vulnerable to damage, and I'm wary of the battery

changing procedure. This involves removing the whole outer case, exposing the delicate circuit boards etc. Finally, the front panel printing around the range switch is spaced in such a way that the click stops of the switch get "out of phase" with the panel legend. In the extreme case, on the direct current range, the knob tends to point more to "AC mA" than "DC mA".

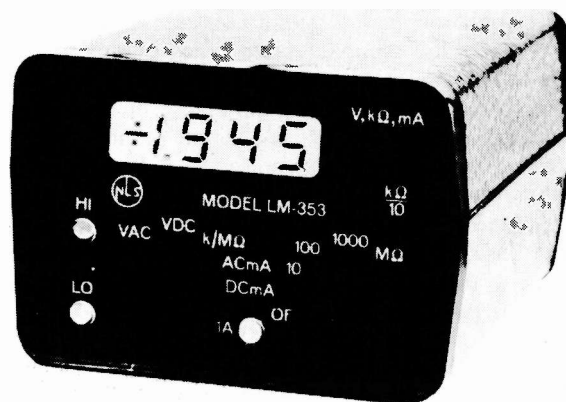
On the credit side, the main case and back cover are made of a tough, flexible material, and a useful multiposition prop/hook/handle is provided - I slipped some sleeving over this during the time that I had the meter for test, so that the instrument could be laid in a working TV set without the risk of the metal prop causing fireworks.

## Conclusion

If your requirement is for a DMM of minimum size for general purpose use, you won't find one smaller than this! It works well, but is certainly not under priced at £75 plus VAT.

One of my TV servicing colleagues long years ago regularly used to carry out his field servicing on a company Lambretta motor scooter. If the current depression bites much deeper, maybe we shall all have to return to this economic but hazardous mode of transport. Just right for the super technician who never has to bring a TV set back to the workshop (does anyone know any?). If this comes to pass, test equipment such as this meter and the baby oscilloscope recently reviewed will be much in demand!

The LM353 is available from Lawtronics Ltd., 139 High Street, Edenbridge, Kent TN8 5AX.



The NLS LM353 "baby" digital multimeter.

# Fun and Games

*Malcolm Burrell*

SOME ten years or so ago it was discovered that a simple sort of bat and ball game on a TV screen could be produced by combining a few ramp generators and monostables. Since then, motorway service areas and amusement arcades have sprouted tall cabinets with windows and joysticks, to which hundreds of thousands of bored youngsters have flocked to insert their pocket money and challenge each other to a game. The monotonous slow shuttling back and forth of the "ball", along with its "plink, plink" sound, soon came to be produced by cheap games that found their way into Christmas stockings. There was a brief battle for supremacy amongst the manufacturers of simple monochrome games, with a choice of different games – ice hockey, football and so on – being added along with alternative speeds of play and sizes of bat. A further boom occurred when specialised chips took over most of the circuitry and the games started to be displayed in simple colours.

Pubs and bars were also afflicted from the start by these pings and plonks. Then, with advances in microprocessor and memory technology, more sophisticated games of American and Japanese origin started to appear, offering the skill of shooting without a gun and, instead of conventional ball and skittle presentations, alien beings and rockets. Space Invaders had appeared.

## *The Innards*

The latest generation of machines use monitors specially made for the job, by various American and Japanese firms, instead of modified TV sets. Most are self-contained, needing only a nominal 117V supply, are all solid-state and very reliable. The logic boards for the Space Invader type games usually contain about half a dozen PROMs and up to a couple of hundred other individual i.c.s, mainly of the TTL variety. There are usually three or four boards, each about ten inches square. The circuits are reliable, which is fortunate in view of the rather rudimentary service data available. This tends to contain brief notes on the settings of the function switches etc., and advice of a rather general nature – don't instal the machines outside in the rain, close to radiators, and that sort of thing. Such is the competition and speed of development that only a few basic patents seem to exist, which may account for the general shortage of more detailed information on particular units.

The upright cabinet versions continue to be made, but more recently the compact table types of machines have started to appear in considerable numbers. Most have a plate glass top to prevent beer, ash and so on contaminating the interior, with tinted Perspex over the monitor's screen to improve the contrast in the presence of bright lighting – something that most service engineers will testify is not all that common. The few remaining monochrome games generally use narrow-neck tubes, while for colour games the PIL type of tube is the rule. With no need for convergence, reliability is good indeed.

## *Colour*

The Space Invaders game uses coloured filters to add the

colour effect, but more recent designs, using RGB drive to the monitor, usually at TTL level, enable six fully saturated colours in a very sharp display to be obtained. The usual drive controls are present, but since grey-scale tracking is not necessary slight adjustment for the best colour rendering is all that's required. All colour monitors have degaussing coils fitted to the tubes, and these are usually automatically energised at switch on. Many engineers who are more familiar with fruit machines are mystified by the presence in some games machines of a "magic button" which when pressed causes the picture to quiver and momentarily change colour. The manuals often give purity and convergence instructions for the tubes which, strangely, don't always have their magnetic rings sealed. The popular Galaxian game, of which there are several variations, featuring rows of alien craft which fly down and bomb the player's rocket unless he shoots them first, has a crosshatch option. Fortunately the need for adjustment is rare.

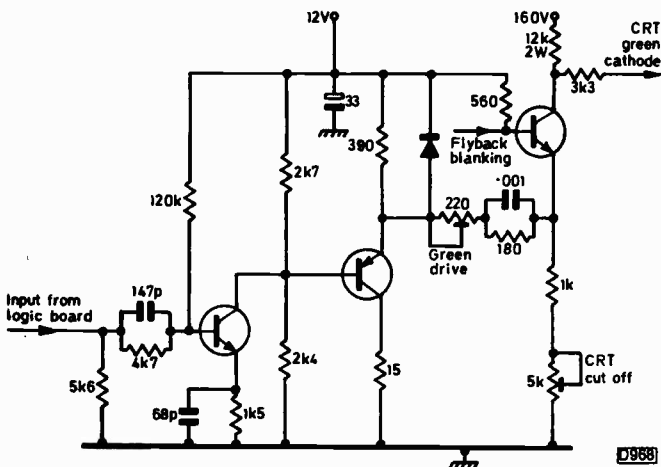
The logic boards for recently introduced games machines usually slot into the cabinet on one side and are connected by plugs to the monitor in the middle, with the power supply on the other side. Access to these table-top units is obtained by unlocking the glass lid. Where there's a single large logic panel this is relatively easy to withdraw: the smaller stacked panels are rather fiddly to remove. The monitors are the most difficult parts to get at, since they lie on the bottom with the c.r.t. mounted vertically. The components and controls, always minute presets, live beneath in a well. With the tubes often mounted separately, adjustments with the unit operating tend to be rather risky.

## *Scanning Standards*

Because of their source of manufacture, most of these video games employ the 525-line, 60 field system, often with sequential instead of interlaced scanning. The raster is formed conventionally, but since the tubes may be viewed with the action taking place rotated through 90° the setting of the line and field hold controls can be confusing. The power supplies are well regulated, so hum problems are rare. Early machines which had the mains transformer placed close to the c.r.t. suffered from an annoying quiver on the display however, due to the induction of 50Hz ripple on the 60Hz raster.

## *The Electrohome Monitor*

One monitor for which a fair amount of information is available is that used in the Galaxian game. It has a 20in. PIL tube, is made in Canada, and uses twenty one transistors plus an i.c. for flywheel line sync and the line and field generator stages. A series regulator provides a 120V supply rail. The components are mounted on three compact printed boards: the main one for the power supply and the line and field timebases, a c.r.t. base panel which also carries the RGB output stages, and the video interface panel which also houses two sync amplifiers. The sync amplifiers accept the separate line and field sync pulses from the logic board. The field generator in the i.c. drives the two field output transistors directly, while the conventional line driver and



**Fig. 1:** The green interface/output circuitry used in the Canadian manufactured Electrohome G07-901 monitor for use with TV games such as Galaxian. The input from the logic board is a 0-4V signal at a nominal impedance of 5kΩ. Drive controls are provided in the red and green channels only. The 160V supply is obtained from the line output transformer, the main h.t. rail being at 120V, stabilised by a series regulator circuit. The 19in. PIL tube (type 19VJTP22) is operated at an e.h.t. of 24kV. The first anode preset is provided with an 850V supply. The tube's grids are simply connected to chassis, with the signal drives applied to the cathodes. Line and field flyback blanking are carried out at the bases of the RGB output transistors - the bases are held at a steady 7V by a common series stabiliser transistor, which is operated in the emitter-follower mode, in the absence of blanking pulses.

output stages drive a diode-split line output transformer that also supplies the c.r.t. heater current.

### Games Variations

An early variation of the Space Invaders game was called Alien. In some machines this was combined with another game, also in colour, called Head-On. The latter involved a car chase through a maze, with the player trying to avoid a collision with a car of different colour controlled by the machine's internal logic. Another variation is called Space Chase, using rockets instead. All these games were produced by Taito, one of the giants in the video games field. At least 50,000 Space Invaders machines are said to have been imported.

Recent developments have resulted in more sophisticated games such as Falcon Apodo, in which random winged characters have to be destroyed whilst avoiding fatal collisions. Depending on one's ability, you can have a brief intermission and the possibility of gaining bonus points by docking a space craft on a launch pad.

### Atari

Another of the giants in the field is Atari - also well known for their domestic video games. They recently introduced a colour game, called Missile Command, using conventional TV display techniques. Perhaps their best known game however is Asteroids. In this the player has five press-button switches with which to control a rocket and fire at large rocks. Hitting these with a missile causes them to fragment, increasing the chance of a fatal collision. It's thus necessary to be able to steer round them and completely destroy them whilst at the same time avoid being hit by missiles from the odd flying saucer that appears. This game first came in an upright version, but is now available in a table-top version. It's unusual in deviating from conventional TV techniques.

The table cabinet is well designed, with a glass top and a rear flap which when hinged down gives access to the enormous single logic board. Option switches enable the price per play, number of rockets per game and the language of the instructions displayed to be altered. Most of the i.c.s are of the TTL type, and an LED indicates that the important 5V supply is present. Option switch settings can be checked by selecting a "test card" which displays a series of zeros and ones on a lattice of diagonal white lines. A central rectangle has a grey scale.

The operation of this game is very complex, since a conventional raster is not used. Instead, the monitor, which again is produced by the Canadian firm Electrohome, is known as a "Quadrascan" or X-Y monitor. There's a conventional thick-neck monochrome tube, but the instructions from the logic board deflect the beam so that it draws the various shapes on the screen. The beam is also modulated so that the rocket and other shapes have different brightness levels. The X and Y output stages are identical, and drive a special deflection coil assembly. This is the reason for the strange test pattern and the grey scale, which enables the brightness and contrast to be set up without the lines joining the various shapes being seen.

### Faults

User controls generally consist of buttons or joysticks which trip microswitches. Since they are subjected to some frantic manipulation by the players, problems arise due either to the switches shifting in their mountings or developing faults. This is especially the case with "fire" buttons.

The monitors are generally reliable and, since the games have a comparatively short life, major faults are rare. Most troubles in the field are due to drift of the hold controls and noisy presets. The drift trouble is usually due to incorrect initial setting, noisy presets causing various obvious troubles such as twitches or loss of one colour. Odd instances of fuse blowing can usually be traced to defective rectifiers or to diodes in degaussing circuits, without any need to refer to service data.

Logic board troubles usually stem from oxidised edge connectors, giving the symptoms of intermittent or incorrect displays. Many machines incorporate a fan, but overheating can sometimes cause the odd intermittent fault, as does the occasional case of an i.c. badly inserted into its holder. Lack of time and shortage of information prevents detailed servicing of these boards. Most suppliers carry a stock of spare panels, often removed from machines kept specifically for spares. Larger suppliers are able to service their own panels, and in some cases do outside repairs as well.

The fact that the machines can function only when a coin has been inserted is the major cause of breakdowns however. The coin mechanism is basically a coin rejector - it has to weigh and detect the metal content and size of the coin inserted. Coins inserted too rapidly, incorrect coins or the occasional bent coin may jam the mechanism, rendering the machine inoperative and causing screams of anguish from users and operators alike.

### In conclusion

Whether such games will remain popular in the long term remains to be seen. One forecasting organisation has suggested that the boom has already reached its peak. Whether this is so or not, it's likely that your visit to the local for a quiet drink will be accompanied by whistles and booms from a dark corner for some time to come. ■

# Service Notebook

*George Wilding*

## TROUBLE MAKERS

Two kinds of sets can give more trouble than may initially be apparent – those that have been subjected to repeated heavy fuse blowing, and those that have been stored for some time in a damp environment. Sets that have been subjected to several heavy overloads can develop i.c. failures, while those that have been stored under adverse conditions are likely to be subject to component deterioration and contact troubles.

An example of the first type came our way recently – an ITT hybrid monochrome set fitted with the VC200 chassis. It had blown its 1A mains fuse, and this had been replaced with a 13A type. In due course the 13A fuse had also blown, due to the mains filter capacitor C93 (0.1 $\mu$ F) being short-circuit. We put that right and obtained normal results, but the following day the owner phoned to say that the sound and vision had vanished, leaving a “white screen”. Almost certainly one of the tuner or i.f. transistors had succumbed, probably due to the severe electrical strain produced by the rupturing fuses.

Now if there's one i.f. strip I rate at the bottom of the table for accessibility, its the one used in these ITT sets – also the one used in the ITT CVC5-9 series of hybrid colour receivers. The transistors are mounted on a small panel which is at right angles to the main chassis, with the soldered side facing into the cabinet. To make meter checks therefore you have to unclip the chassis from the two plastic end supports and try to lodge it in an inverted position. Checking is not helped by the fact that the second and third i.f. amplifier transistors TX4 and TX5 don't have emitter resistors, so that in both cases the emitter voltage is zero and the base voltage 0.7V, while making resistance checks on the base-emitter junctions is made difficult by the fact that both junctions are shunted by low-value resistors – only 680 $\Omega$  in the case of TX5.

We started our tests at the first i.f. amplifier transistor TX3, and discovered that its collector was at the supply rail voltage while its emitter voltage was at zero, despite the presence of a 1.8k $\Omega$  emitter resistor. There was ample base voltage, so the transistor was clearly defective – with an open-circuit base-emitter junction. Fitting a replacement restored the signals.

As an example of the second type of set, we came across a Pye hybrid monochrome receiver (569 chassis) recently that had been in a furniture repository for a couple of years. We switched on and got a horizontal white line which didn't reach the sides of the screen. So both the field timebase and the line output stage were defective. The collapsed raster was simply due to the PCL805 field timebase valve, while the lack of width was due to R81 (1.2M $\Omega$ ) in the width circuit having increased in value.

These faults were soon put right of course, but we then found that the line hold was edgy – the picture would remain locked until the channel was changed, but it would then be necessary to adjust the core of the oscillator coil. A new PCF802 line oscillator valve brought no improvement, and as the field locking was solid we didn't suspect the sync separator. This chassis is unusual in using a transistor, VT19, as the flywheel line sync discriminator. The voltages

in this stage were roughly as specified, but since it conducts briefly only once per line we didn't feel that this was conclusive and tried a new transistor. No luck, and no luck either on replacing the 40 $\mu$ F electrolytic in the cathode circuit of the triode section of the PCF802.

It looked as if we were in for a wholesale check of the components in the flywheel sync and line oscillator circuits, but on bending one of the capacitors a trifle to identify its reference number on the panel one of the leadout wires broke away from the casing. Success! On examining the capacitor's exterior more closely it could be seen to be in poor condition. The reference number is C62, and it's part of the flywheel filter network. C63 and C65, which like C62 are of the metallised film type, also showed signs of deterioration. So we replaced the lot, clearing the trouble.

This could have been a very time consuming fault to trace, since there were no voltage changes of any significance and the resistor values all appeared to be correct. It shows how important visual inspection can be – aided by a lightly probing finger!

## BALANCED LINE OUTPUT TRANSISTORS

The complaint with a Bush colour set fitted with the Rank Z718 chassis was simply no results. The fuses were all intact, but a quick check around the line output stage revealed that the fusible resistor 5R6 (68 $\Omega$ ) was open. This resistor is connected to the junction of the two line output transistors, and provides the supply to the line driver stage once the line timebase has started up. We couldn't find any trace of a short-circuit, so we resoldered 5R6 and switched on. This resulted in a good picture within the normal time, but after a few minutes 5R6 went open-circuit again.

Any marked imbalance in the operation of the two line output transistors will result in excessive current flowing via 5R6 and possible damage in the line output stage. Clearly there was excessive current flow, so we decided to rebalance the output transistors. This is done by connecting a meter on a low a.c. voltage range across 5R6 and then, with a non-metallic tool, adjusting the balance coils 5L1/2 for the minimum reading, which should be less than 1V. On the receiver in question the reading was about 7V, so clearly rebalancing was necessary. Incidentally you may have to change the fusible resistor to a higher wattage type whilst carrying out this adjustment, otherwise you might not have enough time to make sure you've got the optimum setting.

Readjusting the balance coils by quite a small amount reduced the reading to just under 1V. The set then worked normally, and during a long soak test with the meter left in circuit there was no significant change in the reading. The set was returned – this was a few weeks back – and no further trouble has been experienced.

## POWER SUPPLY FAILURE

When the owner of a hybrid TV set complains that it used to take a long time to warm up before it went off altogether, the odds are that both symptoms are due to a defective connection or joint in the heater chain. Common causes of this type of trouble are the solder connections to high-temperature components in the heater supply, to the line output valve or boost diode valveholders, or to dropper resistor tags – also thermistors that have encircling contact leads.

We recently had these symptoms with a Bush monochrome set fitted with the A774 chassis. There was no continuity across the mains plug in either direction, so we made a continuity test from the first valve in the heater

chain to chassis to see whether the fault was in the heater chain itself or in the components supplying it. Everything appeared to be in order in both parts of the circuit, so we thought that maybe the mains on/off switch was open-circuit on one pole – it's not unknown on this and other Bush/Murphy monochrome sets. The switch was also in order however.

We next plugged the set into the mains, switched on and checked for voltage at various points. There was mains voltage at the on/off switch, but little sign of life elsewhere. Further investigation showed that the trouble was due to the non-reversible plug/socket P/S3-1/2 between the front mounted on/off switch and the chassis assembly. The plug was making contact with the pins all right, but the pins were found to be bereft of solder and not making contact with the print connections.

Some sparking had occurred, damaging the print, so it was not possible to resolder the pins satisfactorily. The input leads from the switch were soldered directly to a more suitable point therefore. It's the first time we've traced the cause of this sort of trouble to chassis mounted pins – something worth bearing in mind when investigating cases of power intermittency or complete failure.

### A BRACE OF ITTs

Two ITT hybrid colour sets of the CVC5/CVC8 variety came our way recently with quite unusual and contrasting symptoms, though both were caused by the same type of defect.

The first set had bad horizontal dynamic convergence – particularly on blue. Adjusting the relevant controls seemed to produce little effect, while the blue tilt potentiometer R439 had no effect whatsoever. The horizontal dynamic convergence circuit is fed with a positive-going 350V pulse from pin 5 of the line output transformer, so a disconnection or open-circuit component somewhere in the pulse feed was likely. On removing the convergence panel from its box, we discovered that R439 was quite cold. There didn't appear to be any dry-joints or disconnections anywhere however. As a first move, we decided to check whether the pulse was reaching tag 3 of plug E. It wasn't. The feed is via a screened lead, but this doesn't go directly to tag 5 on the line output transformer. It goes to a point near the edge of the main chassis, a printed track continuing the path to the transformer. Close inspection showed that although the outer braiding of the lead was well soldered to chassis, the inner conductor was just poking through the centre of its hole, bereft of all solder. It had obviously been missed during manufacture. Anyway, a spot of solder cured the trouble, though some reconvergence was naturally called for.

The second set had an unbelievable raster – both edges were like giant sawtooth waveforms, about two inches deep, while the raster had a severe hum bar. The hum bar suggested major loss of capacitance in one or more of the main electrolytics, but there seemed to be more than this wrong – a severe hum bar will usually be accompanied by a raster with wavy or undulating edges, but not one with a giant top to bottom sawtooth at each side.

Our first move was to check the h.t. electrolytics. The simplest way is to shunt each suspect with one of comparable but smaller value. To avoid strain on other components however, the way to do this is not simply to stab the test capacitor across suspects while the set is working. Instead, hold the test capacitor across a smoother – not a reservoir – with the set off, then switch on so that the test capacitor charges gradually along with the other

capacitors. Then as you move the test capacitor from one point to another there won't, provided all points are at about the same voltage, be any damaging surges.

On shunting C276, one of the 275V rail smoothers, all the fault symptoms disappeared, leaving a perfect raster. It's part of a multiple can, which we removed to test. All sections appeared to be o.k., though capacitor checks with an ohmmeter provide only a very rough guide. The thought that occurred to us was that maybe the C276 section had an intermittent or high-resistance internal connection.

Replacing the can gave normal results, and after some reconvergence the set was left running on soak test. After about half an hour a fairly strong hum bar suddenly appeared, though it was not as severe as the original one and the sides of the raster were this time all right.

Out came the test capacitor again. First we made sure that an apparently good earth point was indeed at chassis potential, but on removing the negative test prod we noticed a very small spark. Further investigation revealed doubtful soldering here, and after resoldering the joint the hum bar had completely vanished. Perhaps the original multiple electrolytic can had been in order after all, the initial faults being due to the high-resistance connection at the common earthing point. Since the main electrolytics need to be in good condition however, and the set was several years old, they could well have lost capacitance and be of degraded power factor. So there wasn't much point in refitting the original.

### STRIATIONS

The problem with a solid-state GEC colour set (C2110 series) was annoying striations down the left-hand side of the screen. Now this sort of thing is often caused by the line linearity coil of course, but adjusting the coil had no effect on the fault while its 1.5k $\Omega$  damping resistor R606 was perfect. It took us quite a time to track down the culprit, which turned out to be C414 (47pF) across the primary winding of the line driver transformer.

Another of these sets suffered from intermittent field bounce. The regulated power supply employs a BT106 thyristor, which was the first suspect – it could have been firing irregularly, thus varying the h.t. voltage. A replacement failed to cure the trouble, but when the trigger diac D701 (BR100) was changed correct operation was obtained.

### LACK OF BRIGHTNESS

The problem with an ITT solid-state colour set (CVC30 chassis) was lack of brightness – even with the brightness control turned up fully. Advancing the preset brightness control seemed to cure the trouble, but after an initial period when the picture was satisfactory the brightness reduced and got worse. This sort of thing is usually due to a resistor changing value – but where? The TBA560C luminance/chrominance i.c. was discounted since it's been our experience that a luminance i.c. that produces a d.c. output level change usually causes the fault to get noticeably worse as the i.c. warms up, while the brightness level on this set remained constant for a period of viewing.

The manual gives a simple drill for setting up the preset brightness control. By following this we got the voltage at TP511 right, but the picture was now much darker still. Time to do what we should have done earlier – check the c.r.t. voltages. The grids and cathodes were o.k., but the first anodes were low – due to the feed resistor R94 being around 400k $\Omega$  instead of 270k $\Omega$ .

# Long-distance Television

Roger Bunney

THE final month of 1980 produced varied though inconsistent reception – varied since there was propagation via most modes, inconsistent since signals ranged from excellent to very poor over two-day spells.

F2 reception has been the most significant, with signals almost daily throughout the month. There was extremely good reception on some days, with distant Russian signals arriving in the UK from 0815GMT, but on other days the MUF barely rose enough to give fleeting reception of ch. R1 vision (49.75MHz). Signals on ch. R1 provided the bulk of distant reception, but on the 9th here at 0840 a couple of Australian signals put in an appearance on ch. 0 (46.25MHz vision). One consisted of a news announcer (ABMN0, Wagga Wagga), the other being a sub-titled film (MTV0 ethnic TV from Sydney), the news announcer being particularly strong. At Hugh Cocks' East Sussex home some 120 miles to the east however the film was the better signal, the news announcer floating over it. The signals on this occasion came from the north east, but on the 23rd Hugh received an Australian signal at the relatively late hour of 1130GMT from the east – we figure this was a combination of both TE and F2 propagation.

The other highlight of the period was reception on ch. A2 (System M, 525 lines). This occurred first on the 16th, for some thirty minutes, the signals including CBC (Canada) and other, unidentified ones. The second occasion was on the 27th, when strong signals were received here at Romsey and by Hugh Cocks in East Sussex from 1450-1530. There were at least three programmes on the channel on this occasion, including the Flintstones! After the fade out, Hugh noted some activity on ch. A2 at up to 1700GMT. One of the Canadian signals is believed to have been CKCW-TV, New Brunswick. This latter opening was quite widely reported, having occurred during the Christmas break.

On the 21st, Hugh rang to report a southerly F2 opening with signals from Africa – two of them, on ch. E3, both

programmes but one definitely NTV, Nigeria. F2 continued throughout December then, though with perhaps less intensity than last winter.

Coupled with high sunspot activity there occurred an Aurora on the 19th. This produced recognisable video from RTE (Eire) Gort ch. B, Scottish Band I stations and some Scandinavian Band I transmitters. Noises were heard throughout Bands I and II and into Band III.

Tropospheric reception improved on the 10th, with W. Germany at v.h.f. and u.h.f. and really strong NOS (Holland) signals throughout the u.h.f. bands. There was another slight lift on the 24th.

The Geminids meteor shower produced good signal pings from the 12-14th December. At 2107GMT on Christmas night a large Russian space vehicle re-entered the atmosphere, producing a dramatic visual display from the south west to the north east, visible along the south coast. There have been no reports of reception due to the ionised trail, though the local media had a field day with comments ranging from meteorites to UFOs!

Ryn Muntjewerff (Holland) has sent us an interesting report. On November 16th he received from 1640-1700 via SpE both RAI (Italy) ch. C and also Albania on the same channel (82.25MHz vision). This was followed at 1702 by TE reception from Africa – boxing and a coloured newscaster on ch. E2, thought to be from either Ghana or Zimbabwe. The signals ended at 1839, and there were adverts every quarter of an hour. Thoughts are that the signals were initially propagated via TE, subsequently being enhanced by SpE propagation to arrive in Holland.

In Australia, Robert Copeman (Sydney) received ch. C1 Nanking and Lanchow via TE on November 22nd. During the same period Anthony Mann (Perth) noted ch. R1 signals from China via TE, with SpE enhancement. He's also received BBC ch. B1 signals again, including Kirk o'Shotts with a regional variation (on October 13th). Propagation was particularly active on December 13/14th, with BBC, TDF (France), Chinese and ch. E2 East Malaysian signals.

## News Items

**Greece:** Reports have been received from time to time of possible Greek test cards transmitted on ch. E3 – the signal was first received about two years ago, in the Gulf area, and photographed. It seems that this may be from a modified ch. A2 transmitter "left" by the American forces at Thessaloniki. Can anyone confirm?



Can anyone identify this caption, received in Holland on ch. E2 – at 1700GMT on July 9th last?



Identification used by a Dutch pirate TV transmitter operating on ch. 69 with 25W e.r.p.



**Finland:** The YLE TV2 network is now using a modified test pattern on Tuesday and Thursday-Sunday, when the programmes originate from the Tampere centre. The identification reads "YLE TPRE", the pattern being transmitted prior to the start of programmes in the evening. On other days the identification is "YLE HLKI".

**Spain:** RTVE is to commence colour transmissions from its Bilbao regional centre in early 1982. Television Catalonia SA hopes to start "private" TV broadcasting, covering Catalonia, Valencia and the Balearic Islands with a network of nine main and twenty relay transmitters.

**Guyana:** TV broadcasting is to start in late 1982. No decision on the colour system to be used has been made.

**USA:** A form of local TV is being planned, with low-power transmitters operating at both v.h.f. and u.h.f. Controversy has arisen because "drop-ins" could occur, since the distances between transmitters would be less than those previously accepted as the minimum for the avoidance of interference. To minimise interference, a frequency offset would generally be used - the offsets would be +10kHz, 0kHz or -10kHz relative to the nominal carrier frequency. In some cases the distance between neighbouring co-channel transmitters would be only 75 miles.

**Russian satellites:** Bindu Padaki (Madras) reports that the 714MHz Stat T satellite, which transmits directly to North Russia, is to be replaced by another satellite at 99°E later this year. This satellite, designated Stat T2, will transmit at 754MHz. Our South African correspondents comment that the Stat T service is substandard, with noise, signal failures, etc.

**East Germany:** The output power of the ch. E12 Sonneberg transmitter is understood to have been increased from 500W to at least 50kW. There's another 10W relay in operation on ch. E9, and a main DFF-2 transmitter operating on ch. E33 at 500kW e.r.p.

### From our Correspondents . . .

John Petrie-Baker has returned to North India, where he will be DXing at some 12,000ft. in the Himalayas. We hope he'll try to receive the u.h.f. transmissions from the Russian Stat satellite. His location is at Manali, a village in the Lahoul district. The summers are wonderful, but during the winters there's 12ft. of snow and the power lines are inclined to come down, making battery operation necessary.

Wenloc Burton (Melbourne, Australia) reports that station GTV9 is now transmitting teletext pages. Amateur TV activity is present at 440-450MHz and 579-590MHz. Bob Copeman (Sydney) queries whether his DX reception of ABCN ch. 0, Kandos, NSW on a moving train is a "first" in the DX field?

M. Reynolds (Nuneaton) has sent in an interesting report of F2 reception - mainly Russian signals on ch. R1. He also confirms that the ch. E3 grey scale that many saw on October 26th came from Sokoto, Nigeria. He first logged the signal at 1100, though it was present during much of the afternoon as well.

### Up-converter Use

It's been pointed out that the standard type of up-converter used for v.h.f.-u.h.f. conversion covers signals below 40MHz - into the upper short-wave bands. It can thus be used as a helpful, though wideband, device for checking whether the MUF is increasing through the 30-40MHz band. The US paging stations, which mainly operate at 35.22, 35.58, 43.22 and 43.58MHz, can easily be resolved if the conditions are right, and provide useful clues. Unfortunately they now tend to be operated in a tone sequence, but the pile up of tones is unmistakable. Other

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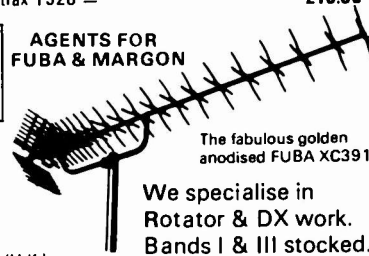
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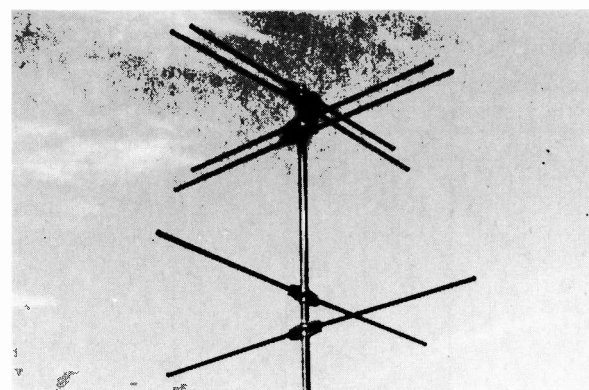
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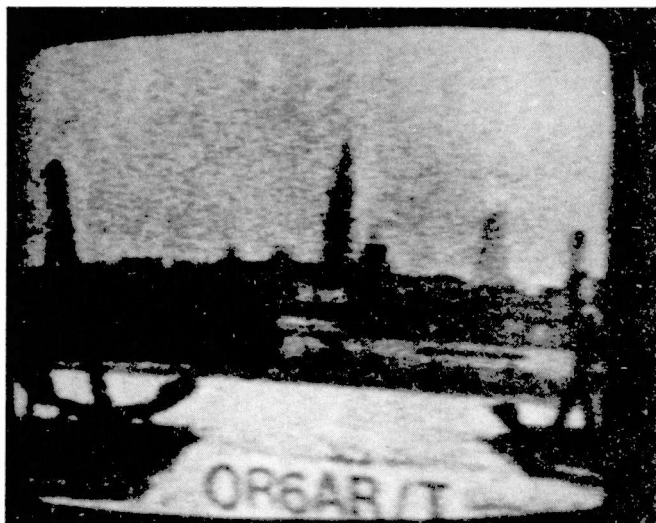
this system has omni directional characteristics when fitted with . . . . .

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A Belgian amateur TV identification slide, received by Cyril Willis (Ely) at 432MHz during a tropospheric opening.

services – police, water undertakings etc. – operate in the 30-50MHz band (known as “VHF lo” in the USA), though in Europe and Africa the band is relatively dead. When F2 conditions open up however you get Russian communications signals at high levels.

### Multi-position Notch Filter

The basic notch filter used in this unit is not new. It’s a bridged-T configuration (see Fig. 1) consisting of the coil L1 which is centre-tapped and connected to earth via VR12, and tuned by the varicap diodes D1 and D2. At resonance it provides very sharp attenuation over a limited bandwidth, i.e. a notch, the insertion loss at other frequencies being low. It’s ideal therefore for removing an unwanted signal or source of interference in a crowded part of the spectrum.

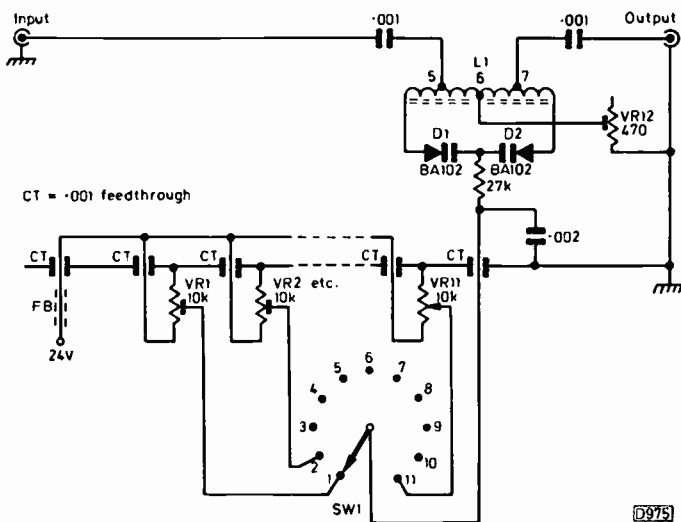


Fig. 1: Circuit of the multi-position notch filter.

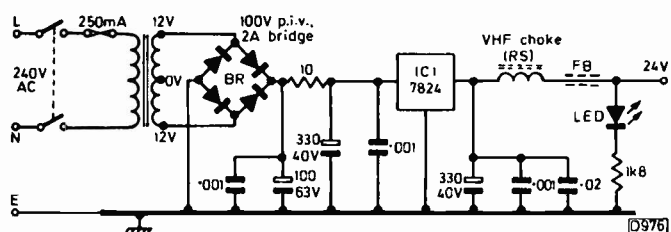


Fig. 2: Suggested power supply circuit.

When DXing, one is after channels that don’t fit in with the local channel frequency allocations. Say for example that you want to receive the Italian ch. IA vision carrier, whose frequency is 53.75MHz, but there’s a local ch. B3 sound carrier (53.25MHz). With both carriers present, the sound splatter will mar or even prevent reception of the Italian channel. The splatter will spread down to the French ch. F2 vision carrier frequency (52.4MHz), and the problem will be worse if the receiver has a wideband i.f. strip (i.e. system I or B/G). A notch filter of the type described will remove the ch. B3 sound carrier, allowing the other channels mentioned to be received with little attenuation.

You may be plagued by several sources of interference however, or wish to be able to filter out carriers at various frequencies. The multi-position version of the notch filter presented here was devised for this purpose, offering, by switch selection, ten preset notches plus an eleventh position which gives variable coverage over the bandwidth 40-70MHz. I initially devised the system because I’m troubled by harmonic radiation from about 26MHz, repeating at every 1.54MHz throughout Bands I and II, from a local VDU installation. The filter, and the aerial phaser circuit described in the January issue, give a complete solution to these various problems.

I’ve set the presets in my prototype unit in order of ascending frequency, but constructors may opt for other arrangements, say with four presets covering the local BBC-1 and a second weaker BBC-1 channel. The variable notch position (VR11) is worth having since it enables any offending signal to be removed.

The unit is simple, the coil being tapped as shown. VR1, VR2 etc. provide different varicap diode tuning voltages and thus different preset notches. Fig. 2 shows a suitable power supply – stabilisation of the tuning voltage supply is essential to prevent notch drift. The regulator i.c.’s output must be well decoupled to prevent r.f. instability, and good smoothing is essential to prevent any ripple reaching the varicap diodes. Place the filter ahead of any preamplifiers used in the receiving system.

The performance figures obtained were reasonable, but great care must be taken to maintain coil winding symmetry. Care in doing this will ensure a good notch performance when the unit is complete.

Measurements were made at 55MHz. The insertion loss at 3MHz away from the notch frequency is 5.4dB. The depth of the notch itself is 40dB. At 500kHz from the notch frequency the loss is 10.4dB, at 1MHz 6dB and at 2MHz 0.94dB (having established that the basic insertion loss is 5.4dB, the generator output was increased by this amount to determine the true filter performance).

The presets and standard potentiometer (VR11) were obtained from Maplin. VR1-VR10 are miniature types, VR12 being a subminiature type. The varicap diodes were obtained from Ambit. The filter switch came from Maplin. It’s listed as a 12-pole, one-way type but offers only 11 poles, the 12th one being neither electrically nor mechanically connected.

The inclusion of this multi-position filter in a DX-TV installation is a great help in minimising various problems. You don’t have to have eleven positions of course, and many enthusiasts will probably find that several fewer will suffice.

The coil itself consists of 11 turns of 26 gauge wire wound on a 1/4in. former with dust core. Space the winding over 1in., and tap it at turns 5, 6 and 7. Adjust the presets slowly. VR12 is adjusted for optimum notch performance after the other presets have been set up as required.

# Servicing the Thorn 4000 Chassis

## Part 1

David Robinson

THE Thorn 4000 chassis was originally designed for the export market. So, as is the way of things, it has a rather higher specification than most of its home market contemporaries. The chassis is designed to drive a 110° delta-gun tube and, when correctly set up, the picture obtained is in my experience hard to beat. The narrow-neck tube with its relatively inefficient toroidal scan yoke means that the power consumption is rather high however – up to 180W. Due to the amount of heat in the cabinet, this results in some reliability problems. Apart from the HMV console Model 2726 shown on the cover, there were a number of rental models. The chassis was also produced in Australia and South Africa. This article deals with the more common faults I've experienced – an Australian contributor adds some notes at the end (see Part 2 next month).

## Tuning System

The touch selection system used is more likely to give trouble than the tuner unit itself. The system will often lock on to one channel, jumping back to this channel after another touch pad has been operated. The fault may be due to nothing more technical than furniture polish on the touch pads! The polish is sufficiently conductive to effectively bridge the contacts. There are two cures. Either dismantle and clean the contacts with methylated spirits or a similar solvent (don't use a switch cleaner that leaves any kind of deposit), or replace them. The contacts are plastic with a chrome finish, and plug into a connector at the front of the touch selection module. Once the module has been removed from the cabinet, the contacts can be carefully pulled out, cleaned and replaced. If this cures the fault, don't forget to clean the front fascia holes before replacing the module.

The next suspect after this must be the touch tuning i.c. Unfortunately this can be fully checked only by replacement – the usual static handling precautions must be observed. Early modules used the BTT8024 i.c., which required a positive-going input. To provide this, links C and D are fitted on the panel. The snag comes if the operator is earthed when touching the pads. The mains bridge rectifier provides, rather unusually, a negative supply rail, which means that the chassis has positive-going pulses on it, i.e. earth is negative with respect to the chassis, so earthing a touch pad makes it more negative. This is not too serious a problem, since the other half of the touch pad carries a positive bias derived from the +150V rail. Later panels use a BTT8124 or BTT8224 i.c. These use negative-going inputs, and can be fitted to the early panels by removing links C and D and fitting links A, B and E.

The neon panel sometimes fails to operate on one or more channels, due either to the lamp itself, the driver transistor or the input connections. When this happens, several of the other neons may light dimly. This is normal, and will cease when the offending stage has been repaired.

The touch tuner circuit applies voltage to the top end of the appropriate present tuning potentiometer, a diode in series with the slider feeding the output to the tuner unit. Some very confusing symptoms occur if a diode is leaky! The result is that adjustment of one tuning potentiometer affects all the other channels.

In the UK, the tuner drawer will usually be the home-market type (u.h.f. only), though it may be the export type with switches to select Band I, Band III or u.h.f. The switch is operated by pressing the tuning knob firmly in and rotating it while watching a small pointer at the end of the scale. The tuner itself will normally be the ELC1043/05 u.h.f. type, but the integrated v.h.f./u.h.f. type ELC2000 may be found. If the export drawer unit is combined with the u.h.f. only tuner, the set will still work with the switch in the Band I or Band III position but the signal-to-noise performance will be poor due to the tuner's a.g.c. voltage being removed. With the ELC2000, the v.h.f. band-switch input must be held high on u.h.f. for best results – this is done by W9 in the export drawer unit.

A misleading cause of no or poor results when using the export drawer unit occurs when one switch is between positions, shorting two of the band selection lines together. This affects all channels. So check that all the switches are in the correct notch.

With patience, the drawer unit can be dismantled and repaired. First remove it from the set and take out the screws in the base. One screw acts as an end stop for the diecast slide, which can then be removed. Next, by carefully levering clear the latches down one edge, the clear plastic base can be removed, giving access to the panel. Note that silicone grease is used to lubricate the switch rotors – this should not be removed. Release the panel by removing the numerous wire clips which connect to the potentiometers. On reassembly, care is needed to locate the a.f.c. switch correctly in its operating lever.

## IF Module

The i.f. amplifier module uses quite a complex circuit. This is justified, since the performance is excellent. The amplitude and group delay responses are first class, the gated a.g.c. is very fast-acting, and the strip is completely stable and very reliable. The only source of trouble here is the edge connector, which gives various intermittent faults including loss of sync. With the ELC2000 tuner, which has extra i.f. gain when used at u.h.f., the set makes an excellent DX receiver, the gain being high and the sync and a.g.c. good. With the ELC1043/05 tuner the gain is lower, though adequate for normal use.

## Sound Circuits

The sound department consists of two i.c.s, a TBA120S intercarrier sound chip and an SN76033N audio chip. The most common trouble is sibilance, which may clear with careful adjustment of the quadrature coil L151. The basic problem however seems to be that the  $Q$  of this circuit is too high, giving low bandwidth and excessive output level. Results can usually be improved by shunting the coil with a damping resistor of around  $1k\Omega$ .

The slider of the volume control can become noisy after a time, the effect being rather more drastic than usual since here open-circuit means full volume. It will respond to cleaning – at first anyway. If the control's action is too fierce near the bottom end, back off the preset volume

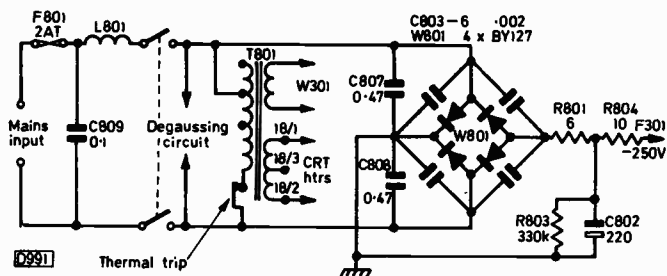


Fig. 1: Mains input circuitry. The h.t. bridge rectifier W801 provides a negative-going output, the chassis being positive with respect to earth.

control R172 – to minimum if necessary.

The SN76033N audio amplifier i.c. can fail, causing lack of sound. The 3V zener diode W163, which drops the supply to the i.c., is worth checking if the i.c. fails. Also make sure that the electrolytics C153 and C159 are fully discharged before plugging in the new i.c.

C156 and R163 in the feedback loop provide bass boost to compensate for the limitations of the internal loudspeaker. The bass may be excessive therefore when using an external speaker (a special adaptor kit with an isolating transformer can be fitted for this purpose). In this event, short out C156.

## Decoders

Two of the colour decoder i.c.s are mounted on the main signals panel. IC155 is a fairly simple device for black-level clamping, brightness, contrast and saturation control and seems to be reliable. IC157, which provides colour signal demodulation, matrixing and PAL switching, is of a type (SN76227) found in many different chassis. It can be responsible for the loss of one of the RGB signals. The RGB output stages (BF258 transistors) are straightforward, the usual faults here being loss of one colour due to a faulty output transistor or a bright screen in either a primary colour or white due to failure of the thick-film collector load resistor unit TF158.

Part of the decoder is on a separate plug-in module, and it's here that most of the troubles in this area will be found. If the colour is intermittent or absent, first check the module's edge connector.

There are three versions of the module. The 438 version has a single i.c., type SN76228. This seems to be reliable, although occasionally the presets may need setting up if colour lock is lost. Unfortunately with this i.c. it's impossible to disable the colour-killer and the phase detector to set up the reference oscillator frequency, so the rather lengthy procedure given in the manual has to be used.

The 428 module uses a TBA395 i.c. but is otherwise very similar to the 438. The setting up procedure differs slightly.

The 430 version is completely different and physically larger, with three i.c.s. The TBA510 has an a.c.c. controlled amplifier followed by blanking and burst gating stages. It also has a d.c. operated saturation control which is not used but merely brought out to a preset potentiometer on the panel. The blanked chroma goes to the SN76227 on the main panel, while the gated burst goes to a TBA540 reference oscillator i.c. The third i.c. is an MFC4040 which is used as the PAL bistable.

It must be said that the TBA510 does not perform too well in this application – in fact it seems to be something of a square peg fitted into a round hole. Both the cross-colour and signal-to-noise performance seem to me to be inferior to the other modules, and this will have to be accepted if a 430 module is fitted. It can be replaced with one of the other

modules (if you can get one) if the link near L163 on the main panel is changed from the "0" to the "8" position. The phase adjustments will also need to be set up.

From the servicing viewpoint the usual problem with the 430 module is that colour is obtained at switch on, and is retained on switching between colour channels, but if the set is run off signal or on a monochrome transmission colour cannot subsequently be obtained. The reason for this is that the TBA510 goes into a lock-out condition when the a.c.c. amplifier is turned up to maximum gain. This problem can usually be cured by going through the setting up procedure for the module, but there are so many resistors, capacitors and links to be added, taken away and generally juggled around that I tend to shy away from doing it and just try a slight tweak to the a.c.c. level control R929, one way or the other. This generally does the trick.

A thing that's noticeable is that the decoder alignment on many of the main signal panels is rather approximate, especially the 6MHz rejector coil L154 and the phase and delay line balance settings. A careful alignment session will often markedly improve results. Sometimes however the delay phase balance just can't be set properly, because the delay time itself is out of tolerance. First try adding a capacitor of about 47pF across R188. If the phase still can't be set up, the choices are to put up with slight Hanover bars or replace the delay line.

The delay line amplitude balance (R190) is one adjustment that should *not* be set up according to the manual! The method of setting this for minimum Venetian blind effect will not work of course if the phase adjustments

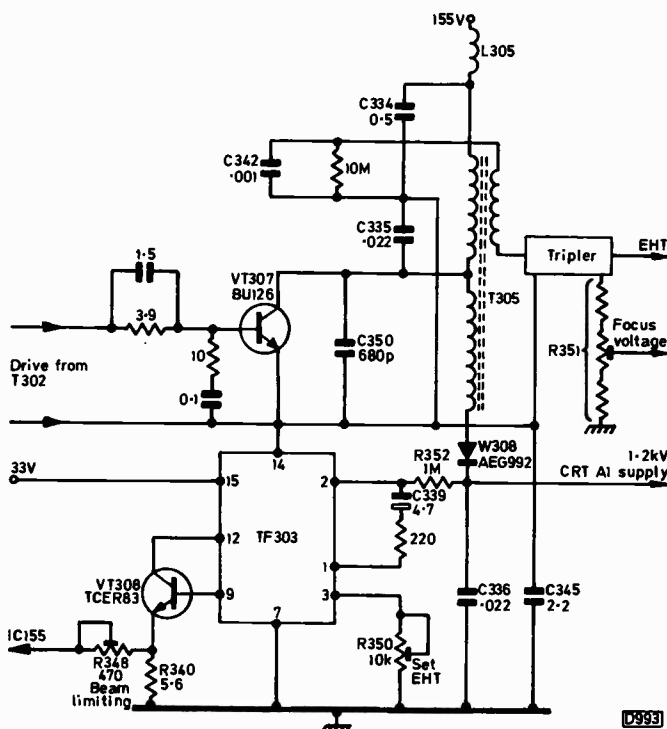


Fig. 2: The e.h.t. generator circuit. VT308 acts as a series regulator, stabilising the h.t. supply to the stage. It's driven by the thick-film unit TF303, which senses the c.r.t.'s first anode supply via R352. The voltage developed across R340, being proportional to the e.h.t., is used to operate the beam limiter. Since the e.h.t. generator and the line output stages are fed via a common h.t. supply resistor (R369), the width and e.h.t. track automatically. If the e.h.t. voltage falls for example, due to increased loading, the conduction of VT307 will increase. The voltage developed across R369 will thus increase, reducing the h.t. supply to the line output stage and hence the width. A 2N5296 (RCA) transistor can be used in the VT308 position.

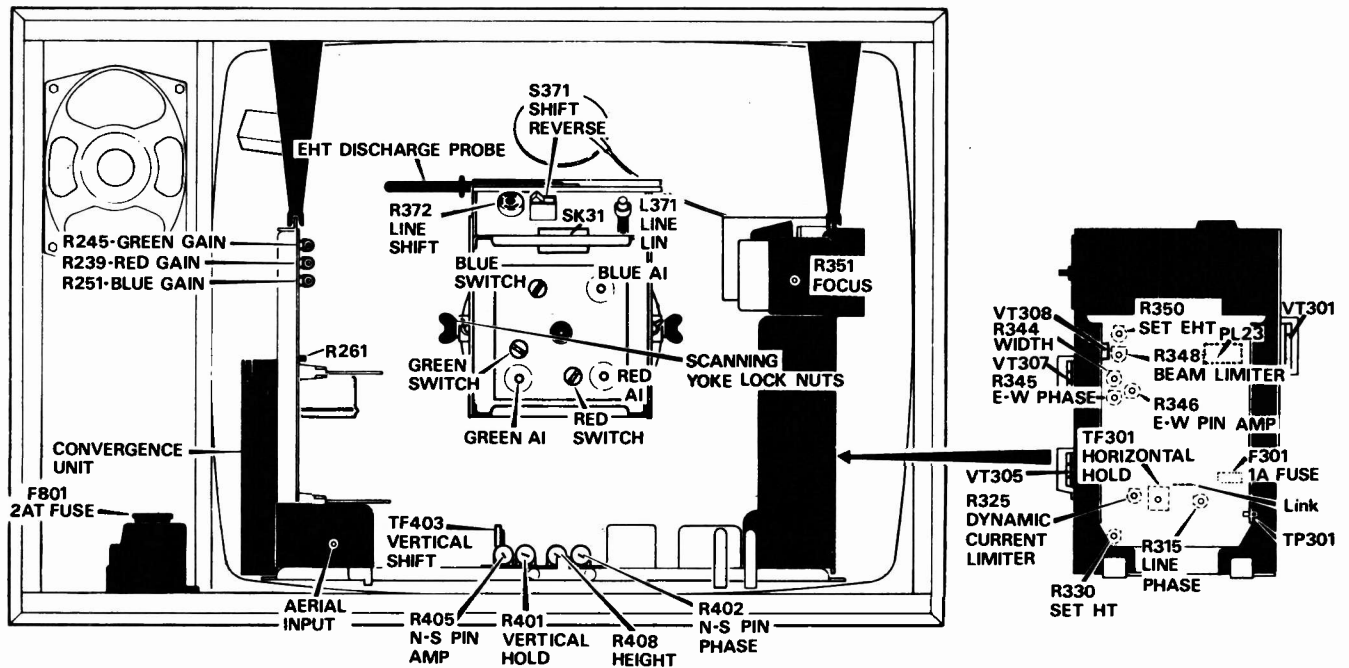


Fig. 3: Rear chassis view. Note that the chassis is at half mains potential. R261 is the preset brightness control.

have been correctly set. The easiest method is to use a special test signal, such as the "demodulator" test on the Philips PM5509 generator. The simple PAL method also works well if a test card or colour bar signal is used – simple PAL is obtained by shorting out R188.

Some odd intermittent effects can be caused by a fault in the 24V regulator (IC152) which feeds the signals panel. It can be responsible for brightness drift, crackling on sound, or thin, horizontal dark lines jumping over the picture – this last one can be mistaken for cross-modulation. Loss of highlights can be due to C170 (1 $\mu$ F) being leaky – this capacitor decouples the preset R175, which sets the bias applied to the luminance input pin 14 of IC155.

### EHT System

The 4000 chassis is one of the few in recent years to incorporate that most worthwhile feature, a regulated e.h.t. supply. Admittedly, the tripler is not included in the feedback loop – the monitoring point is the c.r.t.'s first anode voltage supply, which is obtained from a rectifier fed from a tap on the e.h.t. transformer – but the results are certainly above average.

The tripler fails quite often, probably due more to its mounting position at the top of the module than to any weakness in the tripler itself – it's the heat that kills it. If the power supply starts up at switch on but trips after about two seconds, disconnect the tripler input lead and try again. If the e.h.t. regulation (picture breathing) seems to be poor, check that the main h.t. rail is correct before investigating the e.h.t. generator stage. The h.t. rail was 155V on a few early sets. The later line timebase/power supply module operates at 165V and can be identified by the large 18  $\Omega$  wirewound resistor on the print side of the panel.

For some reason the e.h.t. regulator has a rather long time-constant. This means that the picture balloons out slightly on a sudden increase in brightness, then jumps back to its original size. An improvement can be obtained by reducing the value of C339 from 4.7 $\mu$ F to 0.1 $\mu$ F. If picture breathing occurs only at higher brightness levels, the beam limiter adjustment is probably set too high. I find it best to measure this directly, by connecting a meter in series with the c.r.t.'s green cathode and switching off the red and

green guns. I then turn the brightness and contrast controls to maximum, and set the beam limiter preset R348 for 1mA.

Varying focus can be caused by slight discharge across the focus spark gap on the c.r.t. base panel.

### Line Output Stage

Since it's not involved in producing the e.h.t. supply, the line output stage is simplicity itself, the line output transformer being very small. Unusually, the stage is balanced, with a +600V flyback pulse at the collector of the BU208 line output transistor and a -600V pulse at its emitter. This arrangement is used because of the limited voltage rating between the line and field coils on the deflection yoke.

The EW modulation system is also simple, a transistor (VT306) in series with the line output transistor/transformer in effect varying the voltage supply to the line output stage. The low-level EW modulator circuits are contained in thick-film module TF302.

Failure of the line output stage will give either power supply tripping or a blank screen with e.h.t. present, the latter symptom arising since the protection circuit on the signals panel (W152 etc.) blanks out the screen in the absence of line pulses, to prevent damage to the tube. Thanks to this protection, the line output stage can be disconnected when tracing the source of a tripping fault. If the line output transistor fails, check the flyback tuning capacitor C331 before risking a new one – it frequently falls in value, with the result that the transistor's peak voltage goes sky high. If you can't check the capacitor on a bridge, replace it. Also, don't run the line output stage with the deflection coils unplugged as this will result in the BU208 overheating.

When servicing a 4000 chassis, check the M3 fixing screw on all three output transistors on the line timebase/power supply module (two BU126s and the BU208). They are tapped into only thin metal plates, and frequently you'll find that the threads have stripped, so that the transistor is not effectively clamped to the heatsink. The cure is to fit slightly longer screws, with shakeproof washers and nuts.

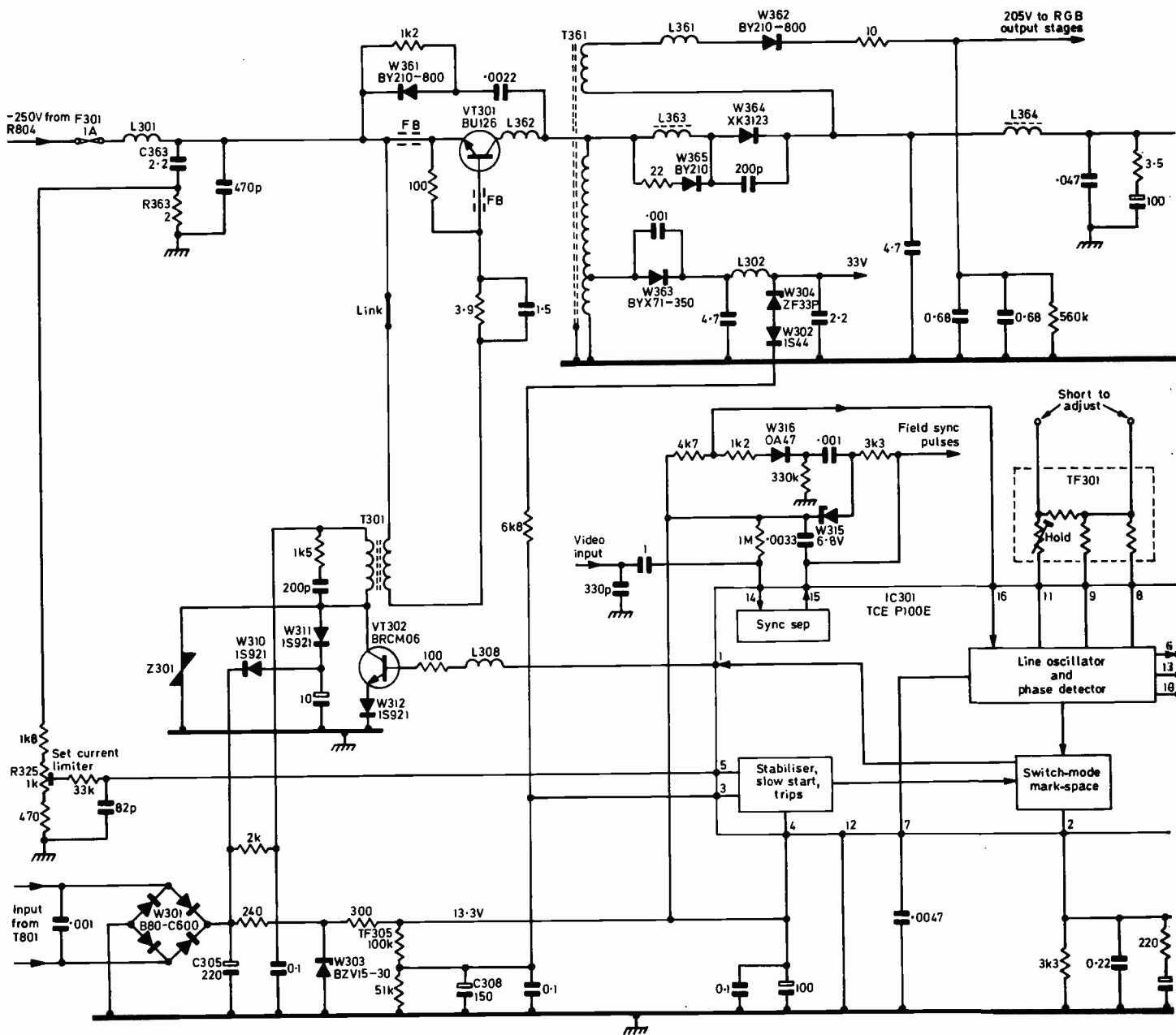


Fig. 4: The heart of the 4000 chassis – the chopper and line output stages and their drive circuitry. The Thorn "special" IC301 controls of the parallel type, i.e. the reservoir inductor T361 is in parallel with the load. VT303 is included to speed up the line driver transistor's frequency parabola is thus imposed on the line deflection. The overvoltage trip operates when the 33V rail rises to 40V. W304 will trip across C308 also controls the maximum available mark-space ratio of the switch-mode drive output. It thus provides the slow-start C363/R363 will increase sufficiently to activate the dynamic trip in IC301, via R325. The chopper transistor's on period is then reduced to the voltage across C308, thus operating the latching discharge switch and providing a permanent overload trip action. In the event of transistor can be used in the VT306 position and a BC337 in the VT302 (chopper driver) position.

The width control R344 has a fairly restricted, though adequate, range. If the width cannot be set correctly, check the h.t., e.h.t. and linearity adjustments.

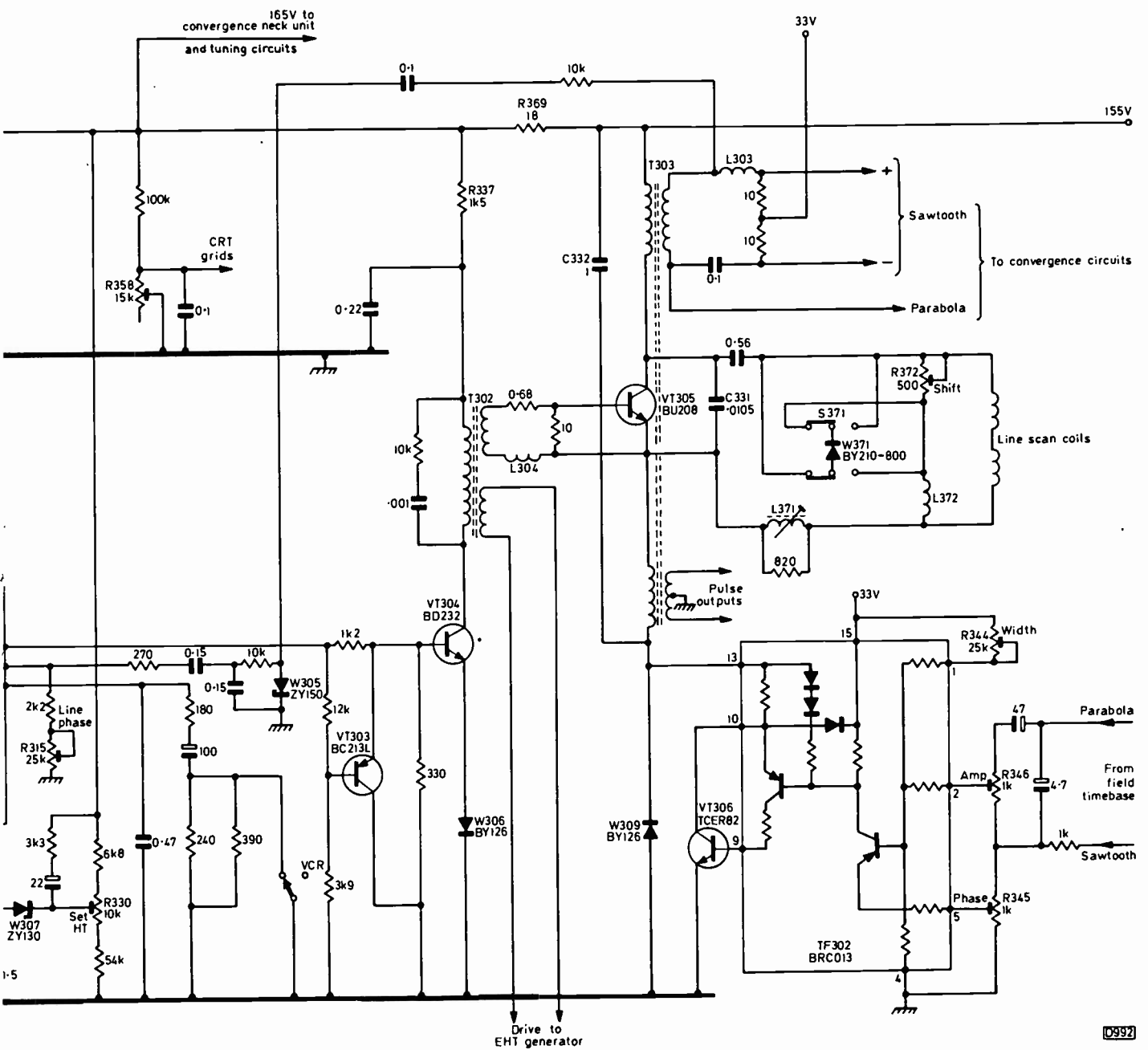
### Switch-mode Power Supply

A parallel switch-mode chopper circuit provides most of the power supplies, with the regulation controlled by a TCEP100 i.c. This chip also contains the sync separator, flywheel line sync and line oscillator stages. Although the chopper works at the same frequency as the line timebase, the i.c. provides separate outputs for each, the line drive having a constant 50:50 mark-space ratio while the chopper drive has a variable mark-space ratio to achieve regulation. Other features of the i.c. include a slow-start system, which

is controlled by the charging of C308, an excess-current trip which monitors the chopper transistor's emitter current (the dynamic current limiter), and an over-voltage trip which monitors the 33V rail via zener diode W304.

If the set is tripping (the power supply starts up then cuts out), check the tripler first – lift the tripler's input lead off the transformer, then switch the set on again. If the tripler is innocent, the line output and e.h.t. generator stages can be isolated in turn by lifting the collector lead of the appropriate transistor.

All this assumes that the excess-current trip is operating. Less often it's the over-voltage trip that's operating. This can be checked by monitoring the voltage at the junction of W304 and W302. If there's a kick just before the set trips, the over-voltage trip is operating. This could be due to a fault



both, containing the line oscillator and a variable mark-space ratio switch-mode drive waveform generator stage. The chopper circuit is switch-off time. EW correction is achieved by connecting the EW modulator transistor VT306 in series with the line output stage. A field-conduct, increasing the voltage across C308. This fires a latching discharge switch in IC301, shutting the circuit down. The voltage feature, as it charges slowly via TF305 when the set is switched on. If the current demand in the set is excessive, the ripple flowing via to less than  $1\mu\text{sec}$ , and the output voltages fall. In the event of an excessive overload the dynamic trip produces an output which adds the supply within IC301 falling below 12.5V, C308 will be discharged by the operation of a non-latching switch. A 2N2598 (RCA)

in the feedback loop, or to W304 itself.

More common if more mundane faults are a piercing whistle from the chopper transformer T361, and arcing at the transformer's tags. The first trouble can often be cured by tightening or loosening the clamp screws, but replacement may be the only solution. The arcing, due to dry-joints on the small panel which is mounted on the transformer's tags, can be a lengthy job if the board is badly damaged.

The line timebase/power supply module has a large number of preset potentiometers which, if of the open skeleton type, collect dirt and become intermittent. They will usually respond to cleaning. Take care not to confuse the line phase adjustment, which centres the picture within the raster, with the line shift adjustment. If an offset in one is corrected with the other, the picture will look central but

the timing of the burst gating pulse may be wrong (there's no separate control for this).

The e.h.t. transformer in later production is stood off the chassis with washers, the space between the transformer and its heatsink being filled with Thermpath 167 heatsink compound. An earth lead was added between the phosphor bronze clamp and chassis to maintain the earthing of the core and avoid intermittent core-to-earth conditions. This modification was introduced to avoid core stress, and should be made when fitting a replacement transformer.

Make sure that the tripler's input lead is fitted into the cleat on its body to prevent it resting against tag H on the e.h.t. transformer, and ensure that the thick-film module TF303 is positioned vertically and out of contact with the tripler's input lead.

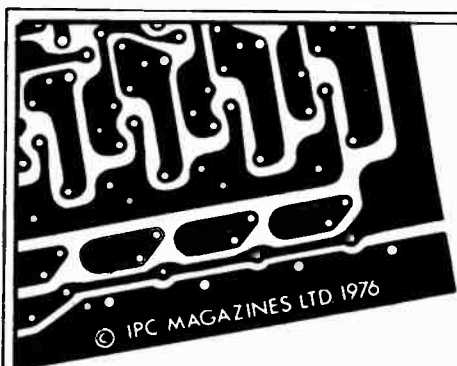
# Video/Audio Input Modification for the Philips N1700 VCR

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

IN THE November 1979 issue I described a circuit for obtaining standard video and audio output signals from the Philips N1700 VCR which, as those readers familiar with this VLP format machine will know, comes equipped with u.h.f. input and output connectors only. The fact that the machine does not have video and audio input/output sockets restricts its use of course, and in addition prevents cameras other than the appropriate Philips one being used with it.

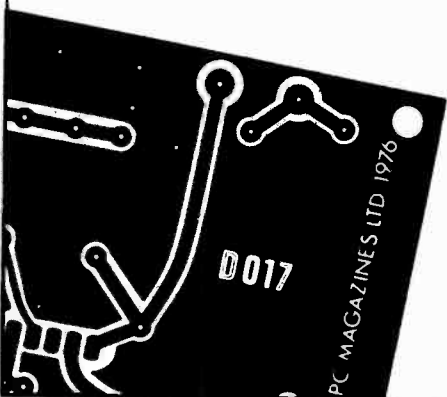
Extracting sound and vision signals is not too difficult, nor is arranging for an external audio input to the machine. The problem comes when trying to find a way of feeding

colour video signals into the machine. Historically, the problem goes back to the days of the original Philips N1500 VCR. Philips did market a version of this, the N1500M, providing video input and output. It incorporated an extra PCB for the purpose. The main cause of the difficulty is that these machines are designed primarily for off-air recording, and as you can see from Fig. 1 (Model N1700) the i.f. section produces separate luminance and chrominance feeds. This means that any external video input circuit must contain not only a buffer amplifier but also filtering to produce separate, compatible luminance and chrominance signals for injection into the existing Philips circuitry.



All boards are epoxy glassfibre and are supplied ready drilled and roller-tinned.

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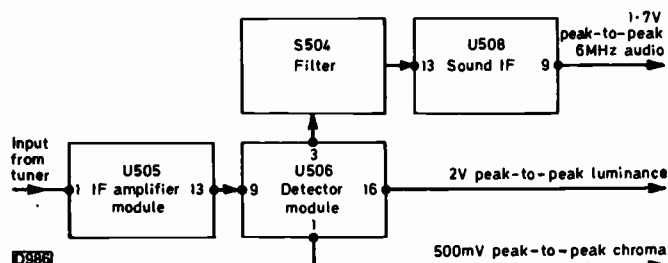


Fig. 1: The detector module in the Philips N1700 VCR provides separate luminance, chroma and 6MHz sound outputs.

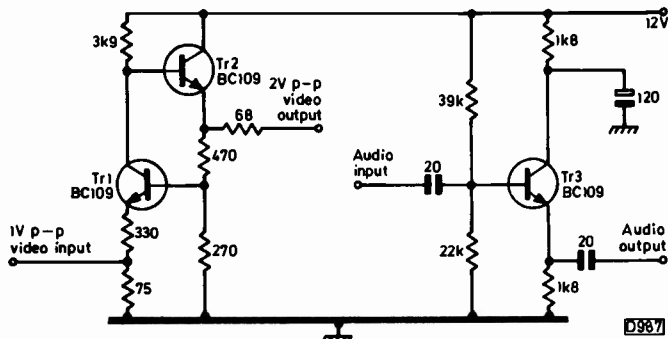


Fig. 2: Suitable video and audio buffer amplifier circuits.

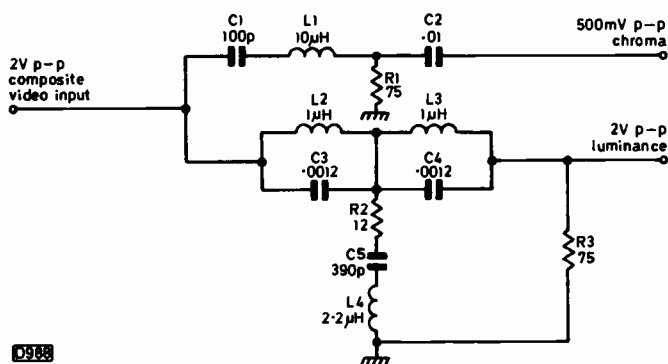


Fig. 3: Filter circuit to separate the luminance and chroma components of a composite video input signal.

The Philips N1502, from which the N1700 was developed, is very similar electronically and had an optional video input/output panel. The version in which this panel was fitted as standard was the N1512. It would be possible to adapt the video input/output panel used with these machines for use with the N1700, but the cost is rather excessive.

An examination of the N1700 service manual doesn't help one much with the problem, since much of the machine is in module form. We had to go back to first principles therefore, and design a filter and amplifier circuit to match the Philips circuitry.

### Luminance Input

The logical place to inject a luminance signal (see Figs. 1 and 4) is between pin 16 of module U506 and pin 17 of module U507. Although this is the luminance feed, the 4.43MHz chroma signal is also still present here, being filtered out in U507. The signal at this point is a high-impedance one at 2V peak-to-peak. Since the standard video signal is 1V peak-to-peak at 75Ω, a buffer amplifier is obviously the first thing required. A suitable circuit is shown in Fig. 2. It will accept a 1V peak-to-peak signal from

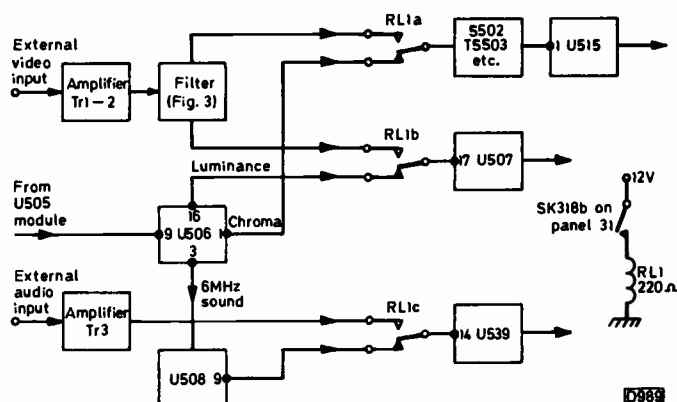


Fig. 4: Arrangement for feeding external video and audio signals into the Philips N1700 VCR, showing the positions of the extra circuits and the relay switching.

another VCR or camera, and provide a 2V peak-to-peak output. If only a monochrome input is required, this output could be fed into the N1700 via a suitable switch.

### Colour Operation

For colour operation – most copying and recording nowadays are done in colour of course – the filter circuit shown in Fig. 3 can be used, connected to the buffer amplifier's output as shown in Fig. 4. The luminance signal is separated from the chroma signal using the 4.43MHz constant-K bandstop filter L2/3/4, C3/4/5, while the chroma signal is filtered out using the series half-section network C1/L1. Ideally, the coils should be fitted with adjustable dust cores and aligned using a scope and wobulator. The circuit has been found to work satisfactorily in practice simply by using the component values shown – these have been chosen from readily available preferred value types.

The layout of the amplifier and filter is not critical, but the use of a PCB and screened cable throughout is a good idea.

### Audio Input

The audio side of things is much simpler. The demodulated audio signal is present at pin 9 of the intercarrier sound module U508, and then passes to pin 14 of the audio signal processing module U539. It's 1.7V peak-to-peak at 1kHz. All that's necessary therefore is a simple buffer amplifier plus switching. A suitable amplifier circuit is shown in Fig. 2.

### Miscellaneous Points

The only remaining thing to be considered is the switching to allow either off-air TV or external video to be recorded. As the audio, luminance and chroma signals all have to be switched, the logical solution is to use a relay. A suitable type is the RS Components 348-627 four-pole double-throw relay. This can be operated by the "channel 8" selector switch on the VCR's front panel – it has a spare set of contacts, SK318b. The arrangement is shown in Fig. 4.

The 12V supply required for the amplifiers and the relay can be obtained from a number of points in the machine, such as the +1 12V supply.

The video and audio output arrangements were described in the November 1979 issue: other N1700 modifications were given in the April/May 1979 and May 1978 issues.■

# Practical TV Servicing: Hum and Hum Bar Problems

S. Simon

LAST month we discussed problems caused by capacitors. They are naturally suspect when there's a hum problem, be it on the sound, the picture, or both. So we'll consider next the causes of poor smoothing – from the standpoint of the person expected to deal with it, i.e. you.

Before looking at specific examples, let's first recap on the basic cause of hum. A portable set used with a battery is unlikely to exhibit hum symptoms because it's being operated from a smooth d.c. supply, i.e. there's no ripple. Under such circumstances the portable may however exhibit severe hum symptoms – if the field timebase, which operates at 50Hz, is allowed to interfere with other stages in the set, such as the video or audio stages. The fact that this is not a common occurrence is due to the decoupling and smoothing used in the set, plus the screening of sensitive leads etc.

So there's a connection between the mains supply and the field timebase, both operating at 50Hz. It's as well to bear in mind that we have within the set a 50Hz generator. We also have the line timebase, operating at about 15kHz, and signal stages operating at all sorts of frequencies. What we are mainly interested in however is low frequency hum on sound (rather than a higher frequency buzz), and the causes of one dark band (50Hz) or two dark bands (100Hz) that affect the picture.

## Simple HT Supply System

In the simplest sort of h.t. supply circuit, used for example in old hybrid monochrome and colour receivers, a diode chops off one side of the a.c. mains input waveform, handing the other side to a fairly massive capacitor (the reservoir capacitor) which thus charges up and remains charged, supplying the set's h.t. supply when the rectifier diode is not conducting. The h.t. supply thus obtained across the reservoir capacitor is still heavily rippled however, and is thus followed by a choke plus capacitor or resistor plus capacitor filter to provide a relatively ripple-free, i.e. hum-free, supply. The most common causes of hum therefore are failure of the reservoir or smoothing electrolytic capacitor.

We didn't specify which side of the mains input waveform is chopped off by the rectifier diode. Normally the negative side is removed, so that the h.t. supply is positive, the negative sides of the reservoir and smoothing capacitors being connected to the other side of the rectifier's input, i.e. usually to chassis. In this latter case the chassis is connected directly to one side of the mains supply, which is quite in order provided we recognise that there is a danger here and provided all the chassis connections are efficiently bonded to chassis so that there's no voltage difference between the large number of "negative", i.e. chassis, returns.

If, for example, several parts of the main frame are punched up to provide connection lugs, these lugs must be thoroughly clean before they are soldered. Otherwise several problems will arise at a later date – when the initially acceptable soldered contact has become "dry". Again, tags may be rivetted to the metalwork, and although the

soldering to the tags may be all right the electrical contact between the rivet and the tag/chassis may deteriorate as time goes by. It's the unenviable job of service persons to find these possible trouble spots and repair the poor contacts.

## Alternative Power Supply Circuits

There's no basic reason why the positive side of the mains input shouldn't be chopped off instead of the negative side, leaving a negative h.t. supply, i.e. the usual arrangement turned upside down. In this event any multisection electrolytics would have to have separate negative tags and a common positive one. In many receivers you'll find both positive and negative supply lines. So we mustn't take too much for granted.

If a mains transformer is used, all sorts of possibilities arise, depending on the arrangement of its windings. The transformer could be used to isolate the chassis from the mains supply, thereby removing the hazard of a "live" chassis; a centre-tapped secondary winding could be used to feed two rectifiers, in which case both halves of the mains input waveform would be used, supplying the reservoir capacitor with an input at 100Hz instead of 50Hz; or a single secondary winding might feed a bridge rectifier configuration, again giving rectification at 100Hz. We could also have both h.t. and l.t. supplies, either positive or negative with respect to chassis.

With a transistor line output stage the simple rectifier plus reservoir capacitor plus smoothing filter approach is inadequate. For one thing, it can't take into account variations in the mains voltage supply. So the main supply line in the set has to be regulated. We can then derive various subsidiary supplies from the line output transformer. There are many variations on this particular theme.

When one's faced with a hum problem, one must first find out what sort of power supply arrangement is used in the set. One can then use one's ears and eyes to assess the problem and look out the lie of the land. Is it a portable with a common supply line, i.e. the sound, signal and timebases are all fed from the same supply line? Does it have separate h.t. and l.t. supply lines, and if so is the audio circuit supplied from the h.t. or an l.t. line? If there is hum on the sound, is the picture also affected? If so, in what way? Is the picture rippled, with the edges curved and undulating, or is the picture straight but marred by a dark band which moves vertically (usually)? The presence or absence of these factors, plus a study of the relevant circuit diagram, will determine the initial line of attack to take. Let's look at some examples.

## Problems with Portables

A 14in. Hitachi portable was brought in with the complaint that after it had been on for an unspecified time the picture would roll. On test it behaved perfectly for some twenty minutes or so, when the field began to trip. At the

same time we noticed that a dark area had appeared across the picture, suggesting that the smoothing had deteriorated. When the cabinet shell was removed however field lock was restored and the dark band disappeared. When heat from a hairdrier was directed on the four diodes in the bridge rectifier circuit there was no effect, but when it was directed on the nearby series regulator transistor the fault immediately appeared. Cool the transistor and the fault went away again. The original type of pnp power transistor was not to hand, so we replaced it with an AD149. There was no further trouble after this.

Note that the main reservoir capacitor was not suspect in this case, due to the effect of the heating and cooling on the fault. The probabilities were either a diode in the bridge going open-circuit when it had warmed up, though in this case the ripple effect would have been more severe, or the series regulator transistor becoming leaky when it had reached its full working temperature.

We have had many cases of a similar nature. The small ITT Featherlight portables commonly give trouble for example. Here the original type of block bridge rectifier used is the main suspect in the event of a severely distorted picture. Where this is not at fault, we've found the series regulator transistor defective. It's on its own heatsink, on the opposite side of the chassis frame. It's of the npn type, and is in the negative return line, i.e. it's connected between chassis and the negative side of the rectifier circuit.

To quote another example of this sort of thing, the AD161 l.t. voltage regulator transistor used in the ITT CVC5 and similar hybrid colour chassis is often responsible for a dark hum bar across the picture. We hasten to add however that the transistor is not the only suspect when tackling hum bar problems in these sets.

### Poor Earth Connections

A hum bar can be caused by a poor earth connection rather than component failure. In the popular Rank A823 solid-state colour chassis for example the power supply panel is secured by two screws. If these are not tight, there will not be an efficient earth connection between the l.t. earth print and chassis, and the result will be a hum bar. Note that this will not ripple the edge of the picture.

The Rank (Bush/Murphy) A774 monochrome chassis is another one that suffers from hum problems. In this chassis, the earth sections of print on the panels are not all connected together. Instead, the metal framework has protruding lugs that enter holes in the panel to provide a common earth line. These lugs are soldered to the print, and poor connections here can cause many peculiar effects, including severe horizontal pulling. The best cure is to solder wires vertically down each side of the tube to make a positive join between all the sections of the print that are meant to be linked by the vertical metal struts.

### Observing the Exact Symptoms

It's instructive on this chassis to study the edges of the raster – decrease the width control setting so that they can be observed. In some cases the sides of the raster will be seen to undulate, thus proving that the line timebase is affected. In this case the right centre earthing is responsible, i.e. the negative connection to 3C31, which decouples the line oscillator's h.t. supply, is not in good contact with the chassis lug. If the raster edges are straight but the picture is pulled, the left centre earth connections are at fault.

This highlights the point that close observation of the finer details of the fault symptom can save much time and

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## ● PUT AN ARROW ON THE PICTURE!

If you'd like to be able to draw attention to points of interest on a TV display, a movable arrow would be handy – one that you can shift around using a joystick control. It's not too difficult to arrange – here's how! The arrow can be in black, white or flashing. Simpler still, a dot can be displayed and moved around. The unit is for inclusion between a camera and monitor in a CCTV set up.

## ● LOCATING INTERMITTENT FAULTS

With the greatly increased reliability of modern TV sets, intermittent faults are accounting for a much larger proportion of the servicing work load. They are more awkward of course, and less susceptible to being tracked down using conventional fault-finding procedures. Derek Snelling offers guidance on this tricky business.

## ● THE THORN TX10 CHASSIS

The TX10 is Thorn's current full-specification chassis for driving large-screen 110° colour tubes. It provides excellent performance, using the latest technology. Eugene Trundle has had one on test, and reports on its performance and the circuitry employed.

## ● SERVICING FEATURES

Dewi James is back running his own servicing business, which means sets of all sorts appearing on the bench. Amongst others, some of the early 13in. Sony colour sets have been in evidence. More on the Thorn 4000 chassis of course, Les Lawry-Johns on The Shooting of Sam Magrew and S. Simon on tackling sets with which you're not familiar.

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trouble. If the set uses valves, some of these will be employed in the line timebase and will be supplied by the main h.t. line. If the h.t. smoothing is impaired, usually due to faulty electrolytics, the edges of the raster will be curved. If the field timebase is fed from the same source, the spacing of the raster lines will vary and the top and bottom of the raster will rise and fall.

Almost certainly the electrolytics will in this event be faulty, and this may be confirmed by the presence of a bulge at the tag end. Alternatively, the can's earth return may not be making good contact with the chassis, either because of a faulty tag or perhaps the retaining clip.

If the raster is even but marred by a dark bar or bars the trouble is almost certainly in the l.t. supply, and it's here that we need to use a bit of guesswork coupled with a knowledge of the circuitry used in various sets. If the set is not known to you, guesswork is out and patient plodding is in. Look for and check the l.t. electrolytics, check the l.t. bridge rectifier if one is fitted, and don't forget the series regulator transistor. If the set is a hybrid one, check the valves for heater-cathode insulation – by substitution.

### **Series Regulators**

Some readers may not see the connection between poor smoothing and a series regulator transistor. When the regulator is working correctly, its output will increase when the supply line falls and vice versa. It will thus provide a degree of electronic smoothing, and anything that upsets the action of the regulator will also affect the efficiency of the set's smoothing. Many have been fooled by the fact that adding an extra electrolytic across the regulated supply line appears to clear the fault. They then change the most likely electrolytic, only to find that the fault is still present, i.e. the real culprit has not been apprehended.

There's another point worth making here. The fact that the regulator is not working properly may mean that its output voltage is higher than it should be, and in a portable this could well mean that the tube's heater is being over run (the heater is usually either connected across the main l.t. rail or fed from a secondary winding on the line output transformer). This does the tube no good at all, so if you've got a portable with power supply problems it's essential to check the regulator's output voltage and take whatever remedial action is appropriate if this turns out to be high. Such action may simply consist of adjusting the relevant preset control, and this may save the tube and in addition clear the poor smoothing effect. Even so, the regulator transistor and its control circuitry should receive close attention to avoid a repetition of the trouble.

### **Thyristors**

We haven't mentioned thyristor regulated power supplies, because unlike transistor regulators they don't normally produce hum effects. A faulty regulator thyristor will normally cause a rapid fluctuation in the size of the picture, with perhaps the over-voltage circuit coming into operation to add to the fun and games. By and large we've found that thyristors do not normally cause confusing hum bar symptoms. Having said that, we'll probably be plagued by a succession of hum bars due to defective thyristors.

### **Hum in Audio Circuits**

If the picture is not disturbed in any way, tracing the cause of audio hum should not prove too difficult. Questions to bear in mind are as follows. Does the set use a valve in the audio output stage? If so, is the h.t. supply to it

decoupled by a separate smoothing electrolytic which could be open-circuit? Is the hum affected by the setting of the volume control? Is the hum actually coming from the loudspeaker, or maybe from a large wooden cabinet which might be amplifying the normally slight vibration of a transformer? Is it a low-frequency hum or a higher pitched buzz? Such questions are usually answered before they can be formulated. There are times however when the answers do not come so easily.

If the hum is still present when the volume control has been turned to minimum, we've at least narrowed the possibilities to what's present between the control and the loudspeaker. If an i.c. is used in the audio department, there would probably be no sound other than the hum if the i.c. is defective. There may also be signs of overloading if the supply has not failed completely due to a fusible resistor going open-circuit or a resistor burning up. Not much room for doubt here, but if there are no signs of distress and there's sound other than the hum the smoothing of the supply to the i.c. should be checked. Discrete transistor circuits present similar problems, but in either case spillage from nearby electrolytics is a possibility which should not be ignored.

It's valve circuits that cause most of the trouble, and in the majority of cases the valve will be a PCL82 or a PCL86. It's no great task to identify the h.t. supply circuit and its smoothing electrolytic, which may be a separate component or part of a multisection can. A test capacitor of between 10 and 32 $\mu$ F, 350V working voltage, is usually around and can be quickly linked across the suspect electrolytic. If the hum remains, you may have jumped the wrong electrolytic or the print to it may be open-circuit. Make the test again nearer the valve's base, having identified the h.t. print.

Having cleared the electrolytic of suspicion, change the valve itself – it may have heater-cathode leakage, or be visibly overheating due to grid-cathode leakage. If the valve and the smoothing are not at fault, check the value of the cathode bias resistor. Do this anyway if the valve was found to be defective. Failure to take this action is an invitation to further trouble, since a bias resistor that has changed value will damage the new valve in a very short time.

If the hum remains, check the valve's base voltages, especially the cathode and control grid voltages of the output section of the valve. The cathode voltage should be as specified. If it's higher than it should be, the control grid voltage might be slightly positive. This is usually due to leakage in the valve, which by now you would have changed, but could be due to leakage in the coupling capacitor. A common offender is C64 in the Thorn 1500 chassis – this small 0.022 $\mu$ F disc capacitor frequently leaks, upsetting the bias conditions in the output side of the circuit. If the hum still persists, check the h.t. feed to the triode section of the valve. There may be a separate electrolytic here.

These are the normal checks. The hum may remain however. One possibility is conduction through the panel material, particularly in older sets, and the proximity of the heater print tracks to the sensitive control grids should be investigated – together with a check on true resistor values and the screening of any plug and socket connections to the volume control. It's difficult to dictate the course of action to take at this stage. It's possible to disconnect the heater tracks and instead provide wired connections, to cut away any conductive panel material, or if necessary change the valve base. Check the volume control and make sure that it has been wired correctly, and that the metal body is earthed as it was originally.

# A Look at Tuned Circuits

S. George

THE day when we can forget about tuned circuits may not be all that far off. Already SWAFs and ceramic filters have considerably reduced the need for them in TV receivers. Before they disappear then, let's briefly summarise their main characteristics.

In a previous article (in the April 1980 issue) we saw that when a capacitor and a resistor are connected in series across an a.c. supply the voltages developed across each will, when added together, give a higher total than the applied voltage. This is because of the quadrature relationship between the resistor's resistance and the capacitor's reactance, i.e. the reactance of a coil or capacitor can (see Fig. 1) be regarded as being at right angles electrically to the resistance present in the circuit.

This quadrature condition arises because while the current flowing through a resistor is always in phase with the voltage across it, the current flowing into a capacitor or an inductor is  $90^\circ$  out of phase with the alternating voltage waveform applied across it. The current flowing in a coil or a capacitor is at maximum when the instantaneous voltage has dropped to zero, and vice versa.

Now whereas the current flowing into and out of a capacitor leads the alternating voltage across it by  $90^\circ$ , the current flowing in an inductor lags behind the applied voltage. Because of these relationships, connecting an inductor and a capacitor in series produces reactance cancellation, i.e. an a.c. short-circuit. Just what we require for removing an unwanted signal at a particular frequency! Connecting an inductor and a capacitor in parallel on the other hand gives reactance addition. These factors form the basis of tuning.

Since reactance varies with frequency, by selecting a coil and capacitor whose reactance at a particular frequency are equal they will, when connected in series, cancel. A coil's reactance increases as the frequency rises while a capacitor's reactance decreases.

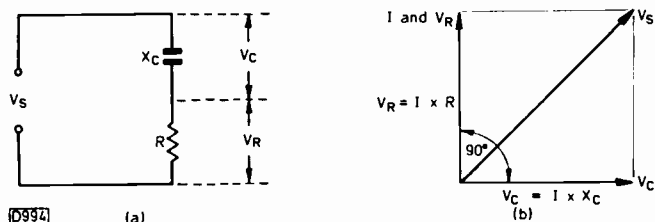


Fig. 1: Series RC circuit. The voltage and current are in phase across the resistor but in quadrature ( $90^\circ$  phase shift) across the capacitor.

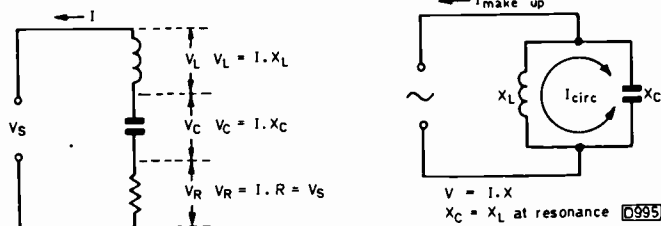


Fig. 2 (left): Series LCR circuit.  
Fig. 3 (right): Parallel LC circuit.

If we connect a resistor, a capacitor and a coil in series (see Fig. 2), then since the reactances of the coil and the capacitor cancel at the resonant frequency any applied voltage waveform at this frequency will be developed across the resistor only. The voltages developed across the coil and the capacitor will equal  $I \times XL$  and  $I \times XC$  respectively. By halving the value of the capacitor and doubling that of the inductor, both will have twice the reactance at the resonant frequency. The tuning will remain the same therefore, but the voltages developed will be doubled, i.e. the circuit's selectivity has been increased.

The parallel circuit condition is shown in Fig. 3. A high voltage is developed across the combination since at the resonant frequency a circulating current flows between the two components. The current forms a charge on the capacitor, which then discharges into the coil where it produces a magnetic field. When the rate of change of the current flowing in the coil falls to zero, the magnetic field collapses and the current flows back into the capacitor. And so on. This circulating current is  $Q$  times greater than the small make-up current taken from the supply to make up for the fact that in practice there is some resistive loss in the circuit.

As the applied signal frequency moves away from the resonant frequency, so the disparity between  $XC$  and  $XL$  increases and the selectivity of the circuit is reduced. This of course is how a response curve arises.

A series tuned circuit can be used to short-circuit an unwanted signal to chassis, or alternatively to allow a wanted signal to pass between two points. Conversely, a parallel tuned circuit can be used to block an unwanted signal, or alternatively the wanted signal can be developed across it and then coupled from one point to another.

Since the voltages developed across a coil and capacitor at resonance can exceed by many times the applied voltage (think of the line flyback pulse), the circuit provides voltage amplification. As to how much, this depends on the circuit's  $Q$  factor. This is the ratio of the resistance in the circuit to the reactance. Obviously any resistance present will introduce an  $IR$  loss. There is inevitably some resistance present, even if it's only that of the wire used to wind the coil.

The coil's inductance is increased when a core of magnetic material is introduced in the winding. This enables the circuit to be tuned. In addition to resistance, the coil's winding has some self-capacitance – in fact the self-capacitance is sometimes used to tune the coil, resulting in a tuned circuit that doesn't quite look like one appearing in the circuit diagram.

Sharp tuning is not always required of course – where we're concerned with a wideband signal such as the vision i.f. signal for example. In this case the addition of resistance enables the bandwidth of the circuit to be increased at the expense of reduced gain.

Damping is also required where it's essential to prevent the circuit continuing to ring. All LCR circuits, depending on the degree of damping used and the LC ratio, produce some response at the resonant frequency, especially when they are operated with pulse waveforms. Fault conditions in line output stages show this up – when striations appear on

the left-hand side of the screen due to the linearity or width coils being inadequately damped. This is caused by a degree of ringing following the flyback pulse. Another example is in video circuits using peaking coils. Here, step waveforms can instigate ringing on vertical outlines, or over accentuate

particular frequencies. This seldom means that a peaking coil's inductance has changed. The coil values are closely related to the values of emitter or cathode decoupling capacitors used in the circuit, and it's the capacitors that are the prime suspect where this sort of trouble is experienced. ■

# VCR Clinic

Steve Beeching, T.Eng. (C.E.I.)

SINCE becoming a retailer, I've had a free choice of the types of VCR I want to sell, such as JVC and Toshiba machines. You know, the good ones. So I decided to give the V2000 system a try. What to do? I decided to get in touch with my friends at Grundig, since . . . I call them my friends at Grundig, but the local rep Tim reckons they've updated the punishment block at HQ and installed microwave ovens.

Anyway, I had a couple of 2x4 versions from them. Then Tim said "we haf a new version zat you will buy", and in due course these 2x4 plus machines arrived. They have stop motion, slow motion and fast motion. Damn good too.

## Timer Trouble

Well it came to pass that I sold one of these machines. One that I'd run at home for a bit as a test. And there I was, doing my bit, installing this 2x4 plus at the customer's home. You may or may not know that when one sets the recording timer on these machines the microprocessor sequences the setting for you once you've done them. So I demonstrate the timer setting, don't I? Set on time, set day and channel, set off time and let it sequence. Display: on time, fourth day and channel, off time. Customer: "Why has it added four days?" Me: "Oh, er, well these microprocessors are also calculators you know." So next day I changed the recorder for another one, and checked out the timer on the first one. On any day setting below four it would add four to it, i.e. day two came out as six.

## No Replay and Vision Instability

I thought that was that, but the following day brought a call to say that there was no replay picture on the second machine, just black and white lines. Ah, says I, probably a bit of dirt on the heads. So off I set, with a luminance replay module under my arm. Fitting the exchange module cured the replay fault. That's why they use plug-in modules: makes life easy until you get back to the workshop and have to carry out the repair.

So I borrowed some extension leads from a friend and set about finding the fault. There are three i.c.s in the circuit. First (see Fig. 1) an amplifier with a drop-out detector and drop-out switching. Secondly a demodulator i.c. with a selector switch to introduce the output from the third i.c. in place of the second i.c.'s own demodulated output in the event of a drop-out. The third i.c. is also a demodulator, and has a one-line delay so that its output is delayed by that amount. The idea is that if there's a drop-out, the first i.c. detects this and arranges for the delayed signal from IC3 to be passed to IC2 to fill the drop-out gap. This of course relies on the fact that the previous line stored in IC3's delay line doesn't

have a drop-out in it. If the drop-out is very bad, the stored line is recirculated. If there's no f.m. video at all, the result is black and white lines.

Since I'd not played with one of these machines before, caution was the order of the day. With a known good tape being replayed, I checked around the i.c.s. There was demodulated video from the delay line in IC3, but nothing was coming out of IC2 - though demodulated video was present at its side of the drop-out switch. The drop-out switching signal is high, and goes low to switch in the delay line. Let's see. With a swift flick of the wrist and two crocodile clips, "clever drawers" earths the switching signal. Eureka, pictures! Well then, it was obvious that the fault was in IC2, wasn't it? No it wasn't!

It was at this time that my friend Peter arrived, along with a delivery from Grundig of a luminance module. So we put the module in this particular machine and it worked. Well, I say it worked, but in fact the display showed distinct signs of video instability.

"The luminance level balance is out between the main demodulator and the drop-out path" said Peter, who knows a lot about Grundigs. "I'll adjust it."

This didn't do a lot of good, mainly because it wasn't the cause of the problem. It's difficult to explain video instability if you've never seen it. It's like changes of black level, but in patches, stimulated by high brightness or high luminance levels, with clogged edges. If you can't visualize that, don't bother trying! Anyway, it was decided that in order to avoid two faults we'd change over IC2 from the replacement board to the original one. Naturally it was later when I got around to doing this, and it was then that I discovered the fault wasn't in IC2 at all. The problem in fact was in IC1, whose switch output was at too high a level. This had the effect of switching IC2 off.

So I swapped over IC1 between the two boards. This produced pictures, but the catch was that they suffered from

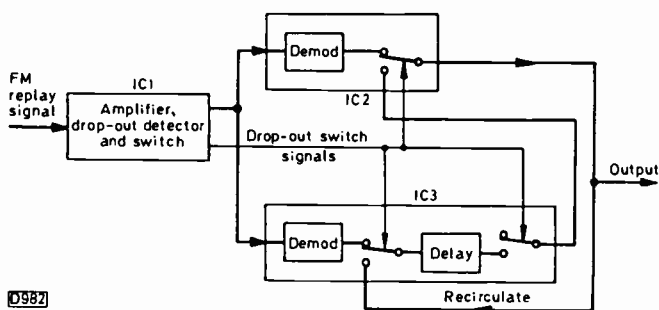


Fig. 1: Arrangement of i.c.s on the luminance board in the Grundig 2 x 4 VCR. IC3 provides drop-out compensation.

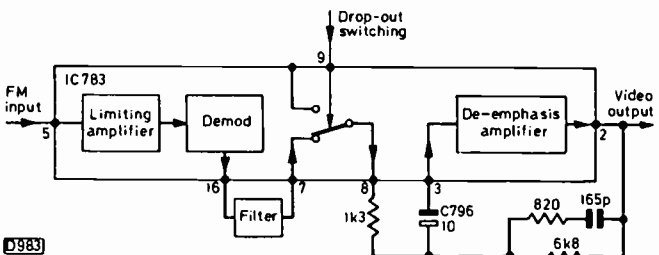


Fig. 2: The luminance demodulator i.c.

video instability. By now, which was some days later, another luminance module had arrived. This was followed by a telephone call from Grundig's technical department, which wanted to know what video instability was . . .

I gave up and installed the third module and set it up. At least that got one 2x4 plus back in full working order. All I have to do now is to sort out why a 2x4 produces herringbone patterning every so often, why another has lots of hum and a berserk drum servo, and another stops after about an hour and the clock display doesn't light.

### Back to the Timer

Ah, I hear you say. What about the timer that added four days? Well, Grundig sent me a replacement keyboard module. So I fitted it and switched on. No channel display, no record light, no set timer light. A close inspection revealed that Grundig spares don't yet know that the keyboard modules for the 2x4 and 2x4 plus are different. So I extracted the microprocessor i.c. and changed it over. It's much simpler that way, and you don't get a multiplicity of extra faults. I must admit that I broke an LED while doing this however. Yes, I did tell Grundig, honest . . . no, not the microwave ovens again . . . you can't do this to me . . .

### Patterning and Fading

Some time later, and we're back in the fray. A 2x4 I'd sold had been duly delivered, and after a while the customer complained that he couldn't get a reasonable recording – the replay had some patterning on it. This was puzzling, since the recorder had been working satisfactorily in the shop for a week or two. Upon investigation, it was discovered that the customer was receiving from a transmitter at the lower end of the band, whereas we'd been receiving at the top end of the band. The patterning was caused by the r.f. amplifier transistor oscillating, so we changed the tuner. After that little job was completed the customer asked whether it would stop the picture fading as well? Apparently it faded after the recorder had been running for some time.

So we sat down (Andy and I) for the obligatory cup of coffee, watching a replay of Twiggy in *The Boyfriend*. As if obscure faults were not enough, we were going to be tortured as well! Patience has its rewards however, and after about half an hour the picture started to fade. At least the luminance content did. In but a few minutes, the replay had become pastel looking with no definition in the dark areas, i.e. the black level was squashed. Why was the black level

being clipped? Surely this happens only with cameras? Anyway, we solved the immediate problem by replacing the luminance module, using one from a 2x4 plus. Yes folks, they are interchangeable, though Grundig say not.

Back at the bench the trusty scope was brought out and the picture levels were examined. It was at first rather difficult to see the video signal changes, as they were subtle. A hairdrier and a can of freezer came to our aid however. Hot up the demodulator i.c. (IC783) and the picture fades as the video content sinks slowly into the syncs. Oh boy do we get 'em! Freeze IC783 and up comes the signal again. Change IC783 from another known good luminance module (we collect them you know). Try again and the fault's still there. It must be the chip – or something around it. Like a leaky tantalum capacitor, such as C796 (see Fig. 2). Applause, applause!

### Several Symptoms

Yet another 2x4 on the bench, surrounded by the trusty scope and other bits and pieces. Only enthusiasm was lacking. This one had no clock display, and if you tried to play a known good tape the drum slowed down to a stop and then unthreaded. I wonder what would happen if I changed the luminance module? This notion was based on recent experiences, on the grounds that it was 99.999% certain that the fault would be on this module, because we collect them. A replacement module immediately restored normal working.

Now lesser men (or women) would perhaps send the board back to Grundig labelled "faulty". Beeching was curious however as to why the fault could be stopping two completely different sections of the machine working? The answer was the oscillator, or frequency generator. This starts out at 4MHz, and is divided by 64 to give 62.5kHz, which is used as the erase and bias signal for the audio panel. Further division gives 50Hz, which is used as a reference pulse for the head drum servo circuit. This explains why the drum slowed down. There's also a feed to the keyboard module. The service manual doesn't say much about this, but one presumes it runs the clock. Anyway, without the 50Hz signal there's no clock display. So why did we have no 50Hz? Because there was no 4MHz. The 4MHz crystal was all right, but the associated transistor TR763 (BC548) wasn't doing very much for the oscillations. Incidentally, just for the record a ZXT300 works fine in this position. Which was more than can be said for the BC548 or for quality control. These were all new machines you know.

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# Vintage TV: The Ekco Model TS105

Vivian Capel

THE name Ekco was very prominent in the early days of television, though many people never seemed to be able to spell it correctly. Ecko and Echo were common variants found on job sheets and customer complaint notes. This was perhaps understandable on the part of those who failed to appreciate that the spelling was taken from the firm's full name, E. K. Cole Ltd.

The TS105 was one of a range of some twelve models that were introduced during the summer and winter of 1949. There were table and console models, fitted with 9 and 12in.

c.r.t.s. The receiver section was of the t.r.f. variety, so different versions were produced for use in the London and Birmingham areas. In the London versions the first two r.f. amplifier stages were common to the sound and vision signals, while in the Birmingham version the sound signal was tapped off following the first r.f. amplifier. All sets employed a total of five r.f. amplifier stages, followed by double diodes – for detection and interference suppression.

A feature of the TS105 was the inclusion of a radio receiver section, which could be switched to drive the

common 6P25 audio output valve. This feature appeared in many early models but soon seemed to die out. In some of these models the TV valves all remained in operation when the radio was being used. Not in the TS105 however. A transformer supplied the heaters of the TV valves and the c.r.t. – it had six secondaries for the various heater voltages required, including a 2V heater supply for the c.r.t. When radio was selected, the transformer's primary winding was switched out of circuit. The heaters of the radio valves and the audio valve were connected in series and fed from a conventional dropper resistor. They remained on all the time, since the audio valve was required for TV as well.

A superhet circuit was used for the radio section. Instead of a continuous tuning scale, a switch selected between three preset medium-wave and one long-wave station.

The h.t. was obtained in the usual a.c./d.c. manner, with separate rectifiers for TV and radio. This was because the PZ30 TV rectifier had a 52V heater which was supplied by the transformer.

The SP61 valve used in the video output stage was d.c. coupled to the cathode of the c.r.t., and incorporated peaking coils in its control grid and anode circuits. The tube itself was a triode type, with the brightness control setting the grid bias voltage. The picture always seemed to have a nice grey range, without crushing of the darker shades. Picture centring was a rather hazardous procedure. The tube neck was supported in a collar which was secured to a frame by two screws. These had to be slackened off and the tube neck moved around to obtain a central picture! The necks were thicker of course and the flares smaller than with modern tubes, but it still seemed a risky business.

The contrast was controlled by what subsequently came to be known as a sensitivity control – a variable resistor in the first r.f. amplifier valve's cathode circuit. The volume was controlled in the same way, by a variable resistor in the cathode circuit of the first sound only r.f. amplifier valve.

The timebases were fairly simple but used techniques that have long been obsolete. Let's take a closer look.

### The Field Timebase

One feature that would be strange to most modern TV engineers was the thyatron (gas-filled triode) field oscillator valve. It was a 6K25, which was something of a standard for the purpose at the time. Fig. 1 shows the complete field timebase circuit.

The charging capacitor is C19, which charges via R23/R24/R22/VR3, the thyatron V7 being used to discharge C19. Basically, a thyatron conducts when its anode voltage reaches a certain critical level. The gas then ionises, and the conduction is heavy. It ceases to conduct when its anode voltage falls to another, much lower critical value – of only a few volts. At the start of the cycle, C19 is discharged and a heavy charging current flows via R23. So V7's anode voltage is low. As C19 charges exponentially, the voltage at the anode of V7 rises. When it reaches the point at which the gas ionises, V7 switches on to discharge C19 – via R24, which provides current limiting, R22 and VR3. The voltage at the anode of V7 falls to a very low level, and V7 switches off, the cycle then being repeated. Positive-going sync pulses trip V7 to maintain synchronisation, and the effect of VR3 on the charging sets the basic frequency of the circuit. Faulty thyatrons were quite common, and gave the symptoms of field judder and inability to lock the picture.

The sawtooth waveform thus produced was a.c. coupled to the height control and then to the control grid of the field output valve. This was an SP61, a valve which the designers

of the chassis seem to have favoured – it was used in the video amplifier, sync separator and line oscillator positions as well. Feedback in the output stage is provided by connecting the valve's cathode bias resistor R28 to the "top" of the field scan coils, and by the linearity control loop between the anode and control grid of the valve.

### The Line Timebase

The line timebase (see Fig. 2) also used an oscillator that won't be familiar to present-day TV engineers – a Miller transitron, V15 and associated components. This was borrowed from war-time radar practice. The basic idea used in a Miller oscillator is to connect a capacitor, C44 here, between the anode and control grid of a valve. Since the valve's control grid is connected to the h.t. rail, via R56 and VR7 in this case, it will switch on. C44 will be charged by the valve's grid current, and the valve will hurriedly switch off. C44 will then discharge slowly via R56 and the hold control VR7. This produces a positive-going waveform at the valve's control grid, and after an initial period when the valve is biased off a very linear sawtooth is produced at its anode. When the control grid is sufficiently positive, the valve saturates and the cycle repeats.

The only problem with this arrangement is the delay introduced while the valve is cut off. This is where the transitron bit comes in – the capacitor (C43) between the valve's suppressor and screen grids and the associated resistor network. The effect of this is to introduce an additional oscillatory action between the valve's screen and suppressor grids to speed up the switching on and off of the valve's anode current.

How this works is roughly as follows. Towards the end of the scan, the valve's anode voltage will be well below its screen grid voltage. The cathode current will thus be increasingly diverted to the screen grid circuit. This is a rapid action, and the resultant fall in the valve's screen grid voltage is applied to the suppressor grid via C43. The cessation of anode current flow is thus speeded up, and you'll notice that the sync pulses (negative-going) are also applied to the suppressor grid to ensure that the flyback starts at the correct time. What about speeding up the switch on? Well, when C44 has charged, there's no anode or screen grid current. The anode and screen grid voltages are at h.t. therefore, and via C43 a positive pulse is applied to the suppressor grid.

Since a Miller oscillator produces a negative-going sawtooth at its anode and a positive-going sawtooth is required to drive the line output valve, V15 is operated as a cathode-follower, the output developed across R55 being

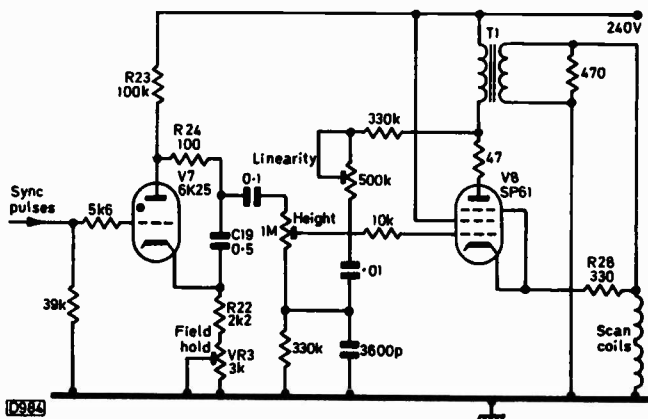


Fig. 1: The field timebase circuit used in the Ekco Model TS105, featuring a thyatron oscillator stage.



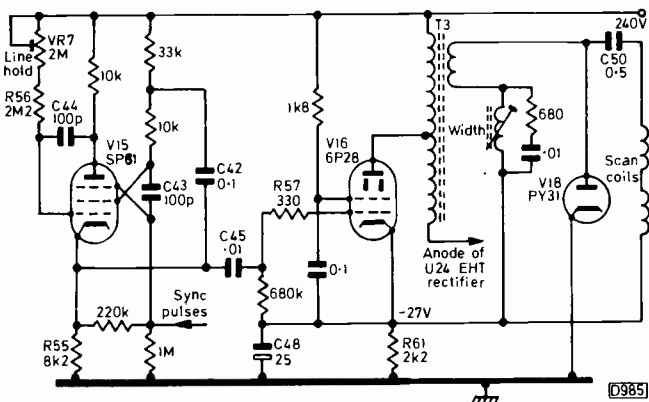


Fig. 2: The line timebase circuit used in the Ekco Model TS105. The oscillator circuit is of the Miller-transitron variety, which features feedback between the anode and control grid of the valve, via C44, and between the suppressor and screen grids, via C43. The output stage is conventional, with the efficiency diode V18 contributing the first third of the scan and establishing a negative boost voltage of -27V across C48.

coupled to the line output valve's control grid via C45 and the 330Ω stopper resistor R57. The line output stage itself is simple indeed. The usual e.h.t. overwinding fed the anode of the U24 e.h.t. rectifier, which produced an e.h.t. of some 7kV. The e.h.t. rectifier's heater was fed from a winding on

the mains transformer rather than the line output transformer.

The boost diode V18 produced all of -27V across C48 in the line output valve's cathode circuit to supplement the h.t. supply, which was thus effectively 267V as far as the line output valve V16 was concerned. C50 was there simply to provide a d.c. block - no need for scan correction in those days. A similar arrangement was used in the Pye 18T - see page 91, December 1980.

In the 12in. version of these sets, a Visconol e.h.t. capacitor was included to augment the tube's final anode capacitance and serve as an e.h.t. reservoir. These capacitors were commonly used in Ekco models, being mounted on the tube's supporting struts. A lead from the e.h.t. rectifier clipped on to the capacitor's top terminal, which was like a valve top-cap, and another lead was taken from the rectifier to the e.h.t. connector on the tube. The capacitor could thus be taken out of service quite simply and the difference in results compared. Without doubt the extra capacitance improved the focusing over the range of brightness from dark grey to white, since the voltage regulation was improved. These capacitors had a habit of going short-circuit however, killing the e.h.t. Many engineers simply disconnected the capacitor, not temporarily while a replacement was being obtained, but permanently. Yes, the bodgers were around in those days too!

# Video Mixer

Malcolm Burrell

A PCB for this project has now been produced: the print pattern is shown in Fig. 8 and the component layout in Fig. 7.

One point that may require a little clarification is looping through. Fig. 6, in conjunction with Fig. 2 last month, should make clear the reason for providing two input sockets for each input to the mixer. The idea is that each video line must be terminated, once only, with a 75Ω resistor. This may be done at the mixer or at the monitor. No terminating resistor was shown in the circuit for our

recent small-screen monitor project, though the note on page 151 (January issue) should make the requirement clear.

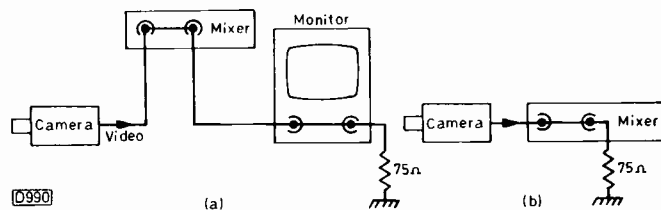
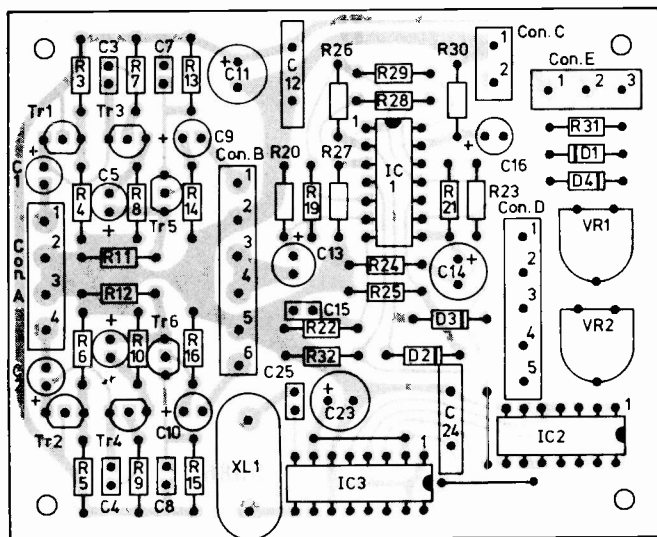


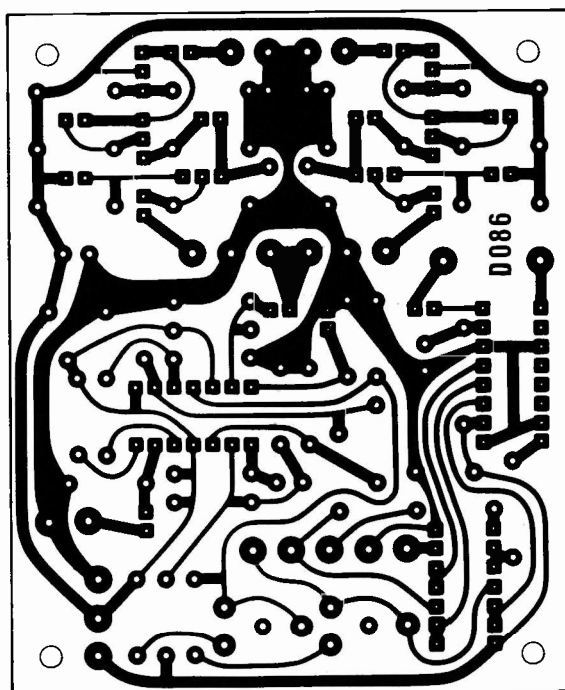
Fig. 6: Video line connections/termination. (a) Looping through to a monitor. Note single 75Ω terminating resistor. (b) Simple camera-mixer link.



TMG821

Fig. 7 (above): Video mixer component layout.

Fig. 8 (right): Video mixer board print pattern.



# Simple In-Situ Transistor Tester

Mike Phelan

NOW that we are all so familiar with semiconductor devices a transistor tester might seem to be a rather unnecessary piece of equipment. Many of these were introduced when transistors first appeared in consumer electronics equipment — some were very simple, while at the other end of the scale there were those that measured all the parameters (and, with germanium devices, all the leakages!). The normal approach to fault-finding today is to replace suspect components.

— low gain, low frequency cut-off, leaky or with an open-circuit junction. It will also identify npn and pnp devices, and will test most transistors in circuit (the exception is those cases, for example line output stages, where the transistor's base-emitter circuit is of very low impedance). In addition, since the supply voltage used is only 3V the device will cause no damage in the event of being connected incorrectly.

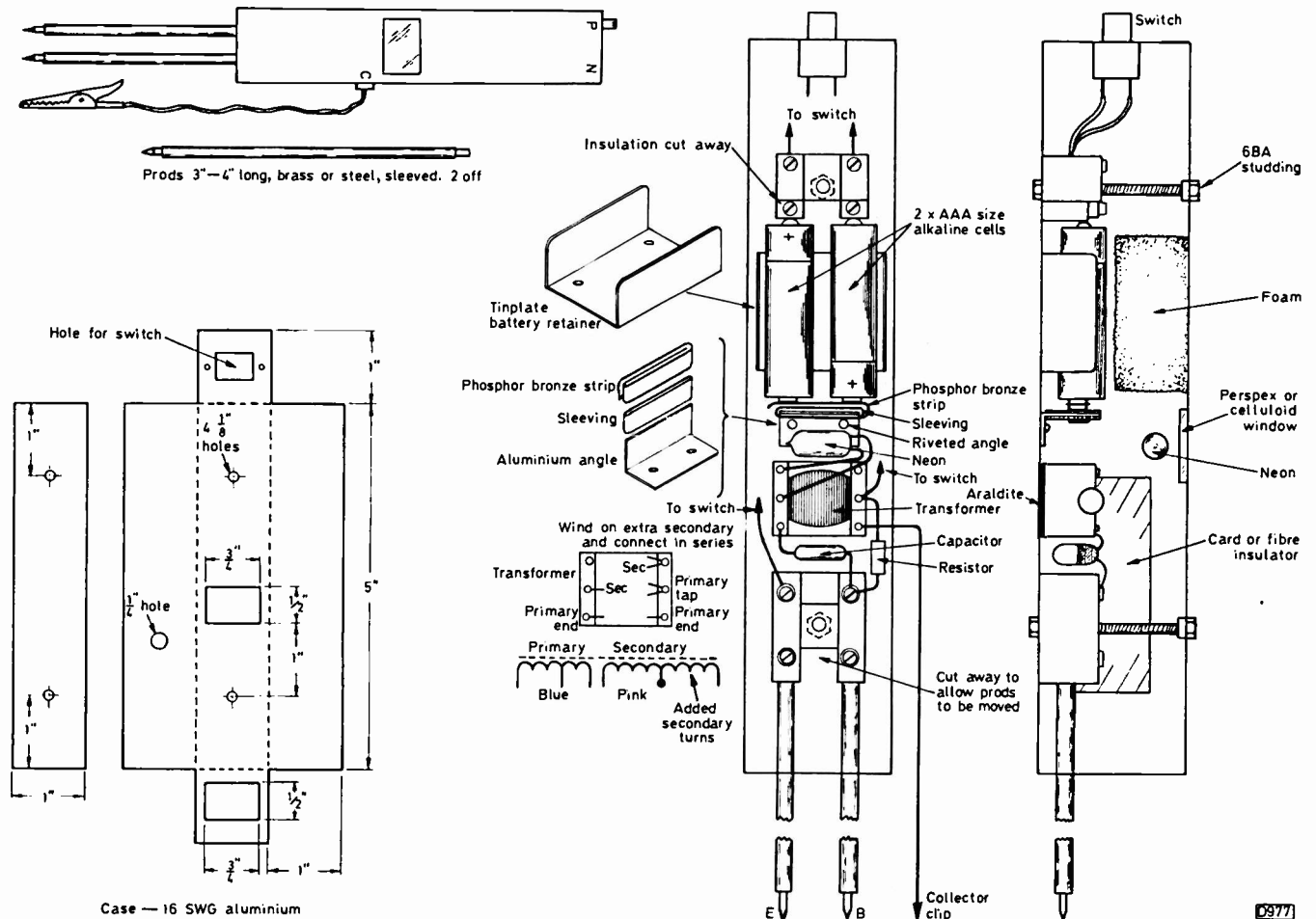


Fig. 1: Constructional details of the tester. A CC3L or similar neon is suitable. A miniature d.p.c.o. slide switch is used for polarity switching. Four pieces of 1A barrier strip are required.

Testing is often not worthwhile since the suspect may measure o.k. when checked out of circuit but may then produce the fault condition on being refitted.

There are situations however where a simple "go or no-go" transistor tester is useful. When checking unbranded or used devices for example, or when servicing d.c. coupled audio or field timebase circuits where a single faulty transistor will produce incorrect voltages throughout the following circuitry.

The gadget described here uses only four components plus batteries and a switch, and is thus simple and inexpensive to make. It will reject transistors with any fault

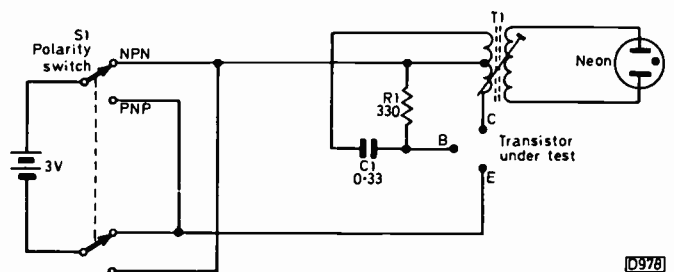


Fig. 2: Circuit. The transistor under test is connected to a Hartley oscillator circuit. If the transistor is o.k., the neon indicator will light up.

The prototype unit was housed in a case made from 16SWG aluminium sheet – Fig. 1 should make the details clear.

The idea is to see whether the transistor being tested will act as an oscillator – the circuit is the conventional Hartley one (see Fig. 2). The coil adopted for the prototype was taken from the remote control transmitter unit (Z918) used with the Bush Model BC6348 (Rank T20 chassis). The former was filled up with 36SWG enamelled copper wire – the exact number of turns is not critical, but the winding must be put on in the same direction as the existing overwinding (i.e. secondary) on the coil. Screw the adjustable core right in and cut the end off as shown. If you wish to make the transformer, use a 5mm ferrite core, with 20 + 20 and 700-800 turns of 36SWG wire.

If the transistor under test is o.k., it will oscillate and the transformer will step up the pulse voltage produced sufficiently to light the neon. Most defective transistors will not oscillate. The values of the capacitor and resistor used are not critical – the resistor can be anything from 180Ω to 10kΩ! The prototype unit, using the values shown, oscillates at about 220kHz.

Provided the leads are not allowed to short together, an on-off switch is unnecessary. The best course is to “park” the collector clip on one of the sleeved base or emitter probes.

When the unit has been built, it can be checked by connecting it to a good transistor or by touching the collector and emitter leads – this should make the neon flash. ■

## Letters

### CAPACITOR TESTER

Going back through old issues of your magazine, over a good number of years, I discovered various capacitor tester designs. Some were very simple, though with limited application, others quite advanced – and thus costly. About five years ago however I built up the circuit shown in Fig. 1 to test non-electrolytic capacitors with values from 100pF to 1μF for leakage or open- or short-circuits. It's very sensitive and I've found it most helpful. Perhaps other readers who require something that's worthwhile but cheap for the purpose will find it of interest.

The housing is not important except that the case must provide insulation. I housed the prototype in an old, unused 5A wall socket with switch, removing all unwanted bits to provide space for the components. I've never had any mishaps or incorrect diagnoses.

When in use, one end of the capacitor under test is disconnected from the circuit. The clips are then connected (with the red lead preferably to the disconnected end). If no suggestion of a flicker is produced by the neon, the capacitor is open-circuit. A good capacitor will light up the neon momentarily, the glow obtained depending on the capacitor's value. If the neon continues to glow, the capacitor is short-circuit. If the neon continues flickering the capacitor is leaky, the leak being proportional to the amount of flicker.

The unit can also be used to find the approximate value of good capacitors where the markings are illegible.

Victor Rizzo,  
Msida, Malta.

### VINTAGE TV

I was very interested to read Mr. Kendall's letter in the December issue, referring to my article on the pre-war HMV Model 901. I've had to work entirely from published data, so the recollections of someone with “hands-on” experience of these sets in their heyday is interesting indeed.

I'm not surprised to learn that the tubes were hand blown. The one in my set has a sort of home-made look about it. I suppose the 6/6 must be a “carrot” tube, though I can't say it looks much like one to me – it certainly doesn't look like an onion! Since the photos illustrating the article were taken, I've had the cabinet repaired and repolished. The improvement in the set's appearance has been quite dramatic. I've read before that the mirrors in these sets were surface silvered, but mine isn't. I can only assume that it has been replaced by a normal type at some time in the past. I knew that the valve screening cans were copper, but thought that the vision chassis was steel: Mr. Kendall is quite right though, it is copper. All the chassis are tinned of course and are the same colour.

The set has been realigned, but not by me, for vestigial sideband operation. I'm now driving the set from a double-sideband modulator however, so I shall in due course be restoring the alignment to its original form. The coil formers are black, but they haven't shrunk and the cores operate smoothly.

Yes, the aerial input has been replaced by a Belling-Lee coaxial socket: this is connected to a few inches of the original feeder, and there are no instability problems. The open-circuit i.f. coil had not been properly waxed in manufacture – whether a coil winding operative with a liking for citrus fruit had been involved I can't say, but it's only fair to point out that the set had been stored under poor conditions before I got it – some of the steelwork was rusty.

Brightness is a largely subjective matter: the set is certainly watchable in a room with normal domestic lighting. It compares badly with a modern 12in. portable, but then the latter operates with over twice the e.h.t. voltage. It's interesting that in the same issue Chas Miller refers unfavourably to the brightness obtained with the Pye B18T, which had a 9in. tube and 6.5kV e.h.t. The B18T is noticeably brighter than the 901.

The mains socket on the back cover is still present, though I unbolted it to make servicing easier. The e.h.t. shorting bar had been “fixed” at some stage in the set's

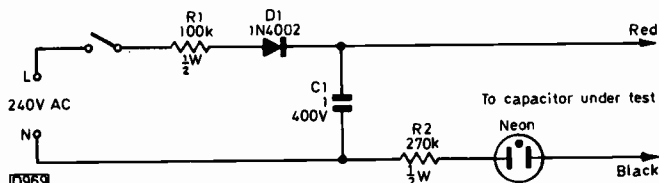


Fig. 1: Circuit of Victor Rizzo's capacitor tester.

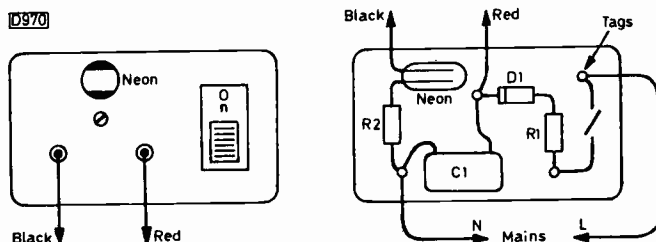


Fig. 2: Arrangement of the tester using a 5A wall socket.

history however. I use the earth terminal by connecting it to the earth conductor of the three-core mains cable.

On a different subject, Vivian Capel in the same issue suggests that Bands I and III may be allocated to educational TV after the closure of the 405-line service. Personally I think this unlikely. The private mobile radio lobby is poised to bid for those bands, and since TV4 will still be very new when the 405-line service closes I suspect that they will be successful.

David Looser,  
Ipswich.

### PRE-1945 ELECTRONICS

E. F. Good's letter last month brings out a fundamental difference between setmaking before the war and in more recent times. Before the war a company such as EMI truly manufactured their products as opposed to assembling them from bought-in components. They would not buy in if this could possibly be avoided. The HMV Model 901 for example was researched, designed and developed by EMI, who in addition made all the components except for the valves and wire. It would be interesting to know what the advantages/disadvantages of these two approaches are, and their relevance to the oft mentioned problem of reliability.

Mr. Good brings up the subject of radar. I wonder whether many readers know that Hertz demonstrated before 1900 that solid objects reflect radio waves, that Marconi suggested in 1922 in a lecture in London that these reflections might be put to good use by ships at sea, particularly in fog or darkness, and that by 1925 research workers at the Carnegie Institute in America had measured the heights of the various ionised layers in the upper atmosphere by means of radio signal pulses? The British Air Ministry set up a committee in 1935 to investigate detecting/locating aircraft by means of reflected radio waves, and as a result we had a radar network of sorts before the outbreak of war.

During the war, the government gave research, development, production and assembly work to all companies in accordance with their abilities and resources. We don't know exactly what these work allocations were, but I'm sure that an account of it all would make fascinating reading. It seems certain that Pye were given the task of producing that 45MHz radar i.f. strip, using a known frequency band. Whether the strip ever had any other connection with TV I don't know. I can't recall it being used in the Pye Model 817 in 1938, or in the B16T etc. series after the war. It's quite possible that like other manufacturers involved in top security work Pye didn't know what the unit they'd been asked to produce was to be used for – until it came to be recognised in service.

It's worth pointing out that many components/circuits were invented or developed during the war and were not available before the war, though time has rather obscured just what was and wasn't around in the late thirties.

Ernie Kendall,  
Ilminster, Somerset.

### UNUSUAL FAULT

A hybrid monochrome NordMende set was brought to us with the complaint of "picture failure". Investigation proved that the failure occurred occasionally and could be provoked artificially by touching the anode of the PL504 line output valve with a screwdriver. It was then necessary to switch the set off and on again to restore normal operation. When the fault was present, the PL504's anode current was very high, the c.r.t. screen was too dark, the

picture was not synchronised and the size of the raster was reduced both horizontally and vertically. In addition to these symptoms, there was a whistle at about 1.5kHz coming from the line output transformer.

The main problem in investigating the cause of the fault was that we couldn't maintain the fault condition for long as the fuse kept blowing and the PL504 and PY88 valves and the line output transformer could have been damaged. The customer complained that two PL504s and two line output transformers had already been fitted. To enable us to make continuous checks with the scope therefore we disconnected the PL504's screen grid voltage.

We discovered that the fault was not present under these conditions, while the line oscillator was operating normally. The waveform at the PL504's control grid was normal, as shown in Fig. 3(a), but when the PL504's screen grid voltage was restored we got the waveform shown in Fig. 3(b). Clearly something was wrong with the line oscillator stage, and this was proved when we found the waveform shown in Fig. 3(c) here. It appeared that some sort of instability was affecting the output – a parasitic oscillation at about 1.5kHz.

Attempts to discover a feedback path were in vain, so we tried to improve the decoupling with additional capacitors. No luck. We then tried to improve the screening. When an aluminium screen was placed over the oscillator coil there was no difference. An iron screen eliminated the fault however. We could have left the set like this, since it was now operating perfectly, but we were curious and decided to continue our investigations.

After a lot of work we discovered that the real trouble was not inadequate screening but the oscillator coil's ferrite core. This was of 14mm length, screwed half way into the former. It's not supposed to be this far in, but we didn't have a replacement and substitutes from radio receiver i.f. coils were not successful. In the end the use of an ordinary iron screw proved to be the best solution.

A. M. Karailiev,  
University of Science and Technology,  
Port Harcourt, Nigeria.

*Editorial comment:* It seems that the iron screen affected the tuning of the line oscillator coil. The permeability of a soft ferrite can increase under adverse conditions, altering the circuit's *Q* factor. The effect is greater at h.f. than at l.f. Maybe the core's permeability had altered and it had been adjusted, an l.f. oscillation being instigated as a result.

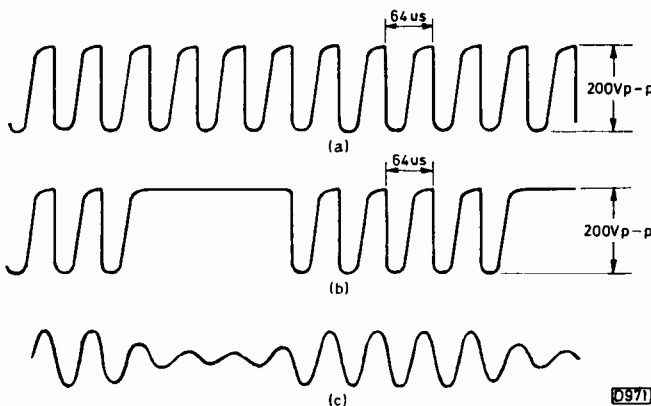


Fig. 3: Waveforms noted by A. M. Karailiev. (a) At the control grid of the line output valve under normal working conditions. (b) At the control grid of the line output valve with the fault present. (c) Line oscillator waveform with the fault, some sort of parasitic oscillation at 1.5kHz, present.

# Service Bureau

*Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 269 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.*

## **SABA F CHASSIS**

**The trouble with this set is loss of the luminance signal, with the brightness control having no effect. A new PL802 luminance output valve has made no difference.**

The brightness control acts on the clamp circuit in the PL802's control grid network. It's fed with a -20V supply which is obtained from the mains transformer. When the supply is missing there's no brightness adjustment and the luminance is lost. Check the relevant rectifier diode Gr606 (BY135) which sometimes goes open-circuit, then the voltage dropper network comprising R436 (1.2k $\Omega$ ) and the 20V zener diode D431. The usual thing that happens here is that the zener diode goes short-circuit and R436 then burns out. Loss of luminance in these sets can also be caused by failure of the coupling capacitors C337 and C340 (both 0.01 $\mu$ F).

## **TELETON TVC20W**

**The trouble with this 20in. colour set is varying height. It's perfect for half an hour after switching on, then there's a loss of half an inch at the top and bottom. The fault sometimes corrects itself. Alternatively full height can be obtained for a while longer by switching off and on again. A new 21LU8 field timebase valve has been fitted, and the field charging capacitor C619 has been replaced.**

The first thing to note is that the height control is R617, not R619 as marked on the circuit diagram. The trouble could be due to R617 itself, or to R725 (1.8M $\Omega$ ) which supplies C619 from the 800V boost rail. If the voltage at the slider of R617 remains steady when the trouble occurs, but the voltage at pin 2 (triode anode) of the 21LU8 varies, check the associated network R616 (1.2M $\Omega$ ), C611 and C612 (both 0.1 $\mu$ F).

## **PHILIPS TS7 CHASSIS**

**The trouble with this portable is that we can't get good linearity at the top of the picture, the result being "elongated heads". Adjusting the height and linearity presets R254 and R255 has failed to produce any improvement.**

If adjusting the linearity preset R255 has no effect at all, check the 4.7 $\mu$ F electrolytic C245 which is in series with it - this could have dried up. If the control has some effect but not enough, C245 could be leaky. If C245 is o.k., check the driver and output transistors TS33-35 and the bootstrap capacitor C249 (47 $\mu$ F).

## **DECCA MS2001**

**The picture suddenly went, leaving a flickering raster with the brightness control working in reverse. The set was switched off and allowed to cool, but a raster was then**

**obtained only with the brightness control at minimum. On repeating the process the raster took longer to appear, but when it did appear the anode of the DY802 e.h.t. rectifier began to heat up bright red. A replacement produced a bright raster with no effect from the brightness or contrast controls and still no picture. The sound is o.k.**

It seems that the e.h.t. rectifier is being overloaded. Since the video output pentode is d.c. coupled to the cathode of the c.r.t., its anode load resistor R45 (3k $\Omega$ ) could be open-circuit. Check the c.r.t. base voltages. There should be 160V at the cathode and 20-120V at the grid, depending on the brightness control setting. If the screen remains brightly lit when the cathode lead is disconnected, there must be an internal short - either grid-cathode or heater-cathode. If the c.r.t. blacks out, check R45, the continuity of the h.t. supply to the anode of the video output pentode, and the coupling capacitor C40 (0.1 $\mu$ F) at its control grid for leakage.

## **PYE 731 CHASSIS**

**There's a general lack of contrast and definition, and a measure of ringing/smearing plus severe flaring when the brightness/contrast/colour controls are advanced, particularly when the set is adjusted for daytime viewing. The tube has been tested on a combined tester/rejuvenator and seems to be satisfactory.**

The fault described is likely to be due to a defective matrixing i.c. - the TBA530Q. At any rate, each time we've encountered this sort of smearing and ringing replacing this i.c. has cleared the trouble. The tube can be the cause of this sort of thing, but appears to be in order.

## **TANDBERG CTV1 CHASSIS**

**The trouble with this set is the presence of field flyback lines on the picture - they are quite distinct at normal brightness control settings. I tried reducing the settings of the c.r.t.'s first anode controls, but this didn't help.**

This chassis is a bit unusual in using RGB drive (three PL802 valves) to the c.r.t. grids, with field flyback blanking at the cathodes. If you have access to an oscilloscope, check waveform 30 at the cathode of D477. This should be a 60V peak-to-peak positive-going pulse at field frequency. If it's absent, check D477, D479 and the coupling capacitor C484 on the c.r.t. base panel, and T301, C485, R481 and R486 on the field timebase panel - these latter components filter and shape the field flyback blanking pulse.

## **WALTHAM W125**

**There is sound hiss when the picture is predominantly light. Retuning removes this, but the picture will then break up on a mainly dark scene.**

It appears that the PCL84 video amplifier/a.g.c. valve is operating under the wrong conditions. The prime suspect is the valve itself, but the preset a.g.c. control R130 may require resetting or replacing if faulty.

## **THORN 1690 CHASSIS**

**The trouble with this portable is field collapse. Is there anything to go for first?**

The usual culprit is the upper transistor in the field output stage, VT23. A BC139 seems to work in this position if you have difficulty getting the correct Thorn type. Other possibilities are the lower transistor VT24, for which we've used a TIP41A, the flyback diode W21 and the output coupling capacitor C107 (1,000 $\mu$ F). If the trouble is further back in the circuit, check backwards until you come to the source of incorrect voltages - this course is necessary due to the d.c. coupling used throughout the field timebase.

### **ITT VC300 CHASSIS**

The problem with this portable is pulling, with the line hold control having little effect. I suspected the sync separator/line oscillator i.c. (IC7), but replacing this made no difference. An earlier problem, hum bars, was cured by replacing the bridge rectifier with four BY127 diodes.

Make sure that the video level preset R50 is correctly adjusted, then suspect the vision detector i.c. – IC6, type TDA1330. If necessary, check R100 (1M $\Omega$ ) which provides bias at the video input to the sync/line oscillator i.c., the 12V zener diode D8, and C82/3 which decouple the supplies around IC7. BY127 diodes are not really adequate for use in the bridge rectifier circuit – you'll find suitably beefy diodes in the RS range.

### **PYE HYBRID COLOUR CHASSIS**

There's a stubborn fault on this set – striations on the left-hand side of the picture, plus at the very edge a section where the picture is present but there's no colour. I've tried all the usual checks for striations – the damping resistors in the line scan circuit, and the components in the flyback blanking circuit – without success. The CDA panel and the line output stage have also been checked over carefully.

It's possible that there is too much burst blanking in the decoder – this was quite common on some of these sets. The problem can be overcome by increasing the value of the burst blanking pulse feed resistor R154 (it's 5.6k $\Omega$  as fitted).

### **THORN 3500 CHASSIS**

The problem is loss of raster. When the set is switched on a small raster appears momentarily, then collapses to give a blank screen. There's e.h.t. however, the c.r.t. heaters are alight, the sound is not affected, all fuses are o.k. and the power supply voltages are correct as far as I can check.

The beam limiter could be cutting off the brilliance. This often happens when R907 on the beam-limiter board goes high in value. Since the line output stage current flows through this resistor, any change in its value will upset the operation of the beam limiter. Next check that the tube's first anode supply is present – the rectifier (W505) sometimes goes open-circuit when its reservoir capacitor C523 goes short-circuit. Finally make sure that the c.r.t. is biased correctly. The three grids should be at around 0V, while the three cathodes should be at some 160V.

### **RANK A823A CHASSIS**

There's something odd with the green on this set. When the set is switched on from cold, the brightness of the green flickers – it usually disappears completely, but can be restored by changing channels. It generally fails again after a few seconds. When the set has been on for some hours however the fault usually clears. Where do I start?

If you're lucky, the trouble could be no more than a dirty green drive potentiometer (3RV11). If replacing this fails to cure the problem, try replacing the associated 6.4 $\mu$ F electrolytic coupling capacitor and the BF337 green output transistor (3VT8). Finally suspect the SL901B colour demodulator/matixing chip (3SIC1).

### **THORN 2000 CHASSIS**

I'm unable to get 2S034 series regulator transistors for use on the power supply regulator panel. Any suggestions for alternatives? There's also a fault on the line timebase panel – no drive at the base of the line driver transistor. The flywheel sync circuit has been checked and the line

oscillator and reactance control transistors have been replaced.

BLY49 or 2N3055 transistors will work in place of the 2S034 type. For the loss of line drive we suggest you check the electrolytics C7/11/13 and diode W3 (OA91) in the line oscillator stage and the connections to the line oscillator coil L1/2/3.

### **SABA F CHASSIS**

I'm having trouble getting a couple of replacement diodes for use in this set. The original problem was that the e.h.t. tripler developed a pinhole and had to be replaced. There's a curious network across the e.h.t. overwinding however, consisting of a 1.8k $\Omega$  resistor, a parallel RC network and two SH62 diodes, all in series. The 1.8k $\Omega$  resistor was found to be open-circuit and the diodes leaky, but no one seems to be able to supply SH62s.

The idea of the network across the overwinding is to help to stabilise the e.h.t. The diodes conduct to remove the overswing at the input to the tripler. Removing the diodes altogether seems to have very little effect on the e.h.t. stability, but if you really want to replace them we can only suggest you contact Saba directly.

### **THORN 9000 CHASSIS**

The problem is no raster, with R725 cooking. Disconnecting the e.h.t. tripler restored R725 to normal temperature, so R725 was replaced and a new tripler fitted. There's still no raster however. With the tripler disconnected, the voltage at the c.r.t. grids is 20V, but with the tripler connected the voltage falls to –70V.

The purpose of R725 is to apply forward bias to the beam limiter diode W722. First make sure that this diode is not open-circuit. If all is well here, suspect the faulty tripler of having ruined the insulation of the line output transformer's overwinding.

### **ITT CVC8 CHASSIS**

The problem is intermittent variations in the brightness level, mainly during the first half hour of operation. The picture also moves slightly to the right, with the result that there's a narrow border on the left-hand side. Changing channels usually restores the brightness to the correct level.

This sort of thing is often caused by earthing problems in the line output stage. We suggest you check the goodness of the joints on the line output valve's cathode resistor R423, and the lugs on the printed-circuit earthing chassis members on the left-hand side of the line output panel. If these are o.k., check the black-level clamp diodes D21/22, D57 at the earthy side of the boost supply, and the beam limiter transistor T24.

### **THORN 1612 CHASSIS**

There are a few minor faults on this portable. First, there's a very thin line down the left-hand side of the screen. It's present at all times and on all channels, and is about a quarter of an inch from the edge of the screen. Secondly there's a buzz on channel selectors 1 and 3, strong with button three selected, more so when something is superimposed on the screen. Finally there's a flashback from the e.h.t. tube lead. Some fine wire strands have been trimmed back, but there are still slight clicks.

The vertical striation will probably be cured by replacing the clipper diode (W15) in the line flyback blanking circuit, and the associated capacitor C107 (0.01 $\mu$ F) which decouples the slider of the brightness control. If necessary, check the first anode supply reservoir capacitor C104

( $1\mu\text{F}$ ) as well. To eliminate the buzz, carefully retune the 6MHz quadrature coil L11. If this produces no improvement, try attenuating the aerial input signal since the problem could be due to overloading. If these steps fail, the 6MHz ceramic filter CF1 is suspect. The only sure cure for the corona discharge problem is to fit a new e.h.t. lead/flower assembly and clean the c.r.t. cavity connector thoroughly.

# TEST CASE

## 219

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.

We have a standard formula when making a field service call to Thorn 3000/3500 chassis sets with the "no raster" symptom. Take an e.h.t. tripler, a meter to check the c.r.t.'s cathode voltages – and cross your fingers that the e.h.t. transformer hasn't failed. In a recent case we followed this procedure but found ourselves faced with an unusual set of circumstances. Sound was present on all channels, the 60V h.t. line was present and correct and the tube's cathode voltages were normal. There was zero voltage at the tube's first anodes however. So we whipped out our set of extension leads, made the line timebase panel comfortable on the ample cabinet top, and rounded up more test gear.

The first anode voltage is obtained from a rectifier (W505) which is fed from a tapping on the line output transformer. So we started to check around the line timebase. There was h.t. at the collector of the R2008B line output transistor, and at the top end of the resistor (R518) feeding the line driver stage – see Fig. 1(a). It seemed that the line output and e.h.t. transformers were not being

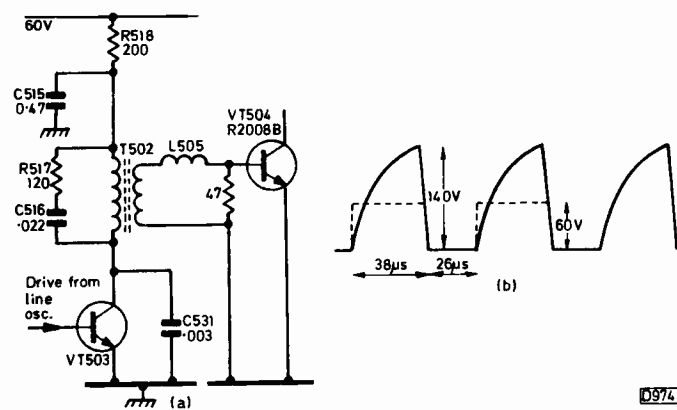


Fig. 1: (a) Line driver stage circuit used in the Thorn 3500 chassis. (b) 140V peak-to-peak waveform discovered at the anode of the driver transistor VT503 – the normal squarewave is shown in broken outline.

driven, and our scope showed no discernible waveform at the collector of the line output transistor, suggesting that it in turn was without drive. The probe was moved back to the collector of the line driver transistor VT503, and we discovered that what should have been a straight-sided 60V peak-to-peak squarewave had taken on the grossly distorted shape shown in Fig. 1(b). The timing was correct, but during the driver transistor's off periods there was a triangular waveform of no less than 140V peak-to-peak! This we felt was no good for either transistor. The capacitor (C515) that decouples the driver stage feed resistor was replaced, also C531 which is in parallel with the driver transistor. We then confidently switched on again, but the symptoms remained unchanged. The line oscillator's output waveform was next checked and found to be of the correct shape, so we decided to replace the damping components (R517 and C516) across the primary winding of the driver transformer T502. This did no good, nor did replacing the driver transistor.

Thinking that there was maybe some evil influence on the secondary side of the line driver transformer, we disconnected L505. This choke is connected in series with the base of the line output transistor. There was very little effect on the offending waveform however, so next the driver transformer was changed. Again there was no difference!

After some experimentation the cause of the trouble was found and the picture was restored. Any ideas on this one? Answer next month, plus another teaser.

### SOLUTION TO TEST CASE 218 – page 213 last month –

The problem we had last month was no colour on a set fitted with the Pye hybrid colour chassis, though detailed checks gave every indication that the decoder was functioning correctly. It was in fact, the B – Y and R – Y colour-difference signals appearing at the decoder outputs and passing to the CDA panel. Here they stopped in their tracks, so to speak. When the two colour-difference signals arrive at the CDA panel, they pass first to a pair of one transistor amplifier stages – VT29 for the R – Y signal and VT31 for the B – Y signal. The collector supply voltage for these transistors comes from pin A of plug 11 via a decoupling network consisting of resistor R365 (100Ω) and capacitor C356 (0.47μF). There was a fine crack in the print run to R365, as a result of which both transistors were robbed of their collector voltages, thus completely deleting the picture's colour content.

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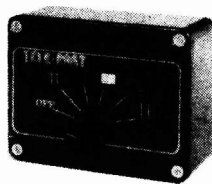
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## REBUILT CATHODE RAY TUBES IN SOUTH WALES

**C.R.T. SERVICES**  
274 Chepstow Road, Newport, Gwent.  
Tel Newport 272005.

### CURRENT PRICE LIST

A44-271X, A47-342X/343X	£30	470ERB22, 470FTB22	£40
A49-120X, A51-110X	£30	A51-161	£40
A56-120X, A56-140X	£33	A56-500X, 560HB22	£43
A63-120X, A66-120X	£36	A66-500X	£46
A66-140X, A67-120X/150X	£36	Add 15% VAT to all prices.	

Prices are based on a type for type exchange tube  
suitable for reprocessing.

**TWO YEAR GUARANTEE ON ALL TUBES**

## MAIL ORDER PROTECTION SCHEME

### INTRODUCTION

The Office of Fair Trading have agreed that the notice of the Mail Order Protection Scheme to appear in periodicals carrying mail order advertising should appear as follows:—

### "MAIL ORDER ADVERTISING

### British Code of Advertising Practice

Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfill orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

### Mail Order Protection Scheme

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, Television will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

- (1) You have not received the goods or had your money returned; and
- (2) You write to the Publisher of Television summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues etc., received as a result of answering such advertisements. Classified advertisements are excluded.

# ★ NEW ★ COLOUR BAR GENERATOR

U.H.F. AERIAL INPUT PATTERN GENERATOR CPG6-RF



All Facilities of our PG6RF

## PLUS COLOUR BARS.

Produces 7 invaluable patterns.

**Robust, Battery Powered, Pocket Sized Unit,  
Plugs Straight into Aerial Socket.**

W H I T E	Y E L L O W	C Y A N	G R E E N	M A G E N T A	R E D	B L U E	B L A C K
-----------------------	----------------------------	------------------	-----------------------	---------------------------------	-------------	------------------	-----------------------

## FEATURES:

- ★ CROSSHATCH GRID
- ★ DOT MATRIX
- ★ VERTICALS
- ★ HORIZONTALS
- ★ WHITE RASTER
- ★ GREYSCALE
- ★ PLUS PAL COLOUR BARS;  
ONLY 3 SIMPLE ADJUSTMENTS.

★ PG6RF OWNERS; Buy Add-On 'C6' Unit!

## ORDER NOW!

PG6RF KIT £25.87 BUILT £33.35 – As per TV Review, Jan. 1979

C6 KIT £18.98 BUILT £26.45 – Add-on Colour to PG6RF

CPG6RF KIT £42.55 BUILT £63.25 – Both above combined.

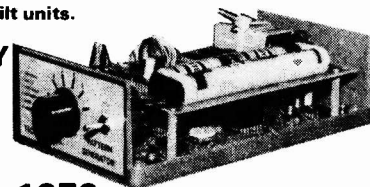
These prices INCLUDE P & P and 15% VAT. Export VHF versions available.

In response to demand we have produced an add-on Colour Bar unit C6 to upgrade the PG6RF to PAL COLOUR. A MUST for TV construction or servicing! Available as a KIT or BUILT & TESTED. Kit includes all components and ready built modulator etc. Hundreds sold, reliable design.

Full 12 month guarantee on built units.

## MAIL ORDER ONLY

Quantity Discount  
on application



**ACCESS  
ORDERS  
WELCOME**

PLEASE NOTE OUR NEW ADDRESS. ORDER FROM:—  
**TECHNALOGICS LIMITED (DEPT. TV)**  
WINDMILL WORKS, STATION ROAD,  
SWINTON, MANCHESTER M27 2BU.

TELEPHONE: 061-793 5293

# TENREC

Tenrec Electronic Engineers Ltd  
502 Bearwood Road  
Warley, West Midlands  
021 429 8150

## Thorn 8000/8500 CTV's

Full working order from £65 + p.&p.

## LCD Watches

from £5.85 + £1 p.&p.

SAE for Complete List.

\*A31-410, 12" Mono Tube New. Special Price for Current  
A38-160W, 15" "Television" Feature: £19. P&P-£2.

Plenty of used colour panels working. S.A.E. for  
list. 50p p. & p.

Trade enquiries welcome

(All prices include VAT)

(T.I.)

## AERIAL SPLITTERS

Two way in white box with three  
black insulated co-ax sockets.

Completely made up with two spare  
co-ax plugs.

Price only £1.70 EACH.

## CALLERS WELCOME

Large stock of capacitor, resistors,  
P.C.B. etching compound, TV valves,  
loft aerial and co-ax cable.

Open for Callers: Tuesday, Thursday,  
Friday and Saturday morning.

## AERIAL AMPLIFIERS

Aerial amplifiers can produce  
remarkable improvement on the pic-  
ture and sound in fringe or difficult  
areas.

**B45** – for mono or colour this is  
tunable over complete UHF television  
band.

**B11** – for stereo or standard VHF/FM  
radio.

**B12** – for VHF television band 1 & 3.

**All amplifiers are complete  
and ready to use.**

Battery type PP3 or 8v to 18v dc, next  
to the set type fitting. Prices **£6.70  
each.**

**SIGNAL INJECTORS** with (pre-set) variable AF, which emits RF harmonics into  
the UHF band. Protected up to 300 volts dc. Complete with leads **£5.70 each.**

All prices include VAT at 15%. P&P per order 30p. S.A.E. for leaflets. Access cards.

## ELECTRONIC MAILORDER LTD,

62 Bridge Street, Ramsbottom,

Via Bury, Lancs. BL0 9AGT. Tel. Ramsbottom (070 682) 3036.

## QUALITY TV's ALWAYS AVAILABLE

GOOD STOCKS OF MODERN COLOUR  
PLENTY OF SINGLE STANDARD MONO  
VERY COMPETITIVE PRICES  
COME TO THE BEST IN THE WEST

## TELETRADERS

ST. LEONARDS WAREHOUSE  
ST. LEONARDS ROAD, NEWTON ABBOT, DEVON  
Telephone: (0626) 60154

## CARDIFF CENTREVISION

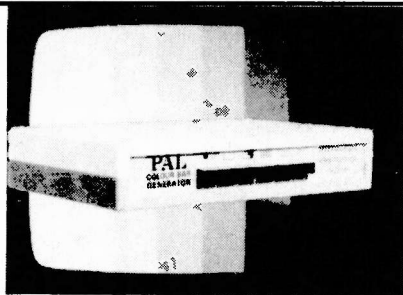
### EX RENTAL T/V's

\*In stock now. Philips G8 Thorn 3500

RBM twin chip and many others from **£15.00**  
Also Mono from **£2.00**

Large range of spares. Call and see our 4000  
sq. ft. warehouse, you won't be disappointed.

Unit 2 corner of Penarth Road and Hatfield Road.  
Tel. Cardiff 0222 44754



N7118

## COLOUR BAR GENERATOR

- \* Now Available with Sound Modulator
- \* Built-in rechargeable battery PLUS Mains Unit.
- \* Push-Button operation selects: Colour Bars, Red Raster, Crosshatch, Grey Scale and Peak White.
- \* UHF or VHF Output, plus (optional) 1V P to P Video.

COMPARE OUR PRICE & SPECIFICATION AND SEE WHY HUNDREDS OF SERVICE ENGINEERS, BROADCAST ENGINEERS, UNIVERSITIES AND TECHNICAL COLLEGES, WORLD WIDE, CHOSE THE N7118.

### SPECIFICATION

Line frequency: 15,625 Hz  $\pm$  0.1%

Field Frequency: 50 Hz  $\pm$  0.1%

Interlace: 2:1

Colour System: PAL

Standard 75% Saturated, 100%  
Amplitude Colour Bars

### SOUND

Carrier frequency: 6 MHz or 5.5 MHz

Modulation: 1 KHz Sinusoidal/Unmod.

### VIDEO

Output: 1V P to P Positive  
into 75 ohms

### EXTRACT FROM APRIL 1980 TELEVISION MAG.

"The N7118 was substituted for our Philips PM5509 and used for some weeks on all bench repair jobs. It worked well, providing over a millivolt of u.h.f. signal without any sign of modulator or receiver overload . . ." "This bar generator really came into its own in field servicing. The ten-hour capability of the internal battery last for many weeks of field servicing . . ."

### PRICES

N7118 Kit £49.95 + VAT. & PP

N7118 Built & Tested £75.00 + VAT & PP

Sound Module (kit) £8.95 + VAT

Sound Module (Built) £9.95 + VAT

Video Module (kit) £8.95 + VAT

Video Module (Built) £9.95 + VAT

(Please add 58p Post & Packing if ordering sound or Video module,  
under separate cover)

### TOTAL

£59.50

£88.25

£10.29

£11.44

£10.29

£11.44



**INTRACEPT**

**ELECTRONICS LTD.**, 203 Picton Road, Liverpool L15 4LG Tel: 051-733 3042

EMO - EUROSONIC - GRUNDIG - TELETON + ALL BRITISH MAKES  
ETC., ETC. ● ALL SPARES READILY AVAILABLE ●

### CREDIT AVAILABLE — TRADE ONLY

Almost any TV Component supplied by return "off the shelf" e.g. LOPTX -  
EHT trays - droppers - OSC coils - switches - cans - smoothers - I.C.'s, etc., etc.

**YOU CAN BE 95% SURE WE CAN SUPPLY ANY  
TV COMPONENT BY RETURN  
IF YOU NEED SPARES FAST - RING NOW!**

ACCESS AND BARCLAYCARD ACCEPTED.

S.A.E. FOR FREE WALL CHART

**TELE-PORT (WTON)** THE TELECENTRE, WORCESTER ST.,  
WOLVERHAMPTON (0902) 773122

## N.G.T. COLOUR TUBES

First Independent Rebuilder with

**B.S.I. CERTIFICATION**

(Certificate No. 004)

2 year guarantee: 4 year option

All Colour Tubes are debanded, high temperature pumped  
and rebanded using new adhesives and new tension band.

19" £30, 20" £32, 22" £33, and 26" £38.

Exchange prices: add VAT at 15%

**N.G.T. ELECTRONICS LTD.**,

120, SELHURST ROAD., LONDON S.E.25

Phone: 01-771 3535.

20 years experience in television tube rebuilding.

## It's easy to complain about advertisements.

Every week, millions of advertisements appear in the press, on posters or in the cinema.

Most of them comply with the rules contained in the British Code of Advertising Practice and are legal, decent, honest and truthful.

But if you find one that, in your opinion, is wrong in some way, please write to us at the address below.

We'd like you to help us keep advertising up to standard.

**The Advertising  
Standards Authority.**

A.S.A. Ltd., Brook House, Torrington Place, London WC1E 7HN.

# WMTV LTD. – THE TV PROFESSIONALS



## THE BEST DEAL IN TV's

- ★ Britains most reliable source of Quality T.V.'s.
- ★ Hundreds of working polished T.V.'s.
- ★ Full customer testing facilities.
- ★ Thousands of untested S/S Colour T.V.'s from **£10.**
- ★ Quantity deliveries arranged anywhere in Britain or the World.

### Special Deals

- ★ Mixed 25" 4 for **£30**
  - ★ GEC 19" 10 for **£100**
  - ★ BRC 26" 10 for **£250**
  - ★ Pye 691 22" 10 for **£120**
  - ★ PYE 205 22" 10 for **£199**
  - ★ Personal collection only
- All above prices are plus 15% V.A.T.*

**RING 021-444 6464 FOR DETAILS OF QUANTITY DISCOUNTS**

### MAIL ORDER TV's – Working Colour TVs supplied by Mail Order and fully tested before despatch.

- ★ BRC 22"/26" **£70**
- ★ BUSH 184 22" **£40**
- ★ BRC 8000 17" **£65**
- ★ BUSH A823 22"/26" **£60**

*Above MAIL ORDER prices include V.A.T. but please add £12 p & p/T.V. Set.*

- ★ New T.V. Stands.
- ★ Fully adjustable.
- ★ **£6.25** plus £1.75 p & p.
- ★ Quantity discounts.
- ★ Price inc. V.A.T.



## EXPRESS MAIL ORDER SPARES

### ★ Ex-equipment Panels

	Con	Power	Line	Decoder	Video	IF	Frame	Tripler	LOPTX
<b>RBM 823</b>	7.00	6.00	14.00	14.00	—	6.00	9.00	3.00	3.00
<b>BRC 3000</b>	6.00	12.00	12.00	6.00	6.00	6.00	6.00	4.00	6.00
<b>BRC 3500</b>	9.00	12.00	12.00	6.00	6.00	6.00	6.00	4.00	6.00
<b>GEC 2100</b>	6.00	—	—	8.00	6.00	6.00	10.00	5.00	5.00
<b>PYE 205</b>	6.00	—	12.00	8.00	7.00	6.00	5.00	5.00	7.00

Postage & packing **£1.25** Panels **50p** Triplers

### Ex-Equipment Valves

	Untested
ECC82	10
PCF80	10
PCF802	9
PCL82	10
PCL84	10
PCL85/805	9
PCL86	10
PFL200	10
PL36	10
PL504	10
PL508	18
PL509	30
PL519	40
PL802	—
PY500	20
PY800/81	10
PY801/88	10
30FL1/2	20

- ★ p & p paid but minimum order of £3.00 please.
- ★ Deduct 10% discount on orders over £20.00.

### Ex-Equipment Colour Tubes

All fully tested

17" (A44-271X)	<b>£18.00</b>
18" (A47-342X)	<b>£18.00</b>
18" (A47-343X)	<b>£18.00</b>
19" (A49-191X)	<b>£18.00</b>
20" (A51-120X)	<b>£25.00</b>
22" (A56-120X)	<b>£17.00</b>
25" (A63-200X)	<b>£10.00</b>
26" (A66-120X)	<b>£20.00</b>
26" (A67-120X)	<b>£17.00</b>

Please add £5.00 p & p per C.R.T.

### Equipment Spares

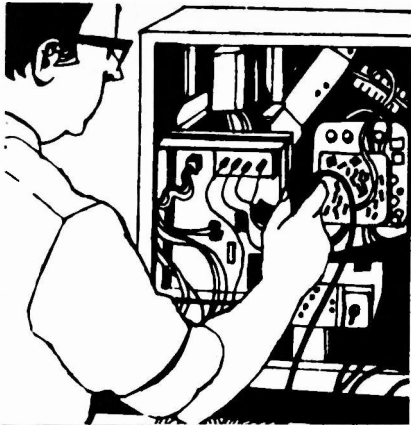
\*Always available

- ★ Colour and Mono Scan Coils **£1.50** + £1.00 p & p.
- ★ Tuners for all makes of Colour and Mono **£4.00** + £1.00 p & p.
- ★ Mono tubes fully tested. All Sizes – please state size on order **£3.00** + £4.00 p & p.
- ★ Reconditioned 50p meters **£92.00/Box of 10** incl. p & p.
- ★ PLESSEY SL918 colour ICs with ● circuit for substitution of SL917 **£2.00** + 25p p & p.
- ★ NEW VHF/UHF Varicap Tuners with circuit and full data **£1.25** + 75p p & p.

**WE ARE OPEN MON-SAT 9.30-5.45**

**PLEASE NOTE – ALL THE ABOVE MAIL ORDER PRICES INCLUDE 15% V.A.T.**

**WMTV LTD. 92 HIGH ST (A435) KINGS HEATH B'HAM B14 7JZ TEL. 021-444 6464  
021-444 2575**



## SETS & COMPONENTS

### TV DX.

High Quality, proven equipment supplied by an expert in the TV DX field.

**Wideband Band I preamplifier module.** Gives approx 20dB gain, low noise-IC used. 12V supply required. **£6.20.**

**Upconverter.** This is an ideal way to start TV DXing. The unit converts band I/III to UHF-A tuned RF stage ensures low noise and cross modulation, a feature which many models lack, 12V supply required. **£10.30.**

**Band I notch filter.** This attenuates the sound and vision frequencies of your local band I channel (please state which) whilst passing with low insertion loss the rest of the band. **£17.95.**

**Philips G8 selectivity modules.** One or two of these placed between the tuner and IF strip of your TV gives reduced bandwidth essential for serious DX work. **£1.50.**

**FM DX!** 88-108MHz tunable Mosfet pre-amplifier. Reduces local signal overload. **£25.95.**

**TV DX receivers** available. Please send sae for my product list to:

**H. COCKS,**

**Cripps Corner,**

**Robertsbridge, Sussex TN32 5RY.**

**Phone 0580 83317.**

*The above prices include post/packing. Overseas enquiries welcome. Callers welcome. Please telephone first.*

### TV PATTERN GENERATOR

UHF output, plugs straight into aerial socket, provides cross-hatch and peak white and 8 bar grey scale. Size 100 x 75 x 40mm.

**£17.75**

price includes battery, P&P, and VAT.

*Further details of this and our other products on request.*

**C. L. JERVIS,**

**15 Mercer Grove,  
Wolverhampton, WV11 3AN.  
TEL (0902) 736606.**

## SMALL ADS

The prepaid rate for classified advertisements is 25p per word (minimum 12 words), box number 60p extra. Semi-display setting £4.80 per single column centimetre (minimum 2.5 cms). All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Television, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

## NOTICE TO READERS

*Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.*

# SUFFOLK TUBES LIMITED

**214 Purley Way, Croydon, Surrey.  
Tel: 01-686 7951/2/3/4**

SUPPLIERS OF MONO AND COLOUR TUBES TO MAJOR RENTAL COMPANIES.

ALL COLOUR TUBES HOT PUMPED AT 385c AND REBANDED TO BRITISH STANDARD. 415 1972 CLAUSE 18-2.

19" and 22" TUBES APPROVED. OTHER TYPES PENDING.

BRITAINS LARGEST INDEPENDENT REBUILDER FOR 21 YEARS.

COLOUR TELEVISION PANELS, complete untested. Many makes. S.a.e. for lists. Camber Television Centre, Lydd Road, Camber, Sussex. Tel. Camber 457.

NEW PHILIPS 511 G6 SPARES. Pre-war onward valves, wireless. SAE: Sole, 37, Stanley Street, Ormskirk, Lancs L39 2DH.

## QUALITY REBUILT TUBES

HIGH TEMPERATURE PUMPING  
COLOUR (2 year Guarantee)

90° up to 19"	<b>£32</b>
90° 20" - 22"	<b>£34</b>
90° 25" - 26"	<b>£36</b>
110° and PIL	<b>£38</b>

MONO (including thin necks) from **£12.**

All prices + VAT

Delivery UK Mainland £6.

4 year Optional Guarantee

Send or phone for full list and terms.

**WELTECH PICTURE TUBES**  
Unit 3-10 Wembley Commercial Centre,  
East Lane, Wembley, Middx.  
01-908-1816

## STS

FOR  
QUALITY  
USED T.V.s

200 EX RENTAL  
COLOUR AND MONO TVs  
ARRIVING WEEKLY  
GOOD CLEAN CABINETS

**Bush ★ Decca ★ GEC**

**Pye ★ Philips ★ Thorn**

**Grundig ★ Sanyo ★ ITT Etc**

*TROLLEY STANDS AND  
ALL SIZE REGUN TUBES.*

**DELIVERY IF REQUIRED**

Call or phone now to:

**SOUTHERN TRADE SERVICES**  
21 COLINDALE AVE.,  
LONDON NW9  
TEL 01-200-7337.

## IRISH TV DEALERS

Call now for a full range of colour and mono TVs. All sets sold working. Delivery can be arranged to any part of Ireland. Call write or phone:

### TELESCREEN

Bellanaleck Quay, Near Enniskillen,  
Co Fermanagh, N. Ireland  
Tel: Florencecourt 388.

When replying to Television Classified Advertisements please ensure:

- That you have clearly stated your requirements.
- That you have enclosed the right remittance.
- That your name and address is written in block capitals, and
- That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

**WERNETH** TUBE TEST INSTRUMENTS  
 TX80 PROFESSIONAL £48.85  
 TX50 LOW COST SERVICE TESTER £29.50  
 TX50 COMPLETE KIT OF PARTS £21.00  
**ELECTRONICS LIMITED**  
**FREEPOST.** IN-CIRCUIT TRANSISTOR TESTER £15-60  
 C.W.O. / S.A.E. for product details.  
 P.O. BOX 9, MARPLE, STOCKPORT, CHESHIRE. SK6 6YE.  
 WERNETH ELECTRONIC PRODUCTS - WINNINGTON RD - MARPLE - STOCKPORT - CHESHIRE.

## COLOUR T.V.s

PHILIPS G8 COMPLETE

22" £55 26" £65

DISCOUNT FOR  
BULK BUYERS

TEL: 965 1230 & 961 3997

SMITH  
ELECTRONICS,

43-43A, PARK PARADE,  
HARLESDEN,  
LONDON N.W.10.

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

## COLOUR TUBES

Rebuilt with new electron gun, to British Standard.  
High temperature pumping.

Here is what you pay.	VAT
17-18-19 inch.....	£29 4.35
20 inch.....	£30 4.50
22 inch.....	£31 4.65
25 inch.....	£34 5.10
26 inch.....	£35 5.25

Guarantee 2 years.  
Exchange basis.

CALLERS ONLY

## TELESTAR TUBES

575c Moseley Road, Birmingham B12 9BS.  
Tel: 021-440 5712.

## LOOK!

### THORN 3000/3500 & 9000 TRIPLERS

High Quality Silicon Replacement Units  
T3500 only £4.95 inc. P.P. Add 74p V.A.T.  
T9000 only £5.45 inc. P.P. Add 82p V.A.T.

Quotes for 50+.

1 Year Guarantee

### WING ELECTRONICS

15, Waylands, off Tudor Road, Hayes End,  
Middlesex.

EXCELLENT QUALITY  
USED COLOUR TV's  
CHOOSE UNTESTED  
OR FIRST CLASS  
WORKERS ENGINEERED  
IN OUR WORKSHOP.

**TELFURB T.V. LTD.**  
WHEATLEY  
08677 3849

### Southern Valve Co.,

2nd Floor, 8 Potters Road, New Barnet, Herts.

Tel: 01-440 8641 for current prices & availability, all popular  
valves stocked. NO CALLERS, SAE Lists. Cash with order.  
Same Day Postal Despatch. (Lunch 12.30-2p.m.)

Valves, Tubes, Aerials etc by LEADING-MAKERS. Send SAE  
Lists or Phone for current prices. Counter or MAIL ORDER. NO  
COD. Speedy Despatch assured. No order under £1.

Philip Beaman, 6 Potters Road, New Barnet, Herts.  
Tel: 01-440 1934/5 (1934 Recording Machine).  
Please phone for opening hours.

## COLOUR PANEL EXCHANGE SERVICE

BRC 3000/3500. 8000/8500

GEC 2110 series

Philips G8, G9 and G11

Three months guarantee on all Exchange Panels.  
Free delivery in London area.

Also Ex-Equipment Panels Thorn 3500 for sale.

All guaranteed Perfect Working Order.

Phone or send SAE for Catalogue.

### KAY JAY TV SERVICE,

34, Clauson Avenue,  
Northolt, Middlesex.  
Phone 864-0350.

# TELEVISION

R  
A  
D  
E

## FREE WINE AND LOW LOW PRICES

YES we are giving away free bottles of wine with every £100 spent,  
PLUS our special **LOW LOW** price spring offers. You'll need the wine  
to celebrate your good fortune. Don't delay, call and see us, we will do  
you a **SUPER DEAL**, on the spot.

(PS. Don't forget your cash)

Most makes colour or mono with good cabinets

GENERAL  
FACTORS

GOOD MOTORWAY ACCESS  
EXPORT ENQUIRIES

UNION ST, DONCASTER DN1 3AE  
TELEPHONE (0302) 49583-68416

WINE OFFER ENDS 30TH APRIL 1981

## SERVICE SHEETS

### 30,000 SERVICE SHEETS IN STOCK COLOUR MANUALS ALSO AVAILABLE

TV Monos, Radios, £1.25. Tuners £1.25. Tape Recorders, Record Players, Transistors and Stereograms + S.A.E. from  
£1.25 each except Colour TV Circuits £2. Car Radios from £1.25. All Radiograms from £1.25.

State if Circuit will do, if sheets are not in stock. All TV Sheets are full length 24 x 12, not in Bits & Pieces. All other Data full lengths.  
Free Fault Finding Chart or TV Catalogue with order. Crossed PO's Returned if Sheets Not in Stock.

C. CARANNA, 71 BEAUFORT PARK, LONDON NW11 6BX. 01-458 4882.

MAIL ORDER  
SAE.

JAPANESE TV service sheet specialists. Catalogue  
25p plus S.a.e. Sandhurst Publications, 49C,  
Yorktown Road, Sandhurst, Camberley, Surrey.

SERVICE SHEETS from 50p and S.A.E. Catalogue  
25p and S.A.E. Hamilton Radio, 47 Bohemia Road,  
St. Leonards, Sussex.

SERVICE SHEETS, Radio, TV, etc., 10,000 models.  
Catalogue 24p plus SAE with orders-enquiries.  
Telray, 154 Brook Street, Preston, PR1 7HP.

Thousands of different full size service sheets Thousands of different manuals of all kinds in stock.  
(Many of above are unique to us and obtainable nowhere else.)

Updated collection of British colour TV circuits/layouts etc. Contained in 3 huge binders - special price £39.50.

Updated foreign colour TV repair system for £22.50. (2 manuals, 1 binder) chassis from Grundig, Hitachi, Skantic, Luxor, Mitsubishi, Kuba, Zanussi.

Complete set of 10 unique TV repair manuals - only £49.50. Mono + colour from dual standards to latest models, McCourt & Tunbridge.

S.A.E. any quotation, also price lists, newsletter, bargain offers, details of our unique TV repair systems.

£1 + large S.A.E. any single service sheet.

Phone: 0698 883334, anytime. Callers 4-6 pm. weekdays, Saturday from 10 am.

G.T.

TECHNICAL INFORMATION SERVICE

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A51/110X	£27.00	£4.05	£31.05
A55/14X	£32.00	£4.80	£36.80
A56/120X	£32.00	£4.80	£36.80
A63/120X	£36.00	£5.40	£41.40
A66/120X	£36.00	£5.40	£41.40
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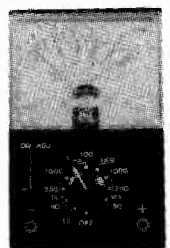
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	MR 501 3amp/100v. <b>7p</b>	PYE TS25-11TBQ. <b>£1.50</b>
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	SCR 957. <b>65p</b>	
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	ELC 1043 AEG. <b>£4.00</b>	1K Ω/V on DC/AC
	<b>PHILIPS SNIPS: CUTS MOST THINGS. £1.50</b>	
	CO-AX plugs. <b>12p</b>	
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	AE Isolating socket. UHF and lead, PYE, THORN, ITT. <b>35p</b>	
	Plug and socket 3+6 pin printed circuit type, pair. <b>10p</b>	
	TBA750, SC9503P, MSC9504P GEC aerial T/V socket & lead <b>35p</b>	
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