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HA13742.56 SN76110N90 HA13773.80 SN76226DN .1.45 HA13884.20 SN76227N1.00 HA13974.15 SN76660N65 HA11312 2.42 STXC039	TA7310P	TV ELECTROLYTICS DECCA 30(400/400)350V 2.50 DECCA 80/100(400)350V 2.90 (800)250V 2.90	PUSH BUTTONS/ 5 DECCA/ITT 4W DECCA/ITT 6W PYE201 6W	TUNERS Avai 6.45 7.95 2SA 15.80 Phot	lable also a range of /B/C/D Transistors. ne or write for lists.
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PRICE INCREASE

The price of *Television* will be £1.10 from our next issue dated February. We regret the need for this increase which is due to the continued rise in our production costs. The next issue will have extra pages however and further bumper issues will be published during the coming year.

INDEXES

The index to volume 33 of *Television*, available from our Post Sales Department (see page 121), sold out rapidly. A reprint has been ordered and the index will soon be available again. The index to volume 34 has been compiled and is now being printed.

TELEVISION

The Video Boom is Over

That remarkable phenomenon the video boom seems to have blown itself out the world over. In the UK the boom peaked in the second quarter of 1983, when deliveries of VCRs to retail and rental outlets totalled 680,000. The figure for the second quarter of 1984 was 268,000 – in fact deliveries for the first half of 1984 were less than for the second quarter of 1983, and the year on year first half comparison shows a decline of 53 per cent. At the peak of the boom, VCR shipments to the UK were exceeding those to the USA and there were more VCRs per household in the UK than in Japan! The rental chains played a great part in getting the VCR established as a household item in the UK but came close to panic earlier last year (1984) when VCR returns rose to the same level as new rental contracts. It seems that the end of the summer produced some increase in consumer demand for VCRs, but rental companies could still be holding very large stocks of returned machines.

The rapid reversal in UK demand was of little consequence to Japanese manufacturers so long as demand in other markets, particularly the USA, continued to increase. But the peaks of the boom appear to have been passed everywhere. Japanese VCR exports rose to a record of just under two million last August. Since then there's been a weakening US demand, accompanying a general economic slow down there, while exports to Europe have continued to decline and sales in Japan itself fell in September. As a result, the Electrical Industry Association of Japan revised its estimate of VCR production for 1984 from 27 million down to 25.7 million. Not a great percentage drop perhaps, but something that hasn't happened before. This levelling off or reduced production is already beginning to affect other parts of the Japanese electronics industry, in particular the semiconductor manufacturers and suppliers of parts to the VCR makers.

The consumer should certainly benefit from this, as price cutting goes hand-in-hand with the introduction of machines offering more features and thus better value. Hi-fi sound and longer playing times are not things that have been easily achieved: they require considerable advances in the basic technology used in VCRs. The Japanese Ministry of International Trade and Industry has been trying to co-ordinate VCR production levels in an attempt to avoid excessive price cutting, but this may have only a limited impact at the retail end of the distribution chain. It's also of significance that South Korean VCR manufacturers are about to start exporting machines – to date they've been limited to domestic production under the terms of the technology transfer agreements entered into with Japanese manufacturers. The next few months may well turn out to be a good time to buy a VCR.

The problem of an over-supplied market does not apply to VCRs alone. Cassette production capacity world wide rose sharply in 1984. Whilst capacity in 1983 has been estimated at being able to supply only 70 per cent of demand, during 1984 it's reckoned to have increased to the point where twice the current demand can be supplied. This again is leading to increased price competition on the one hand and improved quality on the other – 3M for example have been advertising a "lifetime guarantee" for their tapes. 3M's approach has involved considerable investment in tape research and improved production technology. Greater precision has been achieved in specifying parameters for the oxide coating, film and solvents and in monitoring the dispersal of material on the film – specially designed laser scanners are now used for this purpose. Slitting the sheets of coated tape to the width required for spooling has always presented problems. It's claimed that the percentage of satisfactory quality tape coming from the slitters at 3M's Swansea plant has increased from between 60–70 per cent in 1983 to over 95 per cent. The plant is at present in the middle of an investment programme aimed at tripling production. This is against the background of reduced demand – a "serious decline" is the way in which Jarvis Astaire, chairman of Intervision Video (Holdings), has put it. It's evident that the profitability of the distribution side of the tape industry has been badly hit.

One can't help wondering what the Japanese consumer electronics industry will come up with next. There's always been something to offer once a particular market has reached saturation level. Transistor radios, audio equipment, television sets, personal portable audio, then the VCR: the obvious follow-ups would be electronic photography movie equipment and personal computers. Much work has gone into both fields – 8mm video and camcorders on the one hand, the MSX system on the other. Active video has never been a major market however. People tend to treat video as they do other domestic electronic equipment – as something you switch on and let it do its stuff. Movie making is a world apart and something that by its nature has a much more limited market. With electronic still photography the problem remains that quality is inferior to traditional chemical photography while being a lot more expensive. With the personal computer it could be that the Japanese onslaught on the market has for once come too late. Microcomputer demand has weakened in the main markets – the US, UK and Japan – and MSX hasn't met with the instant success that's usual with Japanese offerings.

Is this the end of the boom for the Japanese consumer electronics industry? That's hardly likely. Customers will start to buy again before long, and what's then bought will depend on the continuing efforts of manufacturers. One thing Japanese manufacturers have always done is to maintain their R and D work whatever the market conditions, something that pays off in the long run.

Teletopics

TRADE SCENE

Trade figures (from BREMA) for the first six months of 1984 compared to 1983 show a dramatic fall in deliveries of VCRs, a small fall in large-screen CTV deliveries and a continued rise in small-screen CTV deliveries. Though the totals are relatively small, an increase of 95 per cent in teletext receiver imports, to 39,000, is worrying. Basic figures are as follows:

Product	Jan-June 1983	Jan-June 1984	Change
	(000s)	(000s)	(%)
VCRs	1,230	572	-53
CTVs, large	995	899	-10
CTVs, small	504	699	+38*
Mono TVs	449	326	-27
* UK	produced +27%	, imports $+46\%$.	

Stocks are at present large. The latest survey, Media Leisure, from Leisure Consultants (Lint Growis, Foxearth, Sudbury, Suffolk, price £210) suggests that sales and rentals of VCRs and TV sets, also home computers, will drop in 1985/6, with consumer spending in the domestic electronics field remaining static. TV rentals may be given a fillip by the advent of more sophisticated sets with FS tubes, stereo sound and digital circuitry. An even sharper fall in VCR deliveries is forecast.

At mid-1984 there were 47,000 terminals linked to the Prestel network and 2.16 million teletext sets were in use, a household penetration of ten per cent.

SATELLITE SCENE

The setting up of a privately owned, Luxembourg based TV satellite system called Coronet was mentioned in this column last July. Since then the project's sponsors have been seeking financial backing. The Swedish industrial holding company Investment AB Beijer has now taken a ten per cent stake in the scheme and it appears that the US Home Box Office cable film channel service has taken a further five per cent interest. It thus seems that the scheme, which has the backing of the Luxembourg government, is on the move. The cost of putting up the two satellites (one as a reserve) is expected to be around \$180 million and a launch date in early 1987 is planned with a service start in about June of that year. Coronet will be responsible for launching and operating the satellites: a consortium is to be set up to provide the actual programme material. The medium-power satellites will have a footprint covering most of western Europe – the EIRP for the primary service area will be 51dBW, and most of the UK will be within this area. The satellites are being designed to provide a sixteen channel service in the 12.5-12.75GHz band, i.e. just above the 12GHz broadcast DBS band. While the primary purpose of the project is to distribute programme material to cable TV networks there's no hiding the fact that direct broadcasting to domestic viewers is envisaged. Beijer's investment will give it an interest in two Nordic language channels.

As a result of recent changes to the plans for a UK DBS service the design of the satellites is under review.

When the BBC originally arranged for the design and construction to be undertaken by United Satellites a two TV channel service with extra transponders for telecommunications use was envisaged. Present plans for a three-channel service could lead to the elimination of the satellites' telecommunications channels. In addition cost reductions are being sought to improve the economics of DBS.

The first chairman of the Satellite Broadcasting Board, which is being set up to regulate the UK's DBS services, will be the IBA's chairman Lord Thomson of Monifieth. The board will have six members, half from the BBC and half from the IBA, with the chairmanship alternating annually between the chairmen of the BBC and the IBA. The board has not been formally set up since agreement between the participants in the DBS scheme has yet to be reached. Lord Thomson recently commented that "the challenge the Board will face is to find imaginative new ways of providing the public with services which the present four TV channels cannot fully meet and for which the public will be prepared to pay extra".

The Nordic Council of Ministers has given the go ahead to the establishment of a Scandinavian DBS service (Nordsat) with four TV channels, using the C-MAC/Packet transmission standard. The service is expected to come into operation in 1990.

CABLE DEVELOPMENTS

The government has now announced the names of the majority of the members of the Cable Authority, which is being set up to regulate the provision of cable TV services in the UK. Professor James Ring has been appointed deputy chairman to Richard H. Burton, whose appointment as chairman was announced last August. Other members are Paul Johnson, Elizabeth MacDonald-Brown and Peter Paine. Two further appointments remain to be made. At present the authority doesn't have very much to regulate, but it hopes to start awarding new franchises at the rate of five every four months: Mr. Burton, who feels that the gloom over cable prospects has been overdone, says the "first and paramount priority of the authority will be to get the franchising process moving as fast as possible".

The Cable Television Association's chairman Peter Gosling has appealed to the government for greater help for a "cash hungry business in its formative years". Minister for Information Technology Geoffrey Pattie has ruled out any of the financial concessions proposed by the Association however. He's reported to have commented "I may wish them well but that's all I'm going to do", though he added that "if there's something so fundamentally amiss that there's a danger of them (the cable companies) being wiped out then obviously we would look at it again very carefully indeed".

Plessey Scientific-Atlanta, the Anglo-US joint venture that was set up to develop and sell cable TV equipment in Europe, has ceased operations. Plessey's director of technology Dr. Keith Warren, who was chairman of the joint venture, reported that the parent companies were not prepared to continue to spend money when there was little prospect of any orders materialising. A similar joint venture, GEC-Jerrold, was terminated last March. Plessey Scientific-Atlanta had developed a prototype two-way cable switch which had been specified by three of the original eleven cable TV franchisees, Clyde, Croydon and Ealing, but no orders have been placed.

Thorn EMI, with British Telecom and local newspaper group Courier Press (Holdings) as minority shareholders, has announced that the Coventry Cable service is expected to begin operations this spring. Meanwhile Thorn EMI's cable activities in Swindon seem to have aroused local opposition – a pressure group called CACTUS (Concern About Cable Television Under Swindon) has been formed. Complaints include the fact that cable ducts are being laid to every house in the area whether the householder wants it or not, the disruption caused by the cable laying operations and the unacceptable condition in which the pavements have been left.

WHICH? ON VCR RELIABILITY

The latest issue of the Consumers' Association monthly Which? reports that VCRs are unreliable generally while some models are a lot less reliable than others. The report is based on a survey of 6,340 users in the UK, W. Germany, Holland, Belgium and Denmark. It was found that there's "at least" a one in three chance that a VCR will need repair before it's two years old. The least reliable brands failed four times as often as the most reliable. Panasonic did best with 18 repairs per 100 machines. With all machines the most common faults were streaky pictures and fast wind/rewind problems. A quarter of the repairs to Akai machines related to poor sound, while Sanyo machines tended to go "completely wrong". In the first two years only seven per cent of machines needed new heads: the figure rose to seventeen per cent in the fourth year. The average time taken to repair an owner's VCR in the UK was 8.3 days while rented machines were dealt with in 3.2 days.

MATSUSHITA UK'S TEN YEARS

Celebrations attended by Prince Phillip as guest of honour were held at the Panasonic factory in Cardiff on November 2nd to mark the tenth anniversary of Matsushita Electric UK's establishment. The Cardiff factory now employs over 600 people. Production is expected to reach 220,000 sets this year (1984) of which 45 per cent will be exported. The factory is being extended to increase the production capacity to 300,000 sets a year – there are also plans to start VCR production. Approximately 70 per cent of the components used come from UK or continental sources and productivity is the same as in Matsushita's Japanese plants.

Amongst the interesting items on show at a technology exhibition held at the factory was a record/playback colour video disc system using semiconductor laser technology. The 8in. disc has a playing time of just over thirteen minutes. At present the system is intended for commercial/industrial use.

MITSUBISHI'S COLOUR VIDEO PRINTER

Mitsubishi, who introduced the world's first printer for the instantaneous printout of TV pictures in 1983, has developed a colour version. This consists of five main sections. In the first, composite NTSC video signals are demodulated to provide RGB outputs. These are then converted into digital form and stored in a memory which holds a frame of picture. The signals read from the memory next have to be converted to yellow, magenta and cyan since a subtractive colour printing process is



Mitsubishi's colour video printer.

used. The final section produces a full colour print with sixteen gradations by means of a thermal transfer system.

When the print button is pressed a TV frame in digital signal form is stored in the memory, which consists of twelve 64kbit DRAM i.c.s. The memory's output is then processed and the print made on plain paper. The whole process takes about a minute. The ink sheets are easy to change since they're in cassettes that hold enough sheets to produce 100 pictures.

SERVICING HOME COMPUTERS

The problem of servicing the hundreds of thousands of home computers sold recently once their warranties have expired has been taken up by Computer-fix, which has set up a national network of five hundred dealers (initially) offering cheap, guaranteed repairs in only 48 hours plus the time required for delivery to and from the firm's headquarters at Camberley, Surrey. Faults are diagnosed by a computer called ACUMEN (Advanced Computer Memory Tester) which can detect a fault in any of the top brands of home microcomputers in just seconds - it doesn't even need to be told the make or model it's testing. Prices seem very reasonable, ranging from £15.50 for the ZX80/ZX81 to £40.25 for the BBC model, inclusive of labour, spares, postage, insurance and VAT. All repairs are covered by a threemonths parts and labour guarantee. Further details can be obtained from Computer-fix, Albany Park Estate, Frimley Road, Camberley GU15 2PL.

THE TV LICENCE FEE

Every three years the BBC has to apply to the Home Office for a review of the TV licence fee. And every three years the same old rows seem to resurface. This time the BBC has asked for an increase of roughly forty per cent in the colour licence fee, from £46 to £65, which would provide the BBC with an extra £1 billion a year. The haggling has started, but a decision is not expected until after January, when the accountancy firm Peat, Marwick Mitchell's "value for money" inquiry into the BBC will be completed. The BBC's case is based on the cost of maintaining the present services, with a modest amount for growth, taking inflation into account. As usual when this triennial business arises there have been calls from the advertising industry for the BBC to cover some of its costs by carrying advertising the Institute of Practitioners in Advertising has called on the Home Secretary to allow advertising on all UK radio and television networks. Well it would, wouldn't it? The government appears to be paying little attention to this lobbying. The ITV companies don't seem too happy with the idea either, since it would most likely spread much the same amount of advertising more thinly. The levy on the profits of the ITV companies is also under review. What with all this and the problem of financing a future DBS service the broadcasting organisations seem to be rather on edge at present.

VIDEO MATTERS

TDK have introduced a range of new formulation (Super Avilyn) cassettes for use with Beta and VHS hi-fi VCRs.

Fuji has announced that it will shortly be introducing in Japan an 8mm camcorder, the Fujix-8. It seems that the photographic rather than the traditional video companies are pushing this format at present. There's also the Fujix TV-Photo system which enables you to view colour photographs via a television set: the system involves making a magnetic recording of the photographs on a 47mm floppy disc which can be played back. You buy the player unit – at around £200 – but the recording is done as a service at between £3 and £7 per disc. The Fujix-8 and TV-Photo system both operate on the NTSC standard only at present.

The recently opened National Interactive Video Centre in London is being funded by Thorn EMI, Philips and the government. Its purpose is to promote the use of interactive video systems in industry, commerce, education and the professions.

Japanese components manufacturer Alps Electric is setting up a £5 million factory at Milton Keynes to produce tuners and u.h.f. modulators for use in VCRs. It's expected that the factory will employ some 230 people by the end of the year.

ITT SAFETY NOTE

Reference was made in this column last October to a safety recommendation issued by ITT concerning certain of their TV sets. ITT have now advertised the problem in the national press and will reimburse dealers according to a fixed fee for carrying out the work required. Models affected are as follows: CB502, CB602, CB702, CS512, CS712, CS522, CS622, CS722, CB9504, CB9602, CB9604 and CB0506.

TV AND NECK ACHE

It's perhaps not too widely appreciated that the neck is quite a sensitive part of the body and that stress/strain here can give rise to many problems. Most large-screen colour sets have for many years been supplied with a stand that sites the set below the normal seated adult's eye level. This means that much viewing is done with the head lowered excessively, which doesn't seem to be a particularly healthy situation. Maybe some of our readers with medical knowledge would like to comment?

1985 TRADE SHOWS

The agreed date for the annual London hotel trade shows this year is May 19th-22nd. In addition it's proposed to hold a trade/public exhibition, Vidtel 85, at the National Exhibition Centre, Birmingham, from August 29th to September 1st. This event, called the International Home Video and Television Show, would have two trade-only days followed by two days open to the public. For the present it doesn't seem to be eliciting much enthusiasm from the industry.

SOLID-STATE IMAGERS FROM MULLARD

Two imaging devices for use in solid-state cameras have been announced by Mullard. The new arrivals are charge-coupled, frame transfer devices which produce two interlaced 289-line fields with a 4:3 aspect ratio. Both provide a 604×575 pixel disply giving a horizontal resolution of 420 TV lines, meeting CCIR standards. The NXA1010 (monochrome) and NXA1020 (colour) sensors have a 7.5mm image diagonal that matches the half-inch camera tube format so that they can be used with low-cost, commercially available lenses. They are suitable for all types of 625-line/50Hz PAL/SECAM cameras (525-line, NTSC compatible devices are expected to be announced shortly). The NXA1020 has an on-chip colour-stripe filter to provide RGB outputs. Complementary i.c.s have been developed to provde the necessary timing and drive signals.

THE EUROMAX AERIAL

With the needs of those touring in caravans in mind Maxview Aerials (Maxview Works, Setch, King's Lynn, Norfolk PE33 0AT) have introduced the Euromax Universal aerial. This is in effect two aerials in one, covering both the v.h.f. and u.h.f. bands. The fixing kit supplied with the aerial includes strong suction pads and a bracket and mast. Price is £23.75 including VAT and the aerial comes in a box which gives fitting instructions in eight European languages plus Arabic.

NEW VCRs

Three new VCRs have been added to the Ferguson range. The 3V43 is a full-specification machine with hi-fi stereo sound, two-speed operation and a suggested price of around £679. The 3V42 replaces the 3V36 as a mid-range model with a suggested price of around £549 while the 3V39 is intended as a budget model selling for around £399.

Sanyo have introduced a Beta hi-fi VCR, Model M40, at around £600. The new Mitsubishi HS306 is intended as a budget machine, carrying a suggested price of £440. Grundig's second VHS machine, Model VS220, features stereo sound. Suggested price is £489. Both machines now have infra-red remote control as standard. The first Philips all European VHS machine, Model VR6560, has been released with a suggested price of £459. There are also three new Philips V2000 format machines, Models VR2334, VR2350 and VR2840.

AERIAL CATALOGUE

South West Aerials (11 Kent Road, Parkstone, Poole, Dorset BH12 2EH) have published their 1985 catalogue which is available at 60p per copy. An extensive range of aerials and associated equipment, including a 6in. v.h.f./u.h.f. TV set of particular interest for DX reception, is available from the firm.

SONY PROJECTION SYSTEM

A new Sony projection TV system being sold in the USA for around 33,000 is of interest in employing a 5.25in. beam indexing tube. This type of colour tube has a single beam to which the R, G and B signals are applied in sequence, in synchronism with the phosphor

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Unit 32, Manor Industrial Estate, Bagillt, Clwyd. stripes – indexing stripes laid on the screen tell the control circuitry which colour stripe is being scanned. The advantage is the increased brightness obtained by avoiding the need for a shadowmask – Sony say the brightness level is about seven times more than that obtained with a good shadowmask tube, an important point with a projection system. An ethylene glycolwater cooling system is required.

PICTURES VIA THE TELEPHONE

The Philips slow-rate transmission system for sending video pictures via the telephone system has been given BT approval for connection to the network. Further details can be obtained from Philips Business Systems, Cromwell Road, Cambridge.

TV SETS AND MONITORS

Akai's first TV set on the UK market is a 14in. colour model with infra-red remote control and facilities for RGB and composite video inputs. Suggested retail price is £279. Both ITT and Grundig have announced colour sets fitted with 20in. FS tubes. The Grundig FST range also includes two 14in. models. Samsung Electronics UK Ltd. (Hook Rise, Business and Industrial Centre, 225 Hook Rise South, Surbiton, Surrey KT6 7LD) have released a couple of monochrome portables, the 12in.

Christmas Lights

William Harrison

The mains-driven light chain is a perennial Christmas hazard. A safe alternative is a low-voltage chain using 5mm LEDs of the type available from Sendz. Wire them in colour sequence to get the "travelling" effect. These LEDs require 2V and should be operated at around 20mA for a long life. The red type has a slightly lower voltage drop. To correct for this, I used six LEDs in the green and yellow chains and seven LEDs in the red chain. If the voltage is above 12V it may be necessary to add a series resistor – adjust the value for 20mA drive current.

Fig. 1 shows the basic circuit which uses a 4001B CMOS i.c. as the sequencer. Only three of the four gates in the i.c. are used – the other gate could be used to get four outputs, but I found that start-up was then erratic. The three outputs from the i.c. drive 2N2905 transistors which supply the strings of LEDs.

Fig. 2 suggests some alternative output arrangements to drive longer strings of LEDs. The ULN2003 incorporates seven Darlington amplifiers which can supply 0.5A each. For a still larger output, the ULN2003 can be used to drive TIP2955 power transistors, which will require heatsinks. Note that while the 4001B will work at a lower voltage than 12V the ULN2003 requires a minimum of 12V.

The LEDs are wire-ended, the longer wire being the positive connection. Don't shorten the wires: bend at right-angles, in opposite directions. They can then be soldered in series, in colour sequence along a four-wire cable, to obtain the moving-light effect.

If 2mm LEDs are used the current required is 10mA.

The unit was housed in a Verobox type 303 ($120 \times 80 \times 35$ mm), with the components on a piece of stripboard.

Model BT309K at around £50 and the 14in. Model BT351K at around £60.

Philips' BM7502 monitor has a 12in. green phosphor tube that gives a full screen display of 25 lines with up to 80 characters per line. The circuitry has been designed for minimum distortion and is suitable for graphic displays. There's a built-in speaker for sound and the suggested price is $\pounds 79.95$. It's intended for home computer users and is compatible with most home/personal computers, e.g. the Apple II series, Commodore Vic 20 and BBC.

TV HEADPHONES

Ross Electronics (49-53 Pancras Road, London NW1 2QB) have introduced a headphone set, type RE2280, designed specifically for use with TV sets and VCRs. The frequency response is given as 20Hz-20kHz. The price, which includes a 6.4mm stereo jack plug, an adaptor for 6.4 and 3.5mm monosound sockets and $16\frac{1}{2}$ ft of cable, is £8.95.

NEW MULLARD LINE OUTPUT TRANSISTOR

Mullard's new BU508D line output transistor is an uprated version of the BU508A incorporating a parallel efficiency diode. Like its predecessor, the BU508D is encapsulated in the easy to mount SOT93A pack.

A five-way DIN socket with a mating plug on the light chain completed the job. The LEDs can be obtained from Sendz or from Cricklewood Electronics Ltd., 40 Cricklewood Broadway, London NW2 (who can also supply the box and i.c.s).



Fig. 1: Basic circuit, with sequencer to drive three chains of LEDs alternately to give the travelling light effect. If miniature electrolytics are used, connect the positive sides to pins 1, 5 and 8 of the 4001B i.c.



Fig. 2: Alternative arrangements for driving longer strings of LEDs.

VCR Clinic

Hitachi VT9700

Intermittent no operation was the complaint with an Hitachi VT9700. At switch on all was well for five minutes after which the counter and operate light began to flash on and off though the clock remained steady. We've had problems with the voltage regulator i.c.s used in this machine. They are on the rear panel, bolted to the heatsink. In this case the 9V regulator's output was intermittent, a replacement curing the problem. **D.S.**

Panasonic NV333

A Panasonic NV333 came in with the symptoms playback o.k., no record. In fact no stations could be tuned in with the machine in the E-E mode. The tuner proved to be faulty – only the second faulty tuner I've had in a VCR in three years. **D.S.**

Hitachi VT8000/VT8500

There are two $1.5k\Omega$ resistors in the Hitachi VT8000/8500 power supply circuit (syscon panel), R054 and R069. I've had both fail on several occasions, but not together. R069 has been mentioned before and gives the no record symptom as there's no not-playback 12V line when it goes open-circuit – this line supplies the tuner and the i.f. strip. When R054 goes open-circuit there's no operation, with no operation light, as the regulated 15V supply is no longer present. If you get no operation but the operation light comes on, check the 5V supply to the microcomputer IC901: I've had zener diode D055 (RD5-1EB) go shortcircuit on a couple of occasions. **D.S.**

Ferguson 3V35

The complaint with a Ferguson 3V35 was that there was no TV picture on three channels with the machine connected. Sure enough when I got there a quick check showed that with the aerial connected directly to the TV set (an old GEC model) everything was o.k. (ignoring a flat tube and half a dozen minor faults) but when the VCR was connected only BBC-2 worked, the other three channels producing a blank screen. All four channels were present in the E-E mode however. Luckily I had a Philips colour portable in the car. A quick check with this showed that all was well with the VCR or did it? Closer examination showed that the picture was slightly noisy. In fact the VCR's aerial amplifier turned out to have marginally low gain as far as the TV set was concerned, a replacement curing the problem. Obviously something was faulty or out of adjustment in the TV set to produce a blank screen when the signal was only marginally down - in fact if it hadn't been for this the customer would probably never have noticed the slight loss of gain. D.S.

Sharp VC9700

One of these popular VCRs came in with the complaint "chews tapes". On trying the machine we found that it had very little take-up torque but too much supply reel Reports from Derek Snelling, Dewi James, Philip Blundell, Eng. Tech., Keith Hamer, Garry Smith and Steve Beeching, T.Eng.

torque. The take-up torque is adjustable but the supply reel torque isn't. To measure the take-up torque you monitor the voltage across R7783, which is in series with the reel motor. This resistor is driven by transistor Q708 which turned out to be short-circuit. **P.B.**

Hitachi VT8500

Little did I know when my friend Geoff sent me an Hitachi VT8500 that wouldn't eject what trouble and expense it would cause. The machine wouldn't unlace and it was found that Q902 in the loading motor drive circuit (see Fig. 1) was open-circuit. The curious thing was that it turned out to be a BD131. Other transistors had been removed and replaced as well - legs were sticking out at all angles. I hate to see this sort of thing. Why can't some people be bothered to tidy up? Three i.c.s had also been soldered and may or may not have been removed. The 9V supply for this part of the circuit comes from the series regulator transistor Q060: R081 $(2\cdot 2\Omega)$ which is in series with this transistor was opencircuit. I replaced it with a posistor, a standard modification, but this didn't have any bearing on the main fault.

When Q902 was changed to a sturdier TIP31 the threading problem was cured. So the machine went back to Geoff with the comment that it had already received attention. Geoff phoned the following day to complain that it wouldn't wind fast forward and enquired whether I'd checked this? Well yes, play, record, rewind - but perhaps not fast forward. He also said his customer was adamant that apart from head cleaning the machine had received no servicing attention during the three years he'd had it. This time one of the transistors in IC906 (TA4193) was open-circuit. So the i.c. was replaced and Geoff took the machine back to check it for himself as a final quality control. The remote control unit didn't work due to corroded batteries and he had some difficulty in setting it for timer recordings, but apparently the customer wasn't too concerned about the timer.

A week later Geoff called with a "guess what?" comment to tell me that the Hitachi had again blown up. This time we had more accurate information. The customer had left the machine in fast forward and had subsequently returned to find it stopped and smoking. Back on the bench we found Q902 once more opencircuit and R081 burnt up. This was getting serious: it was obvious that the problem was of a somewhat unusual nature.

After replacing the defective components I left the machine in fast forward. After a while Q902 got very hot. So did IC906. This was strange as Q902 should be off for fast forward. I left the machine to cool down then put it into fast forward in order to make a few measurements. Result: there was 600mV that shouldn't be there at the base of Q902. It took some time to find the source of this voltage. Tracing back I found that it came via pins 6 and 7 of IC905 from pin 6 of IC906. Within IC906 the current was flowing via Tr4, a 265 Ω resistor, a diode and a 220 Ω resistor. Q901 and Tr1 are



Fig 1: Reel motor drive circuit, Hitachi VT8500. Q901/Tr1 drive the motor for fast forward; Tr2/Q902 drive the motor for rewind. Q901 and Q902 are also part of the loading motor drive circuit.



Fig. 2: Modifications to the control circuit: (a) original version; (b) version in the faulty machine; (c) the later version.

on for fast forward: as Tr1 heated so Tr4 turned on more until eventually Q902 turned on. At this time the only circuit I had for the machine was one that didn't show Q927: telephone calls to Hitachi confirmed that there had been modifications to this part of the control circuit.

I suggested to Hitachi that the transistor that should be used in the Q902 position, type 2SC1162WT, might have some special characteristics. It transpired that the Vbe of a 2SC1162WT is 800mV, so some were sent for. On fitting one things were a little better, but as IC906 got hot 800mV was reached at the base of Q902 and it switched on. Cooling IC906 with freezer reduced Q902's base voltage and it switched off.

A new reel motor was tried to see if it ran without heating up IC906 too much. The temperature stability was much improved, but not to my satisfaction as there was some 650mV at the base of Q902. Not enough margin with respect to 800mV for safety. The new reel motor was accused of consuming too much current and thus causing IC906's temperature to rise. Another new motor produced quite good results: I could run fast forward through an E180 cassette without overheating, but that 650mV was still there!

Whilst making further checks it was discovered – by accident – that if the recorder was put into the timer record mode while hot the reel motor turned in a slow rewind. This was due to Tr4 turning both Tr2 and Q902 on. As Tr2 was not fully on it got very hot.

At this point attention was directed at the circuitry around Q927, since a modification had been carried out here. The connection to the collector of Q927 had been cut, leaving pin 5 of IC906 open-circuit, and a diode (D090) had been added between pins 8 and 9 of IC901.

IC906 was replaced but the rogue 650mV persisted. Pin 4 of IC906 was disconnected and it went away. The microcomputer system-control i.c. (IC901) was next suspected and changed but we were still no nearer a solution. It was then realised that the modification had left the base-emitter junction of Q927 in circuit. Now the reverse breakdown voltage of such a junction is only 2-3V, so a leakage current path was present via D090, Q927 and the base circuit resistance. It was enough to turn Tr4 on.

Fig. 2 shows the circuit changes in this area -(a) the original version of the circuit, (b) the version in the machine in question and (c) the final version.

Whoever was responsible for the defective (b) version will probably never be known. What I do know is that the repair was carried out over a number of weeks and cost me a fortune. It cost the customer very little. I wonder who put the BD131 in? S.B.

Ferguson 3V35

A one month old machine came in with the complaint "no clock display". The various supply voltages were in order but on disturbing the filament power generator subpanel, which is mounted on the reverse side of the tuner/presetter board, the display returned. Further disturbance extinguished the display but there was no visual evidence of dry-joints around the oscillator. We resoldered all the connections in this area but the intermittent fault remained. The connections inside the oscillator coil screening can were the only ones untouched: to gain access we had to remove the complete coil assembly from the board. We then spotted the cause of the trouble – a loose lump of solder on pin 6 at the base of the oscillator coil (T1) was intermittently shorting to the can. At least it made a difference from having too little solder on the connections. K.H.-G.S.

Panasonic NV333

We've had several problems with this machine, as follows. **Intermittent audio erase:** Remove R4049 (4.7Ω) in the bias oscillator circuit and replace it with a shorting link. **Intermittent chroma on record:** Connect a fast-acting diode (MA161 or MA162) between pins 11 and 12 of IC6003 on the syscon board, cathode to pin 11. **Clock not lighting, capstan motor not turning:** No 18V regulated line due to Q1002 (2SD973) being opencircuit. **D.J.**

My friend Jim

I've known Jim for a good few years now. He's in the trade and often pops in to buy some bits and pieces he needs and hasn't got in stock. Usually my last G8 line output transformer or 9000 tripler – you know, the kinds of things you're going to need during the next minute or so. He's not all that interested in servicing however. His main interest seems to be in building. The upshot is that whenever he gets a set he doesn't like the look of he'll bring it along with a comment like "have a look at this for me old chap, only I've got a floor up and really must fix it before the wife comes home". And off he goes leaving me with a bitch of a job.

The Thorn 9600

He carted this Ferguson 9600 in and left it with me. The 2.5AT mains fuse had blown in a nasty way so I went straight for the filter capacitor, which was innocent. Next the bridge rectifier, which was short-circuit. So I whistled a happy tune as I replaced it, stuck a new fuse in and switched on. There was the usual pause, then it started up normally. A white line appeared across the screen so I checked the supply to the field timebase and then the output transistors. These were all o.k. It wasn't until I turned to the line/field oscillator subpanel on the right-hand side that I found a BC147 transistor (VT402) opencircuit.

With this replaced we had full scan, quite a nice picture and loud, clear sound. I then remembered something else Jim had said. Apparently the set often worked all right for some ten minutes or so and then tripped out. I left it on for some time and sure enough it suddenly gave a few gulps and went into a strike situation. I noticed that just before it did this the sound went down. So with enormous presence of mind I removed the 500mA fuse (F513) in the supply to the audio panel. The set then came on when asked to and apparently stayed on.

I removed the left-hand side audio panel and checked each transistor separately. They all proclaimed their innocence of course. The output pair were on heatsinks but the driver wasn't, so bearing in mind the loss of volume before the set tripped I reasoned (wrongly of course) that the driver could well be at fault. This is a BD386, which I didn't have in stock. I put in a BD204 instead, confident that it wouldn't give in easily. Quite right, it didn't. The set behaved happily for an hour or so then Jim came in to collect it.

Jim's Return

Within the hour Jim was back with it. "Tripped after ten minutes" he said. So I removed the audio panel and left the set on without it. After half an hour it tripped. Back went the audio panel and the set played away happily enough for quite some time. Then the sound decreased and off it went into sullen silence. Everything shut down except the supply to the chopper circuit. I checked everything in sight and out of sight. Then I started to think.

The sound went down before the set tripped, and the

Les Lawry-Johns

fault wasn't in the audio panel. So I removed the 500mA fuse F511 in the feed to the 24V regulator. This upset the field timebase but the set didn't trip. To cut a long story short, it wasn't until I removed the supply to IC2 (MC1358P) on the signals panel that the tripping stopped. When this i.c. was replaced our troubles were over. The intercarrier sound and audio preamplifier chip for heaven's sake. What next? Jim then came to collect the set.

The GEC-Hitachi

An hour later he was back again. This time however he didn't lug in the Thorn. Oh no! That was just a forgotten incident now. This time he had a GEC set we didn't recognise. It was a C2265 (Hitachi NP81CQ chassis) and it took me some time to realise that what I took to be a chopper transistor was in fact a chopper i.c. (1C901, STR441). So I studied the notes in the manual, hoping to get a clue as to how to start the thing up. They did provide a lead, and when I put the meter on R605/6 in the chopper feedback line the set sprang to life. It frightened the life out of me because the sound had been left turned fully up. I turned it down and switched off. When I switched on again the set remained dead until I prodded around the feedback network – the chopper is a sort of blocking oscillator arrangement. The set then came to life. Until the meter probe slipped. There was a nasty flash and the 2.5AT mains fuse disintegrated. "Oh dear" I said,

Like a fool, I put another fuse in and tried again. FLASH! I checked the strange STR441 and found it short-circuit. So I ordered one and got it (along with some other things) next day. I fitted the three-legged device and bravely switched on. The fault was still there. I checked each item in the feedback network and they all read right. I then took them out to make sure. They were all right, so I put them back again and after that the set performed perfectly. Just another dry-joint? Must have been, but it certainly didn't show.

Thanks Frank

On the subject of GEC I must pass on a message of thanks from several of my trade friends who have had cause to be grateful to Frank Pretty of the GEC technical advice department. He's been most helpful to all who have phoned asking for advice and have received more than they hoped for. I haven't had the pleasure of talking to Frank yet, but I very nearly did over the C2265.

The Passing of Ben

You no doubt remember me chattering about our dog and cat (and bird). Well Ben isn't with us any more and we do miss him. Spock seems to complain all day long, loudly. Ben lost the use of his back legs and was unable to digest his food. He passed away peacefully but still seems to be around. Thanks Ben. I do wish that cat would shut up.

Letters

STREAMLINING THE TRADE

I'd like to discuss a couple of improvements that I feel would greatly improve the TV business. Most of the work of engineers, and most of the content of *Television*, are concerned with the repair of TV sets and VCRs that are a few years old. It strikes me that this whole area could be streamlined, leading to greater efficiency and profit for each individual engineer and company. The following ideas could also provide profitable business opportunities for anyone putting them into operation.

More often than not, repairing an old piece of equipment involves a long and laborious process of testing this, that and the other, working one's way around the equipment often without a circuit diagram. Once the faulty items have been located there starts an equally laborious hunt around for replacement parts. For many sets these are no longer available from the original manufacturer. Even when they are, the prices are often ridiculous in relation to the value of the set – so wherever possible it makes sense to fit second-hand parts in second-hand sets.

Here's how we could improve on all this.

(1) Compile an exhaustive list of every model sold in this country. List first by brand/manufacturer. then chassis, then individual model. On this list should go the manufacturer's address and phone number.

(2) List the common faults on each chassis. List by symptom, and opposite this put the action and parts required, with suitable equivalents. Such information is not supplied in service manuals since common faults show up only after thousands of sets have been in use for some time. Most of the information could be obtained by going through *Television* from around 1970 onwards. The result would be a complete list of models sold in the UK, with the common faults found over a 14 year period and how to deal with them. Surely this would be welcomed by all, especially employers who would prefer to pay for such information rather than continue to pay for their engineers to do their own trial and error research!

All this information could eventually be transferred to computer storage. This would enable a subscriber to get access to information on a particular set within seconds. (3) List inexpensive sources of further information, i.e. circuit diagram or service manual.

(4) Approach suppliers of second-hand parts from stripped sets for details of what they can supply at what price. This information could be used to expand the list.

When repairing an older set, the action would be (a) to check that the symptoms are as described by the customer, (b) refer to the list, (c) check whether you have a stock fault, (d) look across for the action required, (e) look further for names of suppliers of second-hand parts.

I think this would help us rapidly clear our repair backlogs, don't you?

The converse of this is the business opportunities.

(1) Companies could set themselves up as specialists in new and second-hand parts for particular makes of chassis.

(3) The fault compendium previously described would provide a guide as to the stock levels required for particular parts.

Wouldn't this be better than the present hunt for a line output transformer here, an i.c. there and a speaker somewhere else?

I hope this sets some minds athinking. These suggestions could make a lot of dollars for some people and provide a lot of relief for the rest of us!

Colin Guy, Telly-Centre, Tunbridge Wells, Kent.

DISCO-LIGHT EFFECT

Les Lawry-Johns mentions a strange disco-light effect with a Decca Bradford chassis (November issue). I had something similar with a Thorn 3500 and feel sure that it was due to the shadowmask kinking. The mask would kink back and forth, upsetting all purity adjustments. There was also a very slight pinging sound.

Philip J. Lomas, Television Audio and V

Television, Audio and Video Repairs, Coal Aston, Sheffield.

MAINS FUSE PROBLEM

Over the past few weeks I've been plagued by a mains fuse blowing problem with three early GEC C2110 series sets. In the first case I replaced the fuse in the customer's home and could find no other fault. The

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WE WISH TO PURCHASE VALVES E.G.: PX4, PX25, PP3/250, PP5/400, DA30, DA60, DA100, 807. same with the second set. After going through this procedure on several more occasions with both sets a third came into the workshop. I replaced the blown fuse, switched on and all was well. The set was left working while attention was turned to another one, then suddenly the fuse blew again. After a quick check I replaced the fuse and discovered that the holder was very hot. It was an old rectangular type with a poor grip on the fuse, so I replaced it with a standard screw-in type in a hole just below the original holder. Result: no more problems! The same action was then taken with the two sets in the field. I hope this word of warning will be of help to others: in future I shall always change the holder just in case.

Kenneth D. Bunting, Huntingdon, Cambs.

PLUGTOP MYSTERY -1

The subject of loosening terminals has been with us for many a year. I remember first reading about it in the sixties, when a contributor to another journal complained of having to keep retightening immersion heater terminals. I've often come across the problem and have discussed it with colleagues. Two main points have always been made: (1) that the effect is generally evident only with higher current equipment; (2) that as far as anyone can remember it never occurred with d.c. mains supplies.

Two theories have been put forward. First, that with high currents the terminal contact pins heat up. This continual heating on load and cooling off load and consequent expansion/contraction loosens the terminals. This however doesn't explain why the effect is not present with a d.c. supply. Secondly, around any current carrying conductor there's a magnetic field, therefore between any two conductors there's a force generated by that field. With an a.c. mains supply this field/force will be absent a hundred times a second (at the waveform zero crossover points) and will then rise to a peak. This alternate presence and absence of force will result in vibration - it's the same sort of force that makes transformers hum, LOPTs whistle and electric fires sing. Could it be this vibration that loosens the terminals?

On a totally different matter, I take Mr. Bird's point (letters November) about the return visits to the PCL86 fault. In mitigation I'd like to say that many a "valve" fault turns out to be due to an intermittent passive component fault – how many good valves have been slung away because a new one apparently cured the fault, only for it to return a few days later? In this case it just happened to be what it should have been! Also I don't charge the customer for popping my head around the door – it takes only a few minutes when you're in the area anyway! Nick Lyons,

Normanton, W. Yorks.

PLUGTOP MYSTERY -2

I've been following the correspondence on loosened connections in 13A plugtops with interest. It seems that some of your correspondents, in talking of electron flow from "negative" to "positive", assume the use of a halfwave rectifier in the equipment supplied. With an a.c. mains supply however the neutral pin remains at earth potential while the live side alternates positively and negatively with respect to neutral. Consequently the electron current is alternating too and so far as the load is concerned the crossing over of the brown and blue leads makes no difference – though safety demands that we should follow the code correctly at all times.

I've heard people suggest that "a.c. shakes screws loose" but have no evidence to support this. What I have observed is that both neutral and earth connections can get loose while live generally remains tight. The live connection is usually of a different mechanical type from the simple hole and screw used in the neutral and earth pins. As G.C.C. Wride pointed out, the fuse provides some mechanical isolation for the live termination while neutral and earth can wag about. The cheaper and nastier the plug, the more the likelihood of looseness and burning.

Lastly, a method I've used for years when fitting these plugs. It's never let me down. Strip off enough insulation to provide a length of bared strands twice as long as you need. Twist them first, then double back the end, giving you double thickness. With a heavy cable you'll only just be able to get this into the hole in the terminal, with the screw nearly falling out. Then do up the screw with a good, solid screwdriver (not a grubscrewdriver) as tightly as you can without splitting the screw head. Also use a respectable make of plug. These measures will substantially reduce your troubles. Note also that the quite expensive MK plugs with rigid "bending-post" terminals have never caused me any trouble, even with hefty loads. *Keith Cummins*,

Southampton.

Editorial comment: Our thanks to several correspondents who have written on the subject of the a.c. mains supply and the importance of fitting good quality plugs. David McIntyre points out that some cheap imported plugtops bear a marking stating that they are manufactured to BS1363, but if they don't display the BS kite mark they don't need to be tested by the standards authority and are still suspect. The concensus of opinion is that the different mechanical arrangements at the neutral and live terminations are the cause of burning/ looseness at the neutral pin.

THE THORN 1400 CHASSIS

The Thorn 1400 was probably the last dual-standard monochrome chassis to remain in production. I've been using a couple of these sets, with 23in. tubes, for over two years for domestic and DX-TV purposes. They've given trouble-free service following renovation and provide pictures that are far superior to those produced by sets of more modern manufacture, despite the fact that both sets are fitted with the original tubes which must be getting on for seventeen years old. I've always found that the 19 and 23in. types of tube lasted much longer and gave much better picture quality than the later 20 and 24in. types.

The 1400 can be recommended for DX-TV use because of its excellent gain and the ease with which it can be modified to receive 625-line v.h.f. transmissions. All that's necessary is to move the lead from tag 43 to tag 44 (marked 625-VHF) and to cut the middle (grey) lead from the microswitch on the v.h.f. tuner, leaving the systems switch inoperative. The v.h.f. coils, accessible at the front after pulling off the tuning knob, now need to be reset for the European channels. There's also a demand for sets modified in this way in areas where RTE can be received at v.h.f.

I hope other readers will find the following notes on renovating these sets of use.

First, whether you're a DX enthusiast or not, it's worth carrying out the systems switch modification described above. We all know the trouble that systems switches give, and there would be nothing worse than getting a phone call from a customer to say that the set switched to 405 but wouldn't switch back to 625! Both contrast controls continue to operate when the modification is done as described.

Secondly, the manual suggests that a PCF808 is a suitable alternative to the 30FL14 sync separator/ flywheel sync amplifier valve. This is definitely not the case. I've seen the PCF808 advertised at somewhat cheaper prices than the 30FL14, but using one in the V4 position produces a picture miles out of tolerance with severely loaded-down e.h.t.

If you get the no-results symptom with the 1.5A mains fuse blown the cause is almost certainly the mains filter capacitor C101. It's rated at 600V d.c. but a 1.5kV d.c. rated type should be fitted. As in all sets these filter capacitors can go short-circuit at any time – at switch on or after anything up to several hours' use. Another possibility for fuse blowing at switch on is the BY127 h.t. rectifier diode to the right of the fuse.

No results with the heaters alight usually means that there's a broken mains dropper section. It's better to replace the dropper complete – exact replacements are not expensive. The fusible resistor R145 (100 Ω , 5W) on the dropper will give similar symptoms when open. Note that dropper section R135 was changed to $1.7k\Omega$ in later production to eliminate field cramping.

If you have the six-inch grid pattern an inch from the right-hand side of an otherwise perfect picture, replace the line output valve's screen grid decoupling capacitor C115. This is usually 1μ F but was changed to 0.1μ F, 350V for greater reliability in later production.

Loss of signals on u.h.f. only with background noise is normally due to a faulty u.h.f. tuner. These are available very cheaply. You may well find that the preset channel selector knobs need replacing since modern Thorn tuners use quarter-inch spindle shafts rather than the eighth-inch type previously used.

The $1M\Omega$ width control and its $330k\Omega$ series resistor can fall in value resulting in lack of width – a lowemission PL504 can produce the same symptom.

The most difficult fault I've had to deal with on one of these sets was an intermittent sound spluttering problem (sound intermittently blocked by crackles and spluttering). This was particularly bad while viewing RTE in Band III (I could receive this at times when I lived in Devon). The cause of the fault was eventually traced to one of the ratio detector diodes, W8, which is in the sound detector can. Access to the components in this can is not easy – care is needed while removing the aluminium can itself since the coils can easily break.

As with the later 1500 chassis, the line output transformer is so reliable that it can virtually be forgotten about, which is probably why so many of these sets are still in use. The tripler can give trouble, though I've not personally had this one.

Spares are readily available from advertisers in this magazine – triplers from Manor Supplies, tuners from

next month in

TELEVISION

EXTRA PAGES!

Features in next month's bumper issue include:

• SERVICING THE PANASONIC TC2205

Features of this set (U2 chassis) include a selfoscillating chopper circuit that provides mains isolation, magic-line tuning, infra-red remote control and 10W audio output. The design lends itself to systematic fault finding. David Botto tells how.

LNC FOR 11GHz RECEPTION

Many TV signals are available at relatively high levels from the ECS-1 satellite, while components for use at these frequencies are becoming readily available: Hugh Cocks describes a low-noise converter using the latest devices – details of a companion low-noise amplifier will be given in a later article.

WORKSHOP DECODER ALIGNMENT

Denis Mott describes a simple method of aligning PAL decoders where R-Y and B-Y outputs are available. Using the technique, engineers are able to test, align and repair up to 70 decoder panels a day.

• HIGH-POWER UHF TRANSMITTERS

High-power u.h.f. transmitters are a world on their own, with output powers ranging from about 1kW up to 55kW peak sync. To achieve such powers at u.h.[±], requires special techniques. Nigel Cawthorne d∈scribes what's involved.

HINTS ON THE CVC5-9 SERIES

ΤΟ

The ITT CVC5-9 series hybrid chassis seems to be the great survivor of the breed – large numbers of these sets continue to give good service. Chris Avis provides hints and tips based on his experience of renovating these sets.

PLUS ALL THE REGULAR FEATURES

ORDER YOUR COPY ON THE FORM BELOW:

(Name of Newsagent) Please reserve/deliver the February issue of TELEVISION (£1.10), on sale January 16th, and continue every month until further notice. NAME ADDRESS Sendz Components, the main electrolytic and dropper from PV Tubes, to name just a few items. PM components (Selectron House, Wrotham Road, Meopham Green, Meopham, Kent DA13 0QX) can supply all the valves at decent prices – their Selectronic brand valves are very reliable.

Finally, don't forget to reconnect any earthing strips/ leads to the chassis after servicing one of these sets.

Long-distance Television

Roger Bunney

October proved to be more active than usual, with relatively plentiful Sporadic E reception and two tropospheric openings. Meteor scatter signals also provided some excitement, with several enthusiasts reporting reception in the lower Band III channels. First the SpE log:

- 9/11/84 CST (Czechoslovakia) ch. R1.
- 11/11/84 Unidentified signals in chs. E2/R1.
- 12/11/84 TVE (Spain) E2-4; TVP (Poland) E3.
- 13/11/84 RAI (Italy) IA, B; JRT (Yugoslavia) E3; TVE E2-4; RTP (Portugal) E3.
- 14/11/84 RAI IA, B; TVE E3, 4; RTP E3; MTV-1 (Hungary) R1; EPT (Greece) E3.
- 16/11/84 RAI IA.
- 17/11/84 TVE E2-4.
- 21/11/84 TVE E2, 4; RAI IA; CST R1; NRK (Norway) E2-4; RUV (Iceland) E3, 4; also unidentified ch. R1, 2 signals.
- 22/11/84 TVE E2, 3; RAI IA; RTP E2, 3; SR-1 (Sweden) E2, 3.
- 24/11/84 TVE E2-3.
- 25/11/84 TSS (USSR) R1.
- 26/11/84 TSS R1; TVP R1.
- 27/11/84 TSS R1; TVE E2; plus unidentified ch. E2/R1 signals.
- 28/11/84 SR-1 E2; TSS R1.
- 29/11/84 RAI IA; TVE E3.
- 30/11/84 CST R1.
- 31/11/84 TVE E3, 4.

Our auroral reporter Iain Menzies observed several occurrences. The 11th produced identifiable NRK signals on chs. E2-4 and SR-1 ch. E2 between 21-2300 BST; auroral activity returned on the 18th and 19th, and on the 20th there were identifiable SR-1 signals on chs. E2 and 3. Apart from auroras, which result from storms on the sun, solar activity is at a very low level – we're entering the depth of the present solar cycle.

The two main tropospheric openings could hardly be termed "wide open" unfortunately. During the 12-16th there were widespread signals from the Benelux countries, W. Germany and (unusually) RTE (Eire) in Band III and at u.h.f. RTE Mullaghanish ch. D vertical caused some confusion for most of us, using horizontal Band III arrays. Canal Plus in Band III was widely seen throughout the UK, as far north as Scotland, as were the usual French u.h.f. stations. Conditions tended to favour a more northsouth path by the 15-16th, bringing Tyne-Tees ch. 29 to the south coast and NRK (Norway) on all Band III channels to the central/southern UK for example – with Failure to do so can lead to static problems which can be difficult to solve if you don't realise that a lead or strip has been disconnected somewhere! For a more detailed coverage of the 1400 chassis (with circuit and component layout diagrams) refer to Les Lawry-Johns' articles in the August/September 1976 issues of *Television*. Brian Renforth,

Wallsend, Tyne and Wear.

Denmark ch. E10 as a bonus. French ATV signals, notably F1EDM and F3LP, were seen over a wide area in south/SE UK. One interesting signal was the new ARD (W. Germany) logo – a figure one with various regional identifications inserted. The second tropospheric opening over the 30/31st produced signals from the Benelux countries, France and W. Germany, in Band III and at u.h.f., also DFF (E. Germany) ch. E11 and RTL (Luxembourg) ch. E7 at quite startling levels.

Canal Plus started operations in early November, with scrambling during the evening transmissions – we had been given to understand that scrambling would not start until January.

My thanks to Iain Menzies (Aberdeen), Tim Anderson (Bexhill), Dave Shirley (Hastings), Cyril Willis (Ely), Tony Privett (Basingstoke) and Gareth Foster (Twickenham) for sending in details of their reception.

From our Correspondents . . .

Remember June 22nd, 1984, when an afternoon SpE opening gave UK reception of multi-hop signals with CBHT, Halifax, Nova Scotia ch. A3 and a mysterious "NTV" caption at 1600BST on ch. A2? Frank Lumen (Denver) has now identified Don Bassnett's reception of the NTV caption in Glasgow as Newfoundland Television. NTV is the new logo of the Newfoundland Broadcasting Company Ltd. The ch. A2 outlet operates at 3kW e.r.p. from Grand Bank. It's part of the CTV Network (Canadian TV), with the NTV main office/studios at St. Johns, Newfoundland. Congratulations to Don and thanks to Frank!

During a recent holiday in Bombay Bindu Padaki received Oman TV chs. E5, 7, 10 and u.h.f., Abu Dhabi ch. E9 and Yemen ch. E5. Bindu reports that the Indian government is establishing a network of 180 Band III transmitters, with typically 1kW e.r.p., to relay the INSAT-B programmes from New Delhi.

Marios Colocassides (Nicosia) has sent us a couple of photos showing "Middle East Television", ch. E12. The station operates from a site in the Lebanese mountains and was established by the "High Adventure Ministries" of California, then sold to another broadcasting concern. The signals are well received in the Lebanon, Syria and Israel as well as Cyprus.

Wenlock Burton (Victoria, Australia) recently sent several photocopies of old DX-TV articles from the magazine *Radio*, *Television and Hobbies*, the earliest dated January 1949. An item in this issue reports on the conversion at the Moscow TV Centre from 343- to 625line operation, while the Leningrad TV centre was changing from 240 lines before the war (with regular programmes twice weekly) to 440 lines with programmes four times weekly "soon"! Interesting that such regional variations in transmission standards should have existed concurrently. The March 1957 issue contained reports on London/Sydney ch. B1 reception using a Hallicrafters SX28 which produced the 41.5MHz sound and a 45MHz vision buzz "several times". The 41.25MHz French TV sound was also heard.

News Items

UK: The RSGB, Alma House, Cranborne Road, Potters Bar, Herts EN6 3JW would welcome reports on reception of the new 50·1MHz beacon. Send to the General Manager.

The "Channel 36" pirate transmitter mentioned last month, operating on ch. E21, was closed down by the DTI on October 18th. It was working from Church Road, Crystal Palace, London. Thameside TV, operating on ch. E28, has continued however, using an accommodation address – 1 Grosvenor Parade, London W5. Incidentally Rotterdam is at present free from TV pirates: the cable companies now monitor the system output following main transmitter closedown – if a pirate signal appears it's removed and a "cable test card" is inserted.

Belgium: The Law Courts, Brussels ch. E48 transmitter has been closed following improved coverage from the Botanic Gardens ch. E25 outlet (BRT-2). TV-5, the French programme distributed by the ECS satellite, has been seen on ch. E64: the source is not known.

Australia: New channel allocations have been announced (see below). The new system allows for the introduction of two-channel sound.

Ch.	Frequency	Ch.	Frequency	Ch.	Frequency
	(MHz)		(MHz)		(MHz)
0	45-52	33	561-568	53	701-708
1	56-63	34	568-575	54	708-715
2	63-70	35	575-582	55	715-722
3	85-92	39	603-610	56	722-729
4	94-101	40	610-617	57	729-736
5	101-108	41	617-624	58	736-743
5A	137-144	42	624-631	59	743-750
6	174-181	43	631-638	60	750-757
7	181-188	44	638-645	61	757-764
8	188-195	45	645-652	62	764-771
9	195-202	46	652-659	63	771-778
10	208-215	47	659-666	64	778-785
11	215-222	48	666-673	65	785-792
28	526-533	49	673-680	66	792-799
29	533-540	50	680-687	67	799-806
30	540-547	51	687-694	68	806-813
31	547-554	52	694-701	69	813-820
32	554-561				

New Products

Antiference have added a twin-input (v.h.f./u.h.f.) diplexing amplifier, Model UP3301, to their Uniplus range. The amplifier draws 37mA at 12V and is housed in a CS1000 type case. Performance figures are as follows. V.H.F.: passband 40-230MHz with gain 27dB \pm 1.5dB, a noise figure of 2.8dB and typical maximum signal handling capability 35.5dBmV. U.H.F.: passband 470-860MHz with gain 23.5dB \pm 2dB, a noise figure of better than 3.5dB and typical maximum signal handling capability of 36dBmV.

Another interesting unit is the UP1300/V wideband v.h.f. amplifier. Coverage is 40-230MHz with gain 19dB \pm 2dB, noise 2.5dB and maximum handling capability 26.5dBmV.

Handling relates to a four-channel throughput at 46dB



r.m.s. peak and noise to the complete unit – not the devices.

The W. German Hirschmann company has introduced a new type of Yagi aerial. It has a rather higher gain than previous types as a result of using a double director chain. There's a conventional multi-element director assembly chain with a chain of standard half-wave elements interspaced between the full-wave director assemblies. The result is an increase in gain of some 1-1.5dB. An array with fifteen full-wave director assemblies and the additional complement of half-wave directors spaced along the boom has, in the wideband version, a gain of 12.5dB at ch. 21 rising to 16dB at ch. 40 and 18dB at channel 60, with reference to a half-wave dipole. The front-back ratio is between 27 and 30dB. Ryn Muntjewerff has been testing one recently at his Beemster, Holland location and has found that the system bettered two stacked Fuba XC391 aerials at the group E end of the spectrum though the Fuba aerials had the edge in group A.

Wideband Inductive Combiners/Splitters

Wideband inductive combiners/splitters are available from most UK aerial manufacturers and aerial retail/rigging firms. There are two main versions: external for mast mounting, usually provided with some form of clamp, and indoor types of either wired or integral plug/socket construction. I recently had a need for such a unit with a specific performance requirement and as a result obtained six units from different manufacturers and carried out tests on them.

The performance figures quoted by manufacturers usu-



Fig. 1: Results of inductive splitter/combiner tests carried out by Fringe Electronics. (a) Antiference CS1000 unit. (b) Fringe unit. (c) Labgear CM6011. (d) ACL M1S/Maxview ST3. (e) Triax 7200. (f) Wolsey CS1/4.



Fig. 2: Results of tests on the CM6011 carried out by Wolsey using different equipment.

ally show an insertion loss of around -3.5dB at v.h.f. and -4dB at u.h.f., with a spur isolation figure of about -20dB. My tests showed quite severe variations from manufacturers' specifications, so much so that fluctuations of several dB were occurring within a 10MHz spectrum at v.h.f. Clearly something was wrong and consultations were held with the various manufacturers. The upshot was that for accurate testing of even such a simple device as an inductive combiner/splitter expensive test equipment is necessary. Fringe Electronics tested all six filters for me, for both insertion loss and spur isolation. The results are shown in Fig. 1. Labgear tested their own unit, with the results shown in Fig. 2. These graphs show the performance of the better known splitter/combiner units at present available in the UK (the Maxview unit is made by ACL) and will enable enthusiasts to decide for themselves which unit best matches their particular needs.

The units are all housed in PVC/polythene boxes. The Antiference CS1000 is perhaps the most attractive, in black with a reusable ratchet type cable strap for mast mounting. The Fringe unit also has a reusable strap, the housing being a distinctive bright red. Triax's 7200 was the largest, housed in a standard "continental" plastic amplifier case with plated bracket/wing nut for mast mounting. Labgear's CM6011/OS fits inside the standard dark green circular plastic box while the Maxview M1S is housed in a square, chocolate-brown PVC box. These two have once-only use ratchet straps for mast mounting. The most compact filter, again with once-only use strap, is Wolsey's cream coloured PVC CS1/4. All these units incorporate a PCB with various discrete components and a large ferrite toroid (or several smaller toroids). Constructional standards are good, with generally minimal lead lengths and boards designed for the purpose – the exception here is Triax which seems to use a general-purpose board.

All the units tested have d.c. throughput on one spur and the d.c. block on the other can generally be shorted to give a d.c. pass on both spurs – the blocking capacitor is usually of about 0.001μ F, mounted adjacent to the d.c. blocked spur connection.

In use as a splitter the insertion loss is less than with a resistive unit though an inductive splitter is more expensive.

An inductive combiner is useful where severe ghosting is present and two identical arrays are stacked (using equal feeder lengths!) to obtain a suitable polar response with reduced horizontal beam width.

Don't use a wideband inductive combiner on its own to link the outputs from two different channel group aerials, e.g. where an extra ITV station is required. Since the bandwidth of this type of combiner is over 40-860MHz, pickup of the local signals on the distant aerial and vice versa will produce a confusion of signals at the output. This is likely to be destructive for teletext reception and, depending on the relative phasing of the signals, ghost pickup etc., degraded pictures are likely to be obtained. For this application an appropriate frequency-selective diplexing arrangement with sufficient out-of-group rejection should be used.

Labgear have recently introduced a u.h.f. combiner/splitter, type CM9035, for the 470-860MHz band. It's housed in the usual round case and features stripline techniques. The insertion loss is less than -4dB, typically -3.5dB, with spur isolation -15dB. D.C. passage on both spurs is available. For combining the outputs from different channel group aerials, use 9034 group bandpass filters.

Test Report: Tele-Part Pattern Generators

Eugene Trundle

In the seventeen years (ye gods, is it really that long?) that we in the UK have been in the colour television business, the evolution of the pattern generators we use for test purposes has largely mirrored the development of the sets themselves – in terms of price, circuit integration, current consumption and simplicity. The need for a pattern generator is diminishing with the latest colour sets. Gone are the days when a new set had to be completely set up at the time of installation, and even for routine servicing thereafter the pattern generator tends to stay in the van. Converging a TV set, once a source of satisfaction (or frustration?), is rapidly becoming a lost art, while modern decoders are virtually go/no go devices whose rare failures usually show up in the form of complete loss of colour or an absence or surfeit of one primary colour.

The need for specialised test patterns still exists however, and to meet it two generator "modules" have been introduced by Tele-Part of Wolverhampton. The simpler one, Telegen-1, is a pocket-size $(10 \times 7.5 \times 4 \text{ cm})$ instrument powered by an internal PP3 battery or an external power source via a 3.5mm jack socket. It provides five monochrome patterns – crosshatch, dots, white raster, horizontal lines and vertical lines. Its output is at around channel 32, via a flying lead with a standard u.h.f. plug.

On test I found that the twelve vertical and eight horizontal lines are sharp and well defined. The plain white raster is free from hash and patterning, and a scope test showed that the vision/sync ratio is correct at 7:3 on all patterns. The field sync pulse is of the "simple" type (a single broad pulse), but this is quite adequate for the job in hand. The u.h.f. output measured about 4mV, with virtually no spurious radiation on "ghost" channels and a complete absence of frequency drift. Current consumption came out at just over 10mA at 9V: I found that the unit will operate satisfactorily down to 6.3V, still without modulator drift. Good!

I next dismantled the unit and found a little fibreglass PCB mounted to the case by the pattern selector switch, which is a good quality, fully-enclosed type. Three i.c.s, three transistors and 57 other bits complete the ensemble, which I've no doubt will be very reliable.

Turning attention to its big brother Telegen-2, not very big actually at $12 \times 10 \times 4.5$ cm, I found a similar design and construction. This is the colour "module", offering standard colour bars and plain rasters in red, green and blue, selected by a four-position switch. Telegen-2 works from an external 14-18V supply via a 3.5mm jack socket and provides a similar u.h.f. output to Telegen-1. It contains five chips, an 8.86MHz crystal, a 5V stabiliser i.c. and an on-board u.h.f. generator, all on a similar PCB to that used in Telegen-1. The switch and mounting method are also similar.

I was happy with the colour bars, which scope checks proved to be correct in every sense, particularly with regard to the chroma/burst/sync ratios and the burst timing (the latter is a weak point with some inexpensive colour generating equipment). The plain coloured rasters, particularly blue, were somewhat marred by a spurious patterning due to a form of internal signal breakthrough – the effect disappeared when the instrument was dismantled, but returned when it was reassembled! This didn't distract much from the usefulness of the patterns however. The review model suffered from intermittent colour, due I believe to an internal dry-joint, and a tendency for the u.h.f. oscillator to drift with time and temperature, but this was probably pure bad luck and I wouldn't expect it to happen with other samples.

With some types of TV set it's not always possible to lose the colour completely – the colour control sometimes won't turn it down fully, and an efficient a.f.c. system with no cancelling switch may prevent you from mistuning to try for a monochrome display. For this reason, and since Telegen-1 has no grey-scale pattern, I'd have liked a colour/mono switch on Telegen-2 to facilitate easier greyscale tracking adjustment with these "difficult" sets.

A mains power pack in the form of a "block" mounted directly on to the pin configuration of a 13A plug was supplied with the review pattern generator modules. At $\pounds4.55$ one cannot complain on grounds of cost, but cheap and cheerful is the only way to describe it! It has six unstabilised output voltages (3V to 12V) which are selected by a slide switch. When modestly loaded by one of the Telegen modules it gave an output voltage between 42 and 90 per cent higher than specified, depending on range. This overvoltage caused no damage to either Telegen model during sustained tests, neither did incorrect polarisation of the (reversible!) plug on the d.c. output lead.

Verdict

The odd negative comments in the above review must be considered in the light of the very reasonable price of the units $- \pm 17 \cdot 20$ for Telegen-1, $\pm 34 \cdot 45$ for Telegen-2 and $\pm 4 \cdot 55$ for the power supply, to which must be added $\pm 1 \cdot 44$ post and packing. I found them portable, convenient and useful, and would regard them as good value for money.

The units are available from Tele-Part, 13 Worcester Street, Wolverhampton, WV2 4LJ (telephone 0902-773 122).



The modules under review. Left the monochrome Telegen-1, right the colour Telegen-2, top the mains adaptor.

TV Fault Finding

ITT CMC301 Module

I've had a number of faults on the CMC301 remote control/frequency synthesis tuning module. Here's a typical one. The set wasn't tuning a station in – there was just snow on the screen. The scope was used to check the tuning voltage at connector TC12. For our transmitter (Sutton Coldfield) this is normally around 10V, but in this case a ramp voltage varying between 20V and 30V was present.

Checks were made on the counted-down local oscillator signal coming back from the tuner/i.f. module (plug FD1) but the waveform was correct – a 4V p-p sinewave. The frequency divider switching signal at plug FD3 was also correct – a 5V p-p squarewave. As the ramp on the tuning line wasn't going below 20V, the transistors in the D-A converter circuit were checked out of circuit. T1414 turned out to be leaky.

Other faults we've had in this area are as follows:

One inch wide bars across the picture due to C1425 $(2 \cdot 2\mu F)$ in the tuning voltage smoothing network going open-circuit.

Intermittent switching to standby due to C1419 (2.7pF) in the crystal clock oscillator circuit being leaky. Stuck on standby due to the standby power supply

mains transformer Tr1401 being open-circuit. No tuning voltage due to C1072 (0.47μ F blue

tantalum) on the main panel being short-circuit. **P.B.**

ITT CVC1100 Chassis

Here's an impossible one for you! The reported fault was no sound on VCR operation, and sure enough there was no sound on any signal tuned in via the VCR button. The interstation mute was operating: this is sensed by the TDA1940F sync separator/line oscillator i.c. but a replacement chip made no difference. The VCR button modifies the phase detector time-constant of course, so something in the line generator circuit just had to be out of tolerance. We checked the black electrolytics in the area (usual practice with I'IT sets) to no avail. The digital voltmeter was next brought into play so that the voltages around the i.c. could be more carefully checked. The VCR select pin (pin 5) went high as it should have done, but went 1V too high (to 8.5Vinstead of 7.5V). The pin is fed via a potential divider (R601/R631) and R631, which is connected to chassis, was found to be open-circuit. P.B.

Grundig GSC100 Chassis

This was a real pig! The field engineer said that every three weeks he had to resolder R607. Now this resistor normally runs very cool, because it's part of the start-up circuit, and goes open only when the line output stage fails. After a lot of soak testing and probing I found that on certain fairly cold days the set would trip in this way when first switched on. Much time elapsed before I concentrated on the e.h.t. control module, which controls the supply to the line output stage. It contains a 74-series monostable multivibrator chip. Now these digital chips like a supply of exactly 5V: go much higher or lower and Reports from Philip Blundell, Eng. Tech., Paul Hardy, Keith Hamer, Garry Smith, Malcolm Burrell and Chris Avis

they won't work. This one is supplied by a rail that's stabilised by a 4.7V zener diode, Di2502. At times the voltage across this diode was as low as 3V. Replacing Di2502 cured the problem. **M.B.**

Philips K30 Chassis

One of these sets had cross-modulation lines on the picture, as if the r.f. amplifier was being overloaded. A lot of time had been spent trying to locate the exact cause of the fault, which was cleared by replacing the tuner unit.

The fault on another of these sets was field collapse. A quick check revealed that there was no 32V rail, due to R1590 (1.2 Ω) being open-circuit. When this was replaced it started to cook while the raster disappeared towards the bottom of the screen. The field scan coupling capacitor C1521 (1,500 μ F) was short-circuit. M.B.

Thorn TX9 Chassis

Lack of width was the customer's complaint with this set. On test card the verticals were seen to be bowed while the width and pincushion controls had no effect. Obviously something to do with the EW correction circuit. A check at the emitter of the EW modulator driver transistor TR72 (TIP110) produced a slightly high voltage reading (not much higher than I'd have expected though – the normal reading is quoted as 0.15V). I decided to check the emitter resistor R251 (2.7Ω) which turned out to be high in value. The transistor seemed to be o.k., and replacing the resistor restored normal operation. **M.B.**

Philips K30 Chassis

The set was brought in because it was tripping. All the usual things around the line output stage, even the deflection coils, had been checked by the field engineer. It was difficult to find the cause of the problem until I decided to try disconnecting pin 6 (excess current protection) of IC7322 (TDA2581Q) – not something to do light-heartedly. A picture then appeared, modulated with 100Hz hum. The fault clearly lay in the power supply and was soon traced to the 285V supply reservoir capacitor C1460b. M.B.

Philips K30 Chassis

A sudden drop in contrast with the control itself having no effect led us to suspect a fault in the contrast control network. The fault corrected itself before we could take any further action however and the set remained all right during a prolonged soak test. All we could do was to return it to the customer. Six weeks later it was back with the same fault. Beam limiting is also carried out via the contrast control network, so attention was paid to this. The sample point for the beam limiting is C1565 $(0.068\mu F)$ which is connected to the earthy side of the e.h.t. circuit. This capacitor, which is close to the smoother at the bottom of the hinged panel, turned out to be open-circuit. We've since had the same fault on two other K30s – in both cases it was intermittent. **K.H.-G.S.**

Thorn TX10 Chassis

We were called out to a six-month old Ferguson colour receiver fitted with the TX10 chassis. The customer had complained that the set was dead, but on arrival we found that it was tripping. Disconnecting the e.h.t. lead made no difference so we humped the set back to the workshop for a more detailed examination. Further checks revealed that the h.t. rail was higher than the specified 150V – the supply was building up and shutting down as soon as the overvoltage protection system came into action. Reducing the setting of the set-h.t. control stopped the tripping and restored normal operation but the control was at one end of its travel. Further checks showed that the feedback resistor R813, connected between the control and the 150V rail, was high in value at $160k\Omega$ instead of $121k\Omega$. K.H.-G.S.

Philips K30 Chassis

"Dead" said the job card. Good we said, thinking we'd be in and out of the house in five minutes. The cause of this fault is usually the mains bridge rectifier's surge limiting resistor R6291 (4.7 Ω) going open-circuit. Not this time however. The set worked for several minutes before the gain suddenly fell to zero, producing a blank raster. Lowering the chassis disturbed the fault and the picture and sound returned – but not for long. The tuner is unpluggable so we carried out a quick substitution. This made no difference. Back in the workshop we soon found the culprit. No, it wasn't the TDA2540 i.f. amplifier/detector i.c. A can of freezer (not a whole can incidentally) and a hairdryer led us to the a.g.c. reservoir capacitor C2147 (0.022μ F) which is connected to pin 14 of the i.c. It was going leaky. K.H.-G.S.

Thorn TX9 Chassis

This set was fitted with the U725 remote control panel. The complaint was line drift. The line generator i.c. had already been changed so I put the set on soak and set up the line oscillator. Nothing happened till I switched off and on again. The line timebase was then *slightly* off frequency. Checks were made on the components around the chip but the only clue was obtained by changing channels. When the line was unlocked, pressing button eight (AV) restored lock until the set was switched off. Disconnecting R207 in the AV line resulted in immediate picture lock, as did disconnecting the AV connection on the remote control panel. Moving over to the remote control panel itself brought me to D916 (F425) which turned out to be leaky. M.B.

Grundig 6100

We've dealt with the basic models in the Grundig range for the past two-three years and have found them very predictable with regard to faults. Callouts usually concern tuning troubles, especially on earlier models. With the 6100 we would find that ITV and sometimes Channel 4 had to be retuned every few weeks. If the trouble persisted we would change the tuning voltage supply stabiliser – after removing the fiddly front panel and

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button unit from inside the cabinet. This wasn't the right diagnosis however as the stations didn't drift to the same extent. We eventually found the true cause of the trouble. What happens is that the cabinet can warp and distort the press-button unit mechanics as the room temperature alters. This distortion affects mainly the middle positions of the assembly. The only cure we know is to remove the assembly, twist it round a little and put it back! In stubborn cases, try telling the customer to get the central heating thermostat checked.

Later models aren't affected in this way because the button unit is directly mounted on to a vertical side chassis assembly. We still get problems however. Customers somehow manage to engage all the buttons. They follow the instructions on delatching given in the Grundig booklet, then we're called out to a broken button unit damaged by hairpins, screwdrivers and, by the look of some of them, garden spades! K.H.-G.S.

Thorn 3000/3500 Chassis

Many of these BC (Before Ceefax) vintage sets are still in use. They're prone to displaying teletext "morse code" over the top couple of inches of the picture. I've tried a couple of suggestions relating to the field oscillator circuit without success but a recent consultation with the oracle at the Ferguson service department produced a simple and effective cure: increase the value of R441 in the flyback pulse limiting network across the field output transformer from $2 \cdot 2k\Omega$ to $5 \cdot 6k\Omega$. C.A.

Thorn 1500 Chassis

The complaint was intermittent loss of picture, which turned out to be due to a faulty ring trap – the plastic had cracked with the result that the c.r.t. heater was shorting out. Whenever a tube is scrapped I always keep the ring trap if it's any good, so a spare was soon fitted and the set sent on its way. It was back a few days later however, the symptoms being no picture or sound with a visible raster. This time the ring on the replacement trap was grounding pin 1 of the tube so that the set's l.t. supplies, which are derived from the end of the heater chain, were removed. It turned out that the tube's evacuation pip was malformed, as a result of which the plastic base couldn't be pushed firmly home against the end of the tube – it sprang out. All that was necessary was to file the plastic base till it fitted the tube, then apply some adhesive to ensure that it stayed there. P.H.

Philips G8 Chassis

Every six months or so the 250mA fuse on the power supply panel would blow. No shorts could ever be found on any of the panels or in the wiring loom, a replacement fuse working for a time until it blew for the same inexplicable reason. This went on for a couple of years! There was obviously a fault somewhere however. Close inspection of the panels revealed a very slight burn mark on the component side of the combined i.f./decoder panel, adjacent to R212. R414, which is beside R212, was mounted horizontally instead of vertically, with the result that the earthed side of R414 was very close to the end of R212 that carries 205V. The 205V was intermittently flashing over from the end cap of R212 to the earthed leg of R414. Repositioning these resistors has provided a cure - to date! P.H.

	ECO	NO	MIC	C DE	VI	CES,	P	OB	ΟΧ	228	B, T	ELF	OR	D 1	F 2	8 Q P	
16029 16181	1.58 1.13	2SC1061 2SC1096	0.54 1.05	2SD8988 40408	2.67 0.45	AN320 AN322	4.97 4.38	BC171 BC172	0.10 0.09	BD166 BD168	0.30	BF137 BF152	0.11 0.28	BLY49 BR100	2.00 0.20	BY203/20 BY206	0.18 0.17
16182 16334	1.13 0.66	2SC1104 2SC1106	2.00 4.12	40594 40595	1.39 1.39	AN331 AN337	2.99 3.99	BC172B BC173	0.24 0.15	BD175 BD177	0.39 0.39	BF153 BF154	0.52 0.23	BR101 BR103	0.37 0.45	BY207 BY210-400	0.22 0.24
16335	0.72 0.89	2SC1114 2SC1124	5.61 1.10	40636 40871	0.86	AN340P AN355	1.06	BC174B BC177	0.24 0.18	BD179 BD181	0.44	BF157 BF158	0.23 0.16	BR88B BRC-M-3	0,58 100 1.58	BY210-600 BY210-900	0.27 0.30
16600	1.25	2SC1151A 2SC1152	4.29	40872 60857	1.39 1.10	AN362 AN5111	1.47 2.34	BC178 BC179	0.23	BD182 BD183	0.90 0.90	BF159 BF160	0.16 0.28	BRC116 BRC1330	0.60 1.60	BY223 BY224-400	0.95 0.90
16801	0.06	2SC1157 2SC1162	4.12 0.95	74LS132 74LS138	0.72	AN5132 AN5250	3.99 3.33	BC182 BC182B	0.08	BD184 BD187	1,10 0.48	BF167 BF173	0.34	BRC300 BRC4443	1.82	BY225-100 BY226	0.79 0.28
16905	1.35	2SC1172 2SC1195	1.52	74LS157 74LS161AN	0.79	AN5610	6.75	BC182LB	0.09	BD189 BD190	0.35	BF177 BF178	0.50	BRC5296	1.12 0.70	BY227 BY228	0.44
17127	3.91	2SC1213 2SC1226	0.75 1.32	74LS196	0.25	AN5613 AN5620X	3.72 4.63	BC183 BC183L	0.09	BD201 BD202	0.54	BF179 BF180	0.32	BRC6109	0.75	BY255 BY298	0.97 0.25
1N4001	0.05	2SC1306 2SC1307 2SC1316	1.35	74LS20	0.29	AN6342	1.36	BC184	0.09	BD203 BD204	0.54	BF182	0.29	BRC84	0.98	BY299 BY476A	0.25
1N4003	0.05	2SC1364 2SC1364	0.49	74LS307 74LS373 74LS373	1.93	AN6363	10.20	BC184LB BC195	0.23	BD208	1.00	BF184	0.35	BRX49	0.45	BYX10 BYX55 250	0.30
1N4005	0.07	2SC1398 2SC1410	0.51	74LS73	0.39	AN6552	0.52	BC187 BC204	0.18	BD225 BD228	0.44	BF194 BF195	0.15	BRY55	0.50	BYX55-600 BYX71-350	0.46
1N4007 1N4148	0.07	2SC1413 2SC1505	3.88	74LS75 74LS86	0.52	AN7150 AN7151	2.22	BC207 BC212	0.12	BD229 BD231	0.63	BF196 BF197	0.15	BSR59 BSS38	1.17	BYX71-600 BYX94	0.85
1N4448 1N5401	0.12 0.12	2SC1578 2SC1617	6.67 3.35	74LS90 74LS92	0.75	AN7156 AN7158	2.05	BC212B BC212L	0.23	BD232 BD234	0.44	BF198 BF199	0.15 0.15	BST8D1 BST8D1	409 2.48 405 4.37	BYY56 BZV15-C12	1.09
1N5402 1N5403	0.13 0.14	2SC1670 2SC1678	2.84 1.25	74L\$93 74L\$95B	0.75 0.85	AN7218 AP58076	1.49 4.25	BC212LB BC213	0.23	B0235 B0236	0.43	BF200 BF216	0.33	BSTCD1 BSTC02	46 2.25 3 2.25	BZV15-C12R BZV15-C24	0.72
1N5404 1N5408	0.15 0.18	2SC1810 2SC1815	1.40 0.41	7805 TO-220 7805 TD-3	0.63 1.05	AS560S AU106	1.43 1.96	BC213L BC213LB	0.09 0.23	BD237 BD238	0.38 0.29	BF218 BF222	0.32 0.50	BSTC024 BSTC123	16 4.51 13 3.91	BZV15-C24R BZV15-C30R	0.72
1N914 1S44	0.05 0.06	2SC1829 2SC1875	2.01 4.77	7806 7808	0. 66 0.54	AU110 AU113	1.96 2.15	BC214 BC214L	0.09 0.12	BD239 BD240	0.44 0.36	BF224 BF237	0.15 0.59	BSTC314 BSTCC0	16 0.71 143 2.79	BZX61 Range BZX70-C11	0.16 0.54
1S5012A 1S921	0.73 0.09	2SC1891 2SC1929	3.35 2.25	7812 TO-3 7812 TD-220	0.54	AY102 AY105K	2.62 1.89	BC214LB BC225	0.23	BD240D BD241	0.47 0.45	BF240 BF241	0.15 0.15	BSTC06 BSV57B	3 3.06 2.66	BZX70-C12 BZX70-C15	0.54 0.54
2562 2N1302 2N1302	0.24	2SC1942 2SC1945	5./0 4.11	7815	0.55	BA102	1.98 0.30	BC23/ BC238	0.09	BD242 BD243	0.45	BF244 BF245A	0.23	BSW68 BSX19	0.30	BZX70-C30 BZX70-C47	0.54
2N1303 2N2218	0.34	2SC1953 2SC1957	0.86	AC107	0.55	BA1310 (IC) BA1320 (IC)	1./2	BC239B BC239B	0.11	BD243A BD244	0.50	BF255 BF256	0.18 0.25	85X20 85X21	0.30	BZX79 Range BZY88 Range	0.09
2N2222 2N2546	0.34	2SC1962 2SC1962	1.75	AC123K	0.39	BA145 BA145	0.17	BC252 BC258	0.12	BD245C	0.68	BF257 BF257	0.30	BSY79 BT100A	0.45	BZY93-C18 BZY93-C18	0.99
2N2904 2N2905	0.32	2SC2027 2SC2028	2.67	AC138	0.98	BA155-01 BA156	0.12	BC261A BC262	0.20	BD253 BD278A	0.95	BF259 BF262	0.30	BT106	1.40	BZY93-C24 BZY93-C24R	0.99
2N2906 2N3053	0.34	2SC2029 2SC2057	1.49 1.07	AC142K AC151	0.39	BA157 BA159	0.17	BC287 BC294	0.45	BD317 BD318	1,96	BF263 BF264	0.51	BT109 BT112	1.31	BZY93-C47 BZY93-C68	0.99
2N3054 2N3055	0.90 0.55	2SC2073 2SC2078	1.40 1.25	AC153 AC153K	0.30	BA182 BA222 (IC)	0.17	BC301 BC302	0.36	BD375 BD377	0.38	BF271 BF273	0.30	BT113 BT116	2.25	BZY93-C7V5	0.99
2N3055H 2N3442	0.77	2SC2091 2SC2122A	0.59 4.65	AC176 AC176K	0.17	BA284/2 BA301 (IC)	0.15	BC303 BC307	0.34	BD379 BD380	0.69	BF274 BF324	0.18 0.16	BT119 BT120	1.60	ZX18 C106D	2.47
2N3702 2N3703	0.12 0.12	2SC2141 2SC2166	1.69 1.35	AC179 AC183	0.25 0.65	BA302 BA311 (IC)	0.90 1.06	BC307A BC308	0.14	BD410 BD412	0.44 5.70	BF336 BF337	0.27	BT121 BT122	2.25 2.25	C1129 CA1310E	0.52
2N3704 2N3705	0.12 0.12	2SC2216 2SC2233	0.62 2.20	AC186 AC186K	0.30 0.50	BA312 (IC) BA313 (IC)	0.98 1.28	BC308A BC309	0.09 0.15	BD418 BD433	0.76 0.33	BF338 BF355	0.36 0.36	BT123 BT125	1.80 2.25	CA3044 CA3046	3.18 2.23
2N3706 2N3707	0.12	2SC2278	3.64	AC187	0.35	BA316 BA317	0.07	BC317A BC323	0.11 0.92	8D434 8D435	0.39 0.42	BF362 BF363	0.54	BT126 BT128	2.25 2.25	CA3060 CA3065	1.50 1.17
2N3771 2N3771	1.85	2SC2526 2SC2526	1.70	AC18/K AC188	0.39	BA318 BA328 (IC)	0.00	BC327 BC328	0.15	BD436 BD437	0.42	BF371 BF391	0.45	BT128P BT129	2.79 2.25	CA3089 CA3089E	3.35 1.30
2N3773 2N3819	1.65	2502551 2502570 2502570	0.95 1.80	AC188K	0.40	BA401 (IC)	1.29	BC338	0.06	BD441	0.44	BF393 BF417	0.90	BT151-80	UK 1.47 JOR 1.25	CA3090 CA3094	1.25
2N3823 2N3904	1.06	2SC264A 2SC2671	4.38 1.99	AC194K	0.59	BA521 (IC)	1,30	BC368 BC440	0.23	BD507 BD508	0.54	BF422 BF423	0.25	BTT6218	2.20	CA3132EN	2.83
2N3908 2N4101	0.56 1.10	2SC2728 2SC372	0.95 1.27	AD142 AD143	0.96	BA536 (IC) BA6304A (IC)	2.72	BC441 BC454	0.40	BD509 BD510	1.29	BF435 BF450	0.49	BTT8124 BTT8214	4.44	CBF16848N-07 CD4001	1.41
2N4240 2N4443	3.00 1.35	2SC373 2SC383	1.05 1.20	AD145 AD149	1.45	BA843 (IC) BAV10	3.60 0.10	BC455 BC460	0.32	BD518 BD519	1.36	BF451 BF457	0.26	BTT8224 BU105	2.70	CD4002 CD4008	0.24
2N4444 2N4914	1.12 0.65	2SC388 2SC41	0.45 1.99	AD161 AD162	0.30 0.30	BAV18 BAV19	0.10 0.10	BC461 BC462	0.42 0.27	BD529 BD530	0.38 0.60	BF458 BF459	0.35 0.35	BU106 BU108	2.25 1.90	CD4011 CD4012	0.23 0.24
2N5064 2N5293	0.64	2SC458 2SC495	0.55	AU262 AF114	0.95	BAV20 BAV21	0.10	BC463 BC464	0.58	BD533 BD534	0.60	BF460 BF469	0.54	BU109S BU110	1.90 2.52	CD4013 CD4016	0.37 0.37
2N5296 2N5297	0.40	2SC506 2SC515A 2SC527	1.28	AF115 AF116 AF117	0.79	BAX12 BAX13	0.10	BC460 BC477 BC478	0.58	BD536 BD536	0.44	BF471	0.28	BU111 BU124	3.78 1.25	CD4017 CD4020	0.74
2N5298 2N5490	0.55	2SC558 2SC605L	3.35	AF118 AF121	0.75	BB105B BB119	0.22	BC479 BC532	0.29	BD538 BD544B	0.60	BF479 BF490	0.55	BU134S	4.15	CD4023	0.25
2N5496 2N6107	0.45 0.53	2SC620 2SC643A	1.32	AF124 AF125	0.36	BC107 BC107B	0.13	BC546 BC547	0,15	BD580 BD590	1.06	BF495 BF506	0.58	BU205 BU206	0.98	CD4028 CD4047	0.76
2N6109 2N6122	1.43 1.60	2SC673 2SC681	1.11 4.00	AF126 AF127	0.36 0.36	BC108 BC108A	0.12 0.12	BC548 BC549	0.09 0.09	BD598 BD645	1.13	BF509 BF523	0.37	BU207 BU208	1.50	CD4049 CD4050	0.52
2N6130 2N6133	0.65 0.57	2SC684 2SC685A	1.50 2.62	AF139 AF178	0.48 0.75	BC108B BC109	0.15 0.11	BC550 BC556	0.36 0.12	BD677 BD680	0.55 0.69	BF594 BF595	0.24 0.24	BU206/0 BU206A	2 0.98 0.98	CD4052 CD4053	0.88
2N6178 2N6180	0.66	2SC893 2SC710	0.69	AF179 AF180	0.50	BC109B BC113	0.13 0.12	BC557 BC558	0.09 0.09	BD681 BD695	1.34 2.09	BF596 BF597	0.16 0.24	BU208D BU209	1.43 1.60	CD4069 CD4081	0.23 0.26
2N698	0.39	2SC734	1.34	AF182	0.50	BC115 BC115	0.17	BC560C	0.10	BD695 BD697 BD609	3.27	BF618	0.95	BU226 BU312	2.00	CD4093 CD4511	0.72
2SA1027 2SA1076	1.15	2SC782 2SC790	2.24	AF239 AF279	0.48	BC116A BC117	0.53	BC636 BC637	0.18	BD699 BD700	3.17	BF757 BF758	0.59	BU326A	0./5 1,40	CP5521	1.06
2SA329 2SA351	0.36	2SC806 2SC814	10.28 1.26	AL100 AL102	3.66 1.75	BC118 BC119	0.18	BC638 BC639	0.18	BD702 BD707	2.94	BF759 BF760	0.30	BU406 BU407	1.35	CX034 CX095D	2.45
2SA489 2SA490	1.06 1.51	2SC828 2SC867A	0.25 2.49	AL103 AL113	2.43	BC125 BC126	0.18 0.18	BC640 BC879	0.18 0.28	BD709 BD710	0.72	BF762 BF870	0.30	BU407D BU412	1.29	CX104 CX108	8.49
2SA493 2SA628	0.95 1.03	2SC926A 2SC930	1.29 0.49	AN208 AN210	3.22 2.07	BC132 BC135	0.12	BC890 BCX32	0.28 0.33	B D807 B D809	0.60	BF871 BF900	0.84	BU426 BU426A	1.95 1.67	CX109 CX121	6.92 10.75
2SA637 2SA673	1.32	2SC935 2SC936	3.75 1.58	AN214 AN2140	2.05	BC136 BC137	0.15	BCX33 BCX34	0.24 0.36	BD810 BD879	0.60 0.64	BF907 BF959	1.62 0.38	BU427 BU500	2.67 1.61	CX130 CX131	4.90 10.75
25A063 25A684 25A748	1.46	250937 250940 2501129	3.25 4.25	AN231 AN234 AN235	5.56 5.02	BC138 BC139 BC140	0.30	BCY70	0.60	BD895 BD895	0.65	8F970 8FR39	0.55	BU508A BU526	1.33 1.65	CX134 CX136	10.75 10.75
2SA818 2SA818	1.65	2SD198 2SD234	3.51	AN236 AN238	3.02	BC141 BC142	0.33	BCY72 BD115	0.19	BD901 BD901	0.55	BFR62	0.45	BUS06D BUS06	1.42	CX137	10.75
2SA940 2SA951	1.64 1.23	2SD235 2SD257	0.54	AN239 AN240P	3.95	BC143 BC147	0.28	BD116 BD124	0.63	BDV65B BDX32	1.14	BFR81 BFR86	0.45	BU807 BU826A	1.35	CX157 CX158	4.40
2SA966-1 2SB325	0.54	2SD291 2SD292	2.67	AN241 AN245	1.55	BC147A BC148	0.42	BD124P+K BD131	IT 0.62 0.38	BDX53 BDX53A	0.80	BFR89 BFT41	0.39 0.39 0.27	BUV46 BUVA6	2.79 1.13 1.12	CX177 CX506	0.32 5.99 8.48
2SB337 2SB375	1.65 3.51	2SD313 2SD315	2.59 2.67	AN247P AN252	2.62	BC148B BC148C	0.11 0.11	BD132 BD133	0.38	BDX54B BDX62A	2.37 1.92	BFT42 BFT43	0.39	BUN81A BUN84	3.15	CX507 CX758	6.92 6.92
2SB400 2SB407	0.36 2.94	2SD325D 2SD350	1.36 7.03	AN253 AN262	2.70 1.58	BC149 BC149B	0.10 0.11	BD135 BD136	0.32 0.32	BDX63A BDX64A	1.95 2.37	BFT84 BFW10	0.36 0.79	BUX84 BY126	1.47	D1693 DEC1	2.35
2SB411 2SB511	3.00 1.48	2SD350A 2SD353	2.08 3.25	AN272 AN281	5.36 5.52	BC153 BC154	0.12 0.12	BD137 BD138	0.32 0.41	BDX65A BDX76	2.37 0.53	BFX29 BFX30	0.30 0.59	BY127 BY133	0.11 0.11	DEC2 E1222	1.52 0.36
25856 25856	1.25	2SD401 2SD554	2.19 1.57	AN295 AN301 AN302	5.01 3.30	BC157 BC158 BC159	0.14	BD140	0.27	BDY20 BDY62/01	1.10 4.20	BFX84 BFX85	0.33 0.25	BY164 BY176	0.50 1.38	E5024 E5386	0.25 0.22
230618A 258681 258661	1.40 2.44	250551 2SD588A 2SD521	1.25	AN303 AN305	3.82	BC160 BC161	0.36	BD150 BD157	1.30	BU181 BF115	1.07	BFX87 BFX88	0.50 0.30	BY179 BY162	1.42 0.95	E5529 E8021	0.22 1.17
2SB75 2SB961	0.94	2SD657 2SD731	5.86 2.54 1.72	AN313 AN315	5.0/ 3.10 2.12	BC167 BC169	0.32	BD15/ BD159 BD190	0.60	BF118 BF121	0.36	BFY50 BFY51	0.36	BY184 BY187	0.42	E9003 E9005	0.41
2SC1034 2SC1050	5.61 3.66	2SD811 2SD869	3.86	AN316 AN318	5.58 4.75	BC169C BC170	0.14 0.14	BD163 BD165	0.64 0.54	BF123 BF127	0.11	BFY52 BFY90	0.24	BY198 BY198	1.20	ESN310BP	10.1Z 3.86
IF YO	U DON'T S	EE IT LIS	TED AS	FOR QUO	TE. GN	E MAKE M	DDEL	LOCATIC	DN. REM	EMBER TO	ADD	.60p POS	ST & HAN	IDLING.	ADD 15%		TAL

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E	CO	NO	MIC	D	EVI	CES.	REC	SISTER	ED OF	FICE: 14	4, BEE	LANE,	V10 6	All go F. wi	ods should thin 4 wo	i be delivere king days.	ed
ESM532C	4.18	LM1303P/N	1.50	MPSU05	0.78	SAA5010 SAA5012	4.50	SN74190 SN7420N	1.81	T6029V T6032V	4,41 0,89	TBA395 TBA3950	1.35 1.00	TDA1230 TDA1235	2.93 3.52	TDA9503 TDA9513	2.60 2.40
ESM732C	4,18	LM3065N	0.77	MPSU55	0.90	SAA5020	525	SN7430 SN740N	0.28	T6033V T6035V	0.73	TBA396 TBA400	1.80 2.17	TDA1270 TDA1327A	2.64 1.65	TE527 TE538	1.25 0.36
ETTRIBUIG	2.16	LM339N	0.00	MPSUBO	1.20	SAA5040A	14,75	SN7473	0.56	T9036 T9037	0.44	TBA440P	1.55	TDA1327B TDA1330	1.65 1.69	TE626 TEA1002	1.35 3.15
FT3055	1.85	LM340T5	0.75	MR812	0.60	SAA661B	1.50	SN7490AN	0.53	T6041V	0.86	TBA4800 TBA500P0	1.67	TDA1365	6.35 0.95	TDA1009 TEA1020SP	0.96
GF758 GF759	1.02	LM340112	0.75 0.75	MR914 MSSD700	2 0.65	SAB1009B	4.53	SN79001AN	10 2.25	T6045	1.09	TBA510	1.55	TDA1420	1,48	TEA1087	0.46
GF761 GH3F	0.78	LM342N LM384N01	0.56 1.84	MVS240 MVS480	0.52	SAB1046P SAB3011	3.86 7.34	SN78013N	3.63	T8052V	0.76	TBA520	1.67	TDA1512	2.20	TIC106M	0.55
HA11211 HA11215	2.30	LM567CN LM748	1.30 1.65	MVS480-0 ME545B	2 0.55 2.95	SAB3012 SAB3013	5.34 3.28	SN76013ND SN76013ND) 2.25)G 8.07	T6059	1.05	TBA5200	0.06	TDA1770	5.56	TIC44	0.65
HA11225 HA11226	3.99 7.56	LM8380 LM8361	2.78 2.78	ME5458 ME5534N	3.80 1.48	SAB3021 SAB3022B	7.18 12.34	SN76023N SN76023ND	2.35) 1.04	T9001V T9003V	1.09 0. 06	TBA5300 TBA540	0.90	TDA1905	2.95	TIC45	0.70
HA11229 HA11235	2.51	M1024 M1025	2.55	ME555 ME556	0.34 0.75	SAB3023B SAB3024	11.18 4.77	SN76033N SN76105N	2.33 2.36	T9005V T9010V	2.16 0.87	TBA5400 TBA550	1.15 1.95	TDA1910 TDA1940	2.38 2.54	TIP120	0.96 0.48
HA1124	4.78	M1124 M1130	2,54	ME5560N ME565N	3.16 1.29	SAB3209 SAB3210	4.75 2.93	SN76110N SN76115AN	1.13 i 1.46	T9011V T9013V	1.27 5.81	TBA5500 TBA560C	2.25 0.86	TDA1950 TDA2002	2.54	TIP112 TIP117	0.00 0.06
HA1125	3.99	M191	5,74	ME645BN ME646N	3.00	SAB4209 SAF1031	12.75	SN76131 SN76226DN	1.74 i 1.20	T9014V T9016	1.52 0.92	TBA560C0 TBA570	1.15 1.55	TDA2003 TDA2004	1.05 2.52	TIP120	0.73 1.00
HA1137W	2.57	M51102L	4.02	ME650N	3.94	SAF1032 SAF1039	5.60	SN76227N SN76228N	0.88	T9022N T9034V	0.39	TBA570A TBA5700	1.55 1.35	TDA2006 TDA2010	1.25 2.79	TIP126 TIP127	0.96 1.30
HA11414	2.50	M51231P	2.79	MP1106	4.80	SAS5010 SAS580	7.62	SN76231 SN76242	2.31	T9035V T9038V	1.26	TBA625A TBA625B	1.97 1.97	TDA2020 TDA2030	2.75 1.65	TIP2955 TIP29A	0.78 0.41
HA1156	123	M5134-9341	3.75	DA202	0.10	SASS60S	2.97	SN76243	4.75	T9051	2.55	TBA625C TBA641A12	1.97	TDA2140 TDA2150	1.44	TIP29B TIP29C	0.57 0.40
HATISBU HATISBU	3.45	M5142P	4.38	0A90	0.07	SASS70	1.61	SN76360	1.97	T9054V	0.92	TBA641BX	2.07	TDA2151 TDA2160	1.75	TIP3055 TIP30A	0.65
HA1166 HA1167	3.00 5.13	M5144P	3.42	0A95	0.86	SASS705	2.50	SN76396	2.63	T9063V	2.94	TBA673	2.35	TDA2161	1.68	TIP308 TIP318	0.63
HA11711 HA11713	16.13 6.70	M51513L M51515BL	2.06	0C29	0.90 1.95	SAS580	2.62	SN76530P	1,90	TA7020P	4.36	TBA720	2,85	TDA2510	1.82	TIP31C	0.63
HA11714 HA11715	7.05	M51516L M51517L	3.40 2.90	0C35	0.96 1.16	SAS590 SAS5900	4.56	SN 76532N SN 76533N	1.30	TA702/ TA7050	4.30	TBA7500	1.46	TDA2520	2.15	TIP32C	0.66
HA11718 HA11724	6.79 15.80	M5152L M51522	1.00 4,90	0C44 0C45	0.40	SAS680 SAS6800	2.50 1.29	SN 76540N SN 76544	1,300 1.60	TA7060AP	1.56	TBA780	3.00	TDA2522 TDA2523	2.75	TIP34	1.07
HA11725 HA1160	16.80 4.88	M5191P M5192	4.49 2.00	0C75 0N188	0.40 1.70	SAS680S SAS6610	1.29 1.20	SN76545 SN76546	4.55 3.15	TA7061AP TA7069	0.78 2.84	TBA800 TBA810AS	0.00	TDA2524 TDA2525	4.50	TIP418	0.39
HA1203 HA1306	1.56	M53273P M53274P	0.92 1.20	0N236 0T112	2.90 0.98	SAS670 SAS6700	2.50 1.20	SN76546N SN76549	3.15 2.35	TA7070P TA7071	1.52 3.35	TBA810S TBA810T	1.46	TDA2530 TDA2532	2.19 2.51	TIP41C	0.44
HA1322 HA1339	1.74	MA06 MA8001	0.97	0T121 PD144	0.70	SAS670S SAS6710	1.20 1.20	SN76550 SN76551	0.30 1.35	TA7072P TA7073P	1.35 4.05	TBA820 TBA820M	0.83 1.65	TDA2533 TDA2540	2.09 1.95	TIP42B TIP42C	0.71
HA1342	1.80	M83705	1.62	PT1017 PT2014	2.43	SAS6800 SAS6810	2.30	SN76570 SN76800	2.80	TA7074P TA7076P	1.95 4.95	TBA890 TBA900	1.85	TDA2541 TDA25450	1.95 3.16	TIP47 TIP48	0.65 0.83
HA1365	3.65	MB3713	1.30	PT6042	1.82	SBA550B	1.95	SN78611 SN78620	2.35	TA7089N TA7089P	1.41	TBA920 TBA9200	1.50	TDA2560	1.97 2.81	TIP49 TIS43	3.28
HA1367	3.20	MC13002	4,66	R1039	1.99	SC9488P	1.50	SN76622	1.50	TA7092P	3.85	TBA940 TBA950	1.70	TDA2575A TDA2576A	2.95	TIS90 TIS91	0.22
HA1368R	1.65	MC1303P MC1307P	1.50	R2009	1.20	SC9504P	1.46	SN76630	2.31	TA7102P	5.34	TBA970	2.00	TDA2577	5.31	TL071CP TMS1000NI	2.02
HA1370 HA1377	2.97	MC1310P MC1327P	1.25	R2029	1.20	SCR957	1.30	SN76850N	1.24	TA7109	3.37	TBA990	1.65	TDA2582	1.98	TMS3748NS TMS4116	11.66
HA1389 HA1389R	1.82	MC1330P MC1349P	1.23	R2257	1.29	SC613	7.30	SN76860N	2.25	TA7122B/P	0.54	TBA231	2.33	TDA2591	2.80	TV106 TV6010B	1.20
HA1392 HA1397	2.00 2.97	MC1350P MC1351P	1.10 0.75	R2305	1.95 1.07	SG6533	9.37	SN76666N	0.90	TA7130P	1.15	TC4053BP	3.94	TDA2593	2.24	U05G	1.03
HA1398 HA1406	2.88 1.80	MC1352P MC1357P	1.01 1.95	R2306 R2322	1.23 1.26	SI-1020N SI-1125HD	4.76	SN 76705 SN 76705N	3.38 3.99	TA7136AP TA7137P	0.85	TCA160B	1.62	TDA2594	5.00	U3700	0.55
HA17723 HBF4030AF	5.40 2.25	MC1358P MC14001	1.55 7.15	R2323 R2348	1.23 1.82	SI-1130N SKB2/08	6.30 0.79	SN76707N SN76709	3.99 4.65	TA7141AP TA7146P	3.51 8.04	TCA2700	1.55	TDA2610 TDA2611A	2.53	UA723CA	5.02
HD4480 HD44801A05	15.60 15.90	MC14011 MC14013	0.23 0.37	R2354A R2354B	1,82 1,82	SKE2F 1/04 SKE2G 2/04	1.26 0.95	SN76709N SN76730	4.95 4.23	TA7148P TA7149P	1.51 2.10	TCA270S0 TCA290A	1.65	TDA2611A	u 2.55 4.25	UA783P3C	3.00
HM6231 HM6232	8.50 7.71	MC14016CP MC14025	0.37	R2441 R2443	1.23 0.80	SKE2G 3/04 SKE4F 1/02	0.95 1.26	SN76810N SN76920N	0.62 2.63	TA7153P TA7161P	4,53 5,66	TCA420A	1.90 1.65	TDA2620 TDA2630	1.96 2.34	UAA170 UAA180	2.14
HM9102 HM9104	2.92	MC14049UBC MC1438R	0.52	R2461 R2477	2.10 0.92	SKE4F 1/06 SKE4F 2/06	0.66 2.10	SN94041 SN94042	3,45 3,95	TA7162P TA7169	4.25 4.80	TCA4500A TCA530	1.95 1 .90	TDA2631 TDA2640	2.48 2.25	ULN2165 ULN2204	1.35 7.00
HT4207 IS689	15.60	MC14493P MC14510BAL	2.56	R2501 R2540	1.16	SKE4F 2/08 SKE4G 2/02	0.60	SP8385 STA441C	0.50 2.27	TA7171P TA7172P	2.53 1.28	TCA640 TCA650	2.63 1.85	TDA2643 TDA2651	6.93 2.95	ULN2216F UPC1001H	1.95 2.50
IS751	1.87	MC14556BCF MC1712	3.15	R2540X R2615	3.80	SKE5F 3/10 SL 1310	1.45	STK0029 STK0039	3.42	TA7176P TA7193P	2.25 4.44	TCA660B TCA730	2.63 3.84	TDA2652 TDA2653	7.05 2.95	UPC1009C UPC1020H	5.74 2.12
K174YP	2.95	MC7724CP	3.17	RC4195NE	3 1.96 1.82	SL1327E	1.20	STK0050 STK0059	4.96	TA7201P TA7202P	3.25	TCA740 TCA750	2.25 1.75	TDA2654 TDA2655B	2.91 3.15	UPC1025H UPC1026C	2.49
KC581C	5.47	MC7824CP	4.25	RCA16083	4,81	SL1430T	2.10	STK0000	8.32	TA7203P TA7204P	1.95 1.95	TCA760B TCA800	2.79	TDA2660 TDA2661	2.24 2.24	UPC1028H UPC1030H	0.90 2.06
KC583C	4.80	MC78M24	0.85	RCA16335	1.23	SL414	3.35	STK013	7.04	TA7205 TA7208P	1.25	TCA8000 TCA830S	2.25	TDA2670 TDA2670A	2.50	UPC1031H UPC1031H2	8.05
	1.88	MCR106/5	1.17	RCA16799	2.16	SL437	6.80	STK015	5.12	TA7210P	3.25	TCA900 TCA910	1.85	TDA2690 TDA2690A	2.30	UPC1032H UPC1154H	0.94
LATTIAP LA1201	0.90	ME0402	0.27	RCA16902	0.98	SL480	5.00	STK022	4.77	TA7215P	2.09	TCA940E	1.68	TDA2780A	0 2.18	UPC1156H UPC1181H	1.45
LA1210	1.46	MED404/2	0.42	RCA17074	6.00	SL901B	6.08 7.05	STK040	7.09	TA7222	1.95	TCE527	1.37	TDA2791	2.50	UPC1182H	1.82
LA1352 LA1357N	1.40	ME0412	0.45	RCA60857	4.50	SL916A	5.63	STK054	6.40 20.20	TA7229P	4.10	TCE83	0.98	TDA2800	6.12 2.31	UPC1186H	0.95
LA1364 LA1365J	2.74	ME545B	9.10	RT402	1.40	SN16861N-07	1.59	STK077	7.00	TA7313AP	1.36	TCEP100	4,90	TDA3030A	10.44	UPC1213C	0.95
LA1385 LA1387	4.57	ME6002 ME6102	0.45	S0290	1.94	SN16880N	3.30	STK082	7.54	TA7609	3.00	TD190	0.54	TDA33008	7.75	UPC1350C	1.75
LA3155 LA3300	0.90	ME8001 MJ2501	0.26 4.95	S0281 S041P	1.94	SN 16966N	8.13 5.49	STK2101	5.74	TA7676P	3.05	TD3F800H	2.25	TDA3501	10.99	UPC1353	6.75
LA3301 LA3350	1.28	MJ2955 MJ3000	2.15	S042P S1299	4.30	SN29716N	3.32	STK2230	6.66	TAA310A	0.27	TD3F900H	3.78	TDA3510	5.95	UPC1362	7.95
LA3361 LA4030P	1.30 2.37	MJ3001 MJ3028	1.30	S175 S2062D	18.95	SN29717N SN29722	0.53 10.65	STK415	9.35	TAA350A	1.62	TDA1001A	2.10	TDA3521	12.17	UPC1366	4.23
LA4031P LA4032P	3.00 1.48	MJ481 MJ802	1.39 4.95	S2800 S2800D	5.25	SN29723AN SN29744N	6.95 2.98	STK436	5.70	TAA550	0.33	TDA1004A	2.15	TDA3561	7.50	UPC2002	1.48
LA4050P LA4051P	1.42	MJE2955 MJE3055	1.71 0.78	S2802 S3702S	3.15 4.73	SN29764AN SN29767	3. 5 1	STK437 STK439	6.26	TAA611B12	1.50	TDA1005A	2.15	TDA35710	5.67	UPC32C	4.49
LA4100 LA4101	1.62 1.18	MJE340 MJE520	0.44 0.44	\$3703F \$3707	4.73 3.92	SN29770AN SN29771BN	2.04 4.23	STK441 STK443	8.90 9.35	TAA62TAAT	3.31	TDA1010	2.60	TDA3950	2.81	UPC554C	1.68
LA4102 LA4112	2.55 4.35	ML231 ML232B	2.28 3.30	S40W S551	7.99 4.12	SN29772BN SN29773	4.21	STK459 STK460	6.50 5.70	TAA640	3.85	TDA1028	4,44	TDA4050A	3.15	UPC566H	2.78
LA4125 LA4138	2.46 2.00	ML237B ML238	2.28 4.02	S552 S60808	4.12 2.75	SN29791 SN29798N	1.51 3.89	STK461 STK463	7.14	TAA840	2.35	TDA10348	2.20 1.83	TDA4180P	1.74	UPC575C2	3.51
LA4140 LA4192	0.80	ML741CS ML923	0.36 2.18	S8087AR	4.45 4.32	SN29845 SN29848	2.14	STK465 STK466	7.32 10.70	TAA930 TAA970	4.42	TDA1037	1.45 1.96	TDA4280	6.45 4.06	UPC577H	0.64
LA4220 LA4400	1.34	ML0926 MM5314N	3.25 3.72	SAA1021 SAA1024	4.32 2.55	SN29861 SN29862	2.00 2.00	STK501 STK502	5.74 5.74	TAG232-600	1.91	TDA1044	1.51 2,14	TDA440	1.95	UPC592H	1.02
LA4420 LA4422	1.56 1.56	MM5316N MM5318N	3.72	SAA1025 SAA1050	4.70 3.78	SN72709 SN7400N	0.40 0.24	STR441 STR453	6.34 6.75	TAG626-600 TBA120	0.94	TDA1054M TDA1059B	1,10 0,98	TDA4420	4.25 5.63	UPD851	7.56
LA4430 LA4460	1.48	MM5369N MM5387AA/	1.82 /N 11.50	SAA1051 SAA1081	5.30 3.28	SN7401N SN7402N	0.24 0.59	STR6020 T6007V	7.20	TBA120A TBA120AS	0.95 0.95	TDA1060 TDA1062	2.01 2.65	TDA4430	4.34	X0022CE	1,98 3.67
LA4461 LA5112N	2.00	MM5841N MP8112	5.90 1.35	SAA1075 SAA1082	4.41 8.94	SN7404N SN7408N	0.21 0.24	T6007N T6016	0.62	TBA120S TBA120SB	0.95 8.95	TDA1104 TDA1151	5.95 0.65	TDA4432 TDA4440	2.06 2.52	X00351A X0056CE	4.35
LA7020	6.66 7.31	MP8113 MP8512	1.35	SAA1121 SAA1124	4.32	SN7410N SN74121	0.24	T6017 T6018V	0.65 0.65	TBA120T TBA120U	0.95 0.95	TDA1170 TDA1170S	2,15 1,85	TDA4600 TDA4610	2.58 2.42	X0062CE X0065CE	4.95
LA7800	2.12	MPF256C MPS6570	0.54	SAA1130	4.86	SN74122 SN7413N	0.95	T6021 T6022V	0.3 3.5	TBA120UB	3.47	TDA1180 TDA1190	2.25 1.91	TDA4620 TDA5500	4.50 2.48	X0109CE X1074AF	6.10 6.36
LD3120 LM1011N	1.20	MPSA42 MPSA56	0.59	SAA1250 SAA1251	3.78 5.38	SN74141 SN74151AN	1.41 1.51	T6026 T6027	0.85	TBA1440G TBA1441	3.40 1.59	TDA1190Z	2.25	TDA5600 TDA5700	2.60 2.10	XC949P Y730	1.20
LM1017N	1.96	MPSA92	1.11 TED AS	I SAA5000	3.65	SN74154N	1.15 AODEI	1 T6028V	0.35	I TBA240A	3.42 0 ADD (I TDA1220 0.60n PO9	2.25 ST & HAI	I TDA9403	2.90 ADD 159	1 Y969 6 VAT TO 1	0.60 TOTAL
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Simple Pattern Generator

Barry J. Thurlow

This pattern generator was originally devised for monitor alignment and for the go/no-go testing of video switches and cables. For this purpose it provides a standard 1V peak-to-peak composite video signal (0.3V sync pulses) when terminated externally with a 75 Ω load resistor. An Astec modulator can be incorporated however to obtain a u.h.f. output. The circuit is based around a Ferranti ZNA234E TV pattern generator i.c., with additional circuitry for mixing and providing a reasonable 75 Ω output. The whole lot fits into a 705 Verobox which has a compartment for the four 1.25V Nicad batteries used for the supply. The small PCB that holds the circuit has been designed to fit into this box.

Fig. 1 shows the circuit. The ZNA234E generates the patterns by counting down etc. from a 2.5MHz crystal oscillator. Vertical line width is set by an *RC* combination at pin 10 – in practice R8 and the stray capacitance of the pin. These together give a line width of about 100nsec.

The base of output transistor Tr1 is biased at 2.7V by R3 and zener diode D1. This holds the voltage across R4 at a fairly constant 2V. The junction of Tr1 and R4 is used as a current summing point for the video and sync signals.



Fig. 2: PCB print pattern, actual size, left; component layout right. C1 25V axial, C2 6·3V tantalum, C3 and C5 disc ceramic, C4 polystyrene or plate ceramic.

By virtue of the transistor's gain, a composite signal of about 2V peak-to-peak is developed across R2. The various outputs from IC2 are buffered by IC1 (Tr2 in the case of the grey-scale pattern).

If the u.h.f. version is used, the output from the modulator can be connected to the front panel BNC socket. Alternatively a second socket and selector switch could be used. Although the UM1111 modulator should be operated with a 7.5V supply it seems quite happy operating at 5V and quite reasonable results were obtained with the capacitive coupling arrangement shown. There's room in the case for the modulator – it can be conveniently mounted inside the top section above the battery compartment. The modulator's bandwidth is limited, so I wouldn't recommend using its output for signal adjustments. The picture provided is quite suitable for adjusting picture geometry however.

The board was originally designed for use with an ITT single-pole, twelve-way switch (see photos). This however is not a stock item. We suggest the use of an RS 327-951 two-pole, six-way rotary switch mounted on the front panel with wired links to the board. The seventh position originally provided, blank raster, is no longer available. To obtain this feature, pin 9 of IC1 was connected to chassis



View of the unit with top cover removed.

with the other switch positions left open.

The case was obtained from Maplin and the ZNA234E from Technomatic Ltd., 17 Burnley Road, London NW10 1ED. An alternative source for the i.c. is Celdis Ltd., 37-39 Loverlock Road, Berks RG3 1ED (0734 585 171). It sells for around £10.

Suspect Transistors

George Wilding

As a general rule, the presence of normal working voltages at the collector, base and emitter of a transistor will indicate that it's operational. Where the connection is to the supply line or chassis via a low value resistor or the connection is made to a potential divider however the voltage change with a defective transistor may be small. Fortunately the condition of a transistor can usually be checked in situ with near certainty by making forward and reverse resistance checks across the junctions and a collector-emitter check for possible punch-through. On occasion however you get symptoms suggesting that a transistor is faulty even though these resistance checks indicate otherwise. Here are a couple of examples.

The first was an ITT hybrid colour set (CVC8 chassis) with total lack of line and field lock. The sync separator transistor was naturally suspect but resistance checks at the junctions proved it to be in order. As Fig. 1(a) shows, the collector is connected to a potential divider. It should normally record 65V but in this case the reading was nearer 100V. Considering the proportions of the values of the two resistors in the potential divider network, this suggested that the transistor was cut off all the time. Now this wouldn't be caused by lack of signal at its base, since the input to a sync separator is used to develop the cut-off bias (except during the sync pulse periods). The only possibility therefore was that the $3.3M\Omega$ base bias resistor R330 was open-circuit - a high-value base bias resistor is generally used with a transistor acting as a sync separator to ensure that it saturates each time a sync pulse arrives. What usually happens is that the resistor goes high in value, giving weak field lock. Since the 3.3MQ resistor couldn't be checked in situ a replacement was fitted, restoring perfect timebase locking.

The second case concerned a Thorn monochrome set fitted with the 1500 chassis, the fault this time being no

sound and an unmodulated raster. This could have been due to a tuner, i.f. amplifier or a.g.c. fault. Transistors used as a.g.c. amplifiers seem to be more prone to breakdown than those used in i.f. amplifier stages, so the a.g.c. amplifier transistor VT3 – see Fig. 1(b) – was checked. As is usual in a transistor i.f. strip, forward a.g.c. is used, i.e. the controlled transistors are driven on harder as the signal strength increases. Under no-signal conditions the voltage at the collector of VT3 should be about 0.4V. In fact the collector was at almost the supply line voltage. As a result the controlled transistor would be saturated and thus unable to provide any significant degree of signal amplification.

It seemed likely that VT3 was defective, with one of the junctions open-circuit or the base-emitter junction shortcircuit. Resistance checks on the transistor proved that it was perfectly all right however. Further, placing a short from its collector to chassis or to its emitter restored the sound and vision signals. So the cause of the fault was inadequate forward base bias.

The possibilities were an open-circuit or incorrect value resistor in the base circuit, one of the associated electrolytics being leaky or short-circuit, or maybe the a.g.c. rectifier diode W1 leaky (it normally conducts on the tips of the sync pulses only). In fact the diode had a very low reverse resistance, thus placing R34/5 in parallel with R2.

Suspect transistors are often completely innocent!



Fig. 1: Sync separator (a) and a.g.c. (b) circuits.

Goodbye to 405 lines

The first week of January 1985 sees the end of the TV system that established television in Britain ahead of the rest of the world. All remaining BBC and IBA 405-line v.h.f. transmitters will be switched off. Band I (41-68MHz) and Band III (174-214MHz) will be lost to Britain for TV use, though v.h.f. will continue to provide the main TV channels in virtually every other country. The UK alone is firmly committing its TV future to u.h.f. and to direct broadcasting from satellite

in the 12GHz (and later possibly 40GHz) band. It's the end of the black-and-white system with which the BBC launched the world's first public high-definition service in 1936. Its death has been lingering, entering the terminal phase as long ago as November 1969 when the three-channel colour 625-line u.h.f. service came into being. Broadcasters and the trade have had a decade when few used the 405-line transmissions, but those few who did presented problems with spares and the need for cannibalisation to keep ageing sets going.

Performance

Yet surely 405 deserves a respectful and affectionate wake before the final burial. It served us well. It was not the system's fault that low-cost line output transformers subjected many viewers to a penetrating 10,125Hz line whistle, nor that the pictures viewed were too often off-



Back at the beginning: Alexandra Palace in August 1936. The cantilever arms on the mast supported the wire transmitting aerials which were stretched vertically between pairs of arms. Photo courtesy BBC.

grey rather than with correct gradations from black to white due to the use in TV sets of a.c. coupling without d.c. restoration.

At its best, on studio or transmitter control room monitors, 405-line pictures were far from negligible. The positive vision modulation may have been all to susceptible to ignition interference but could give a fine peak white. The $4\frac{1}{2}$ in. image orthicon cameras of the 1960s gave superbly crisp studio and OB pictures. Admittedly the 377 active lines did show the line structure, though the public seemed to have little inclination to eliminate this by making use of the spot wobble circuit that was a feature of some sets.

The 405-line transmissions could be comfortably accommodated in 5MHz of precious r.f. spectrum. The IBA could have provided two nationwide channels in Band III, as originally intended, had not the BBC and the radioastronomers intervened! Even 405-line colour was pretty good, though in the end the IBA (then the ITA) and ITV hopes of putting out colour on v.h.f. were defeated when the BBC convinced the Television Advisory Committee that Sporadic E interference would make colour in Band I a non-starter!

The present 625-line system gives us marginally better pictures of course, but the time to have dropped 405 without tears would have been in 1946, when EMI proposed a 605-line system for post-war television.

History

The 405-line system has served us for almost fifty years, with a six and a half year interruption due to the 1939-45 war. It was "invented" one Sunday morning in 1934 in a private house in the London borough of Ealing, the home of that brilliant electronics engineer Alan Dower Blumlein, a member of the EMI and later the Marconi-EMI research team led by Sir Isaac Shoenberg. Alan Blumlein, a perfectionist, had come to EMI as part of the takeover of Columbia records.

The EMI team started to develop television in the mechanical, low-definition era, but soon turned to the concept of all-electronic TV originally proposed by A.A. Campbell Swinton in 1912. The key element was the development of the Emitron electronic camera – initially started as an independent project but in its later stages gaining significantly from the work in the USA of Vladimir Zworykin at RCA, a firm with which EMI had patent and financial links.

Following months of bickering between Baird and EMI, with the BBC anxious to end its agreement with Baird to operate an "experimental" 30-line service in the medium waveband, the government in 1934 set up a Television Committee, chaired by Lord Selsdon, to consider what should be done, after investigating the work going on in Germany and the USA. In 1935 the committee recommended an early start to a UK v.h.f. service with a minimum of 240 lines, 25 frames. Both Baird and Marconi-EMI were invited to supply the transmission equipment. A Television Advisory Committee would make final decisions.

It was intended that there should be a single standard,

possibly 240 lines as advocated by Baird or possibly 243 lines interlaced as initially proposed by Marconi-EMI. Electronic interlacing to reduce flicker had been patented by RCA, although an earlier form of mechanical interlace had been used by Baird and others. But the war between Baird and Marconi-EMI could not be resolved. To compound the problem the EMI team next proposed not 243 but 405 lines.

Back to the house in Ealing where, one Sunday morning in 1934, Blumlein, Cork and Eric White had met to discuss how to breadboard a suitable waveform generator to test a system that would put EMI significantly ahead of the Baird company. Baird's 240-line system was developed partly by Captain West and drew on techniques developed by Fernseh in Germany, a company which was loosely linked with Baird. The easiest way of up-grading the 243-line interlaced system proposed by EMI, while retaining this system as a basis for comparison, was simply to change one divide-bythree circuit into a divide-by-five one. Since $243 \times 5/3 =$ 405, this was the system developed and later confirmed by Shoenberg and put into the specification offered to the BBC.

The TAC urged Baird and Marconi-EMI to agree on a single standard, but eventually agreed that both the 240-line, 25-frame sequential and the 405-line, 50-field interlaced systems should be used alternately. It was to be a fight to the bitter end. Baird lost largely because of the inflexibility of his "live" system using the intermediate, fast-processed film technique that had been developed in Germany. He also hoped to use a Farnsworth 240-line image dissector electronic camera, but this

Postscript

Nick Lyons

As I write this the 405-line system is almost at the end of its career. Few people in large urban areas like mine stayed with it to the end, though the odd set has survived – the subject of some sentimental attachment maybe, or as a second or third set in the kids' bedroom, or possibly propped up in the local chippy. It's in circumstances such as these, often with the most pokey bit of knitting needle or coat-hanger to serve as an aerial, that the ability of this v.h.f. system to provide a passable picture come what may proves itself.

As no new sets capable of receiving this standard only have been made for some fifteen or more years, most of the survivors of this breed inevitably now look tired. The same seems to be true of the equipment at the transmitting end. The standards converters used seem to be prone to a variety of problems, with vertical lines of missing picture elements, vision level changes, hum and so on. It's nothing like the quality achieved when origination was on 405 lines.

It's rather sad that the system should end like this. Younger engineers who looked at a surviving set must have wondered how on earth we ever put up with that sort of picture quality. But at its height, from the midfifties to the time of its supersession in the late sixties, the system provided very fine pictures indeed. The fifties saw Mullard and Mazda perfecting the display tubes, with a high standard of both picture quality and reliability, while the English Electric Valve Co. brought proved to be a disaster. Baird's 240-line mechanical film scanner (telecine) on the other hand provided better pictures (though with more flicker) than the original Marconi-EMI telecine.

The 240-line Baird system was dropped in February 1937, leaving the way open for the progressive improvement of the 405-line pictures, continuing right up to the 1960s. But it took time for the pre-war public to accept television as an entertainment medium capable of challenging the then dominant cinema. With screens only 12in. or smaller, apart from a few early projection models, and the cost of a set approaching that of the £100 Ford motor car, it was almost three years before the number of domestic sets in use increased from the initial 300 to 20,000. The BBC was committed to radio rather than television, and the service narrowly avoided extinction. It finally ground to a halt on September 1st, 1939, starting again with the Victory Parade in June 1946.

Sadly, few of the major pioneers of British TV lived to see its post-war success. Baird died in 1946, with his major wartime work on colour largely overlooked. His associate Captain West met with a mountaineering accident at about the same time. Blumlein was killed flight testing airborne radar in 1942. Campbell Swinton died before television was even born. Schoenberg lived on till 1963, Zworykin till 1982. Professor McGee who pioneered the Emitron camera, and Lubszynski of CPS Emitron fame, have happily survived. As also has Dr. Eric White, who was actually present at that meeting in Ealing fifty years ago when the 405-line system was born.

about a revolution in the camera field with their $4\frac{1}{2}$ in. image orthicon tube. This was to become the workhorse of monochrome (or black-and-white as we called it then) television world wide. It was developed by EEV at the BBC's behest for the 405-line system.

Commercial TV also first came to us in 405-line form. This competition stimulated the BBC to produce some very fine programmes indeed. ITV brought some dross but also introduced us to much that was new and innovative, and gave us a taste for the output of that prolific industry across the Atlantic.

But the 405-line system rendered us a TV island. Being so different from any other system, no one else bothered to make sets for it. Mind you in the fifties abroad in electronics meant Europe or the USA: the Japanese industry was just beginning to dabble with transistor radios. UK setmakers had a captive market, and though there was much innovation it was almost a cottage-type industry. Who was to step in and upset this comfy situation? It was the Pilkington committee's report that led to the changing face of the British television industry.

Pilkington signalled the end of 405 lines, though even then it had given us a quarter of a century of service. It brought information and entertainment to millions, whatever your taste, from Quatermass to Perry Mason, Dick Powell theatre to What's my Line, be it Kennedy in Berlin or being shot in Dallas, the excitement of the Tokyo Olympics and pictures via Telstar, the nation rejoicing at a Coronation or the nation in mourning as a barge solemnly carried Sir Winston down the Thames for the last time. All this was brought into our homes by the system that was developed in the early thirties by that brilliant team at EMI.

Video Servicing

Mike Phelan

Last month we looked at a few minor bits of camera electronics – items that have nothing to do with actual signal generation. This month we'll consider first the overall camera system – see Fig. 1.

Overall Camera System

We might as well start at the 12V input line. This input is usually stepped down to 9V via a simple series regulator - one or two transistors, an operational amplifier and a zener diode. The unregulated 12V supply is used for the zoom and iris motors. The various high voltage supplies required for the vidicon tube are often generated by an inverter driven by one of the signals from the SSG – sync and subcarrier signal generator. We'll move over to this section next, but in passing should mention that the electronic viewfinder consists of conventional though small self-contained a monochrome receiver whose high-voltage requirements are generated in the line output stage in the usual manner.

Sync and Subcarrier Generator

Most video cameras of the type we're discussing use a dedicated chip, type HD44007A, in the SSG department (see Fig. 2). Few extra components are required. The output from the free-running crystal oscillator linked to pins 24 and 25 is divided by four within the chip to produce the 4.43MHz chroma subcarrier which emerges at pins 26 and 27 with the correct phase for V (R - Y) and U (B - Y), the V subcarrier being switched through 180° on alternate lines as required for PAL signal processing.

The LC oscillator – pins 3 and 4 – runs at 282 times the line frequency and is locked to the 16MHz crystal oscillator by a phase detector within the i.c. and an external varicap diode – the filter components are connected to pin 6.

Most of the other i.c. pins provide various outputs at



Fig. 1: Block diagram of the electronics of a typical video camera.

line and field rate. It may be stating the obvious, but the deflection signals that drive the tube's yoke must be in synchronism with the composite sync added to the camera's outgoing video signal. Line and field drive emerge at pins 8 and 7 respectively and go to their respective output stages. The 7.8kHz output at pin 20, if used, drives an inverter for the high-voltage supplies – otherwise these supplies are obtained from the line output stage as in a TV receiver. The various outputs can be buffered or inverted by CMOS logic gates – if this isn't done it's necessary to fit small-value capacitors, typically 27pF, from each pin to chassis to remove spurious clock pulses.

Deflection Arrangements

The deflection arrangements used vary from one model to another. Very little power is required and of course the signals are already locked to the master crystal oscillator. A simplified circuit of the arrangements used in the 3V17 is shown in Fig. 3 – this camera uses a driven inverter to provide the tube's high-voltage supplies.

The field output stage is contained in IC2, an operational amplifier. Part of IC5 acts as an integrator whose sawtooth output is fed via the height control to the non-inverting input of IC2. Negative feedback from the output to the inverting input enables the linearity to be adjusted – this is more important than in a TV set, for reasons that will become apparent when we come to the chroma encoding. There's a conventional shift control and C11 with R19 provide a path to chassis for the scanning a.c. The parabola generated across R19 is fed back to provide additional linearity correction.

The line output circuit is in two halves. Transistors X1 and X2 are driven by the line drive pulses from the SSG and in turn drive the line output transistor X3. When X3 conducts, the current in the output transformer T1 rises exponentially. X3's collector is coupled to the scan coil via C4. The rate of change of the current flowing in T1 is governed by the conduction of X4 and X5, this in turn being dependent on the setting of the width control. The other end of the scan coil is driven by a linearising



Fig. 2: Outputs from the HD44007A sync and subcarrier signal generator i.c., and the external oscillator components.

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Fig. 3: The deflection and high-voltage supply arrangements used in the Ferguson 3V17 camera – simplified circuits. (a) The field timebase. (b) The line timebase. (c) Inverter used to provide the high-voltage supplies.

sawtooth current produced by IC4 and IC1, the latter having a feedback linearity control. At the start of the flyback X3 is turned off and the scan coils resonate with C3. The efficiency diode D1 conducts to damp the overswing in the usual manner. L1 and R8 isolate the a.c. component from the shift control.

What happens if one or other of the timebases fails? No, you don't get a display of line or field collapse on



Fig. 4: Simple audio amplifier used in the 3V17.



Fig. 5: Video preamplifier circuit used in the 3V20.

the monitor! Consider failure of the field scan. You might think that the vidicon will produce a single line which will be repeated on every line of the monitor's screen – such a display would consist of vague vertical lines. Since the vidicon's target would be ruined in a matter of seconds, protection circuits that monitor the scanning and shut off or reduce the beam current in the event of scan failure are generally incorporated – just one thing to look for when servicing. Only field scan failure protection is required in cameras where the vidicon's supplies are derived from the line output stage.

Audio Channel

The audio circuit is self-contained and independent of the rest of the electronics – all it has to do is to amplify the signal from the microphone to a suitable level. A typical circuit is shown in Fig. 4.

Video Preamplifier

Now to the video circuitry, starting at the front – the head preamplifier, see Fig. 5. This has to take the minute signal from the vidicon's target and amplify it while adding as little noise as possible. In this example the first stage consists of a cascode f.e.t. arrangement – X101-3. It has the advantage of very high gain with low noise and excellent linearity. The gates of X102/3 are a.c. coupled to the target as the latter requires a d.c. bias of about 25V, supplied via R101. The reason for using two f.e.t.s in parallel is to reduce noise: as the noise is random, some of it must cancel out – this applies only to noise produced by the f.e.t.s of course. X103 was omitted in later production. X104-7 comprise a direct-coupled amplifier from which feedback is taken to the gate of X102, adjustable by C107. L101 is toroidally wound on a ferrite core and is included to compensate for the capacitive signal source (the target). X106's emitter is not decoupled so that the gain of this stage can be modulated by a waveform derived from the deflection circuits. This waveform is also used for dynamic focusing – it consists of field- and line-rate parabolas. The reason for applying it to the preamplifier is to increase the gain at the edges of the picture to compensate for the slight darkening that would otherwise

occur. This feature is not used in many cameras.

The entire preamplifier is enclosed in a heavily screened box which is attached to the vidicon's shield – the connection to the target is less than half an inch long. Note that the output is labelled "CMS": this stands for colour multiple signal – next month we'll discuss how the colour information comes to be there and how it's encoded to provide a conventional PAL signal.

Servicing the solid-state Indesit T24EGB

Mike Phelan

The 24in. solid-state monochrome Indesit Model T24EGB (chassis C) looks similar to its hybrid predecessor (Model T24EGB, chassis B) both inside and outside, but there are a great many differences. Gone are the mechanical tuner and rotary controls, but there's still a row of wirewound resistors along the top edge of the chassis, and as before they do their best to burn holes in the panel. Still present is the aerial socket that backs away from you when it's approached with a plug, due to the mountings bending.

Chassis Arrangement

The chassis consists of a long, narrow vertically mounted PCB that hinges down to a horizontal position. It looks like the PCB used in the ITT VC200 or GEC Series 1 chassis. The i.f. strip, which consists mainly of a TBA440C i.c., resides in the larger of the two cans along the edge of the panel. The small can houses the TBA120 intercarrier sound i.c. Although most of these Italian made sets should have been converted, one or two slipped through with 5.5MHz filters fitted - a coil and capacitor conversion was available from the manufacturers, or 6MHz filters. Sibilance can be reduced by changing the value of Cl314 in the intercarrier sound can from 0.022μ F to 0.047μ F. There are separate modules, each with a TBA800 i.c., for the audio and field output stages. These modules are interchangeable - quite often a TBA800 that gives slight sound distortion works o.k. in the field output position. All cases of sound distortion can't be blamed on the chip however - the speaker can give problems. Another module contains the TBA950 sync/line oscillator i.c. and its associated components.

Circuit Features

Before going farther, a brief description of the circuit, which has some unusual features. The power supply is shown in Fig. 1. Mains rectifier D901 is followed by a series of dropper resistors that supply 170V to the collector of TR901. This transistor, in conjunction with R906, R928, TR902 and the 6.2V zener diode D904, reduces the h.t. to a reasonably stable 120V. This is the supply to the line output stage – the set's other supplies are derived from the line output transformer. The 120V rail is set by R911 which acts as the width control (set for 120V at TP20).

D905 produces 30V across its reservoir capacitor C913. R921/C912 drop this to 25V for the field output TBA800 while R923/C916/D907 (12V zener diode) produce a stabilised 12V supply for most of the rest of the circuitry. R924/C919/D909 (12V zener diode) produce a stabilised supply for the timebase oscillators. D906 produces 26.5V across C917: R922/C908 and the shunt stabiliser consisting of TR903/D902 and associated components produce a regulated 13V supply for the audio output TBA800 – this helps to stabilise the current demand from the line output transformer, as the current drawn by the audio output TBA800 is a function of the volume.

Note that the negative side of C901/2/3/4 (common can) is connected to chassis via C921. The 2.6V present across C921 is used as the start-up supply.

Apart from the TBA800, the field timebase consists of a unijunction transistor oscillator (TR401, type 2N4871) and the flyback switch transistor TR501 (BC327). If the BC327 goes short-circuit the result will be severe top foldover. The unijunction transistor can cause field jitter – so can the sync separator bias resistor R1406 ($1.8M\Omega$) on the TBA950 module.

The line driver and output stages (see Fig. 2) look very strange – there's no driver transformer for a start. The output from the TBA950 switches TR402 on and off. When it's on, TR403 and TR404 are off. When TR402 is switched off, TR403 and TR404 can conduct. The key to this is D401, which produces some 4.6V across C406 during normal operation. In addition, C404 is charged by TR404's emitter current. When TR403 switches on C404 is discharged and the emitter of TR404 is at almost chassis potential. The arrangement is self-stabilising up to a point, as the voltage produced by D401 to forward bias the bases of TR403 and TR404 is dependent on the line output transformer's load.

Common Faults

So much for the theory, now for the problems. The usual one is a dead set. In this event check all the wirewounds in the power supply for being open-circuit or having dry-joints – they sometimes burn holes in the PCB. If all is in order there should be 120V at TP20 – check here or at one end of R907 – and a similar voltage at the collector of TR404. Next check pin 8 of the line oscillator module for a burst of line frequency squarewave at switch on – if this is absent, a 9V battery connected across C919 will supply a start-up voltage for the oscillator. If every-thing sounds strained, switch off. A feature of this system is that if anything stops the line output stage working the 12V l.t. rail will disappear and stay that way until the set is switched off, R925 discharges C903/C921, and the set is then switched on again.

A short-circuit BU205 will open the fusible resistor R902. Other line output stage faults give the h.t. present but otherwise dead set symptom. The most common fault



Fig. 1: The mains input and h.t. supply circuitry. The mains filtering components may not be fitted in UK sets.



Fig. 2: The line output stage, showing the various supplies derived from the transformer. R922 may be 27 Ω , 6W with R930 12 Ω , 4W in series.

of this type is a defective e.h.t. stick – unfortunately it's in the line output transformer. All the large resistors in the line can are worth checking for dry-joints or being opencircuit, as are TR402 and TR403. If the line oscillator isn't working, check Cl407 (0.01μ F) and the TBA950.

Nothing will happen if the 2.6V supply is not generated across C921.

If there's no supply to the audio output stage, check D902 (ZPD12) and TR903 (BD433) in the shunt stabiliser circuit. Repeated failure is due to R920 (33Ω) going opencircuit. The line/field oscillator supply regulator D909 (ZPD12) is prone to going leaky.

The signal sections are fairly reliable. The tuner occasionally fails, as also do the video driver transistor TR201

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(BC238B) and the video output transistor TR202 (BF257), failure of TR201 giving a negative picture.

The on/off switch sometimes falls to bits – or the contacts burn out. It's a special type unfortunately.

Spares

Spares, including the line output transformer, for the T24EGB chassis C can be obtained from RTC International Ltd., Victoria Parade, Urmston, Manchester (telephone 061 748 1129). Certain spares for other Indesit TV sets can also be supplied (excluding the mains lead and aerial plug for the T12). Spares can be supplied only as long as present stocks last.

Colour Bar Program

G. J. Phillips, B.Sc., C.Eng.

The standard BBC Model B microcomputer can be easily programmed to generate the colour bar test pattern (see below). This may seem like using a sledgehammer to crack a nut, but many establishments now possess a microcomputer that may stand idle for a lot of the time. The program consists of only eleven lines of basic and can be typed in a few minutes.

Line five clears the screen and line six calls up mode two of the microcomputer to facilitate colour graphics. The Move and Plot commands are used to generate a scries of triangles which are joined together to form vertical rectangles. Line fifty is an algorithm to convert the rectangle or bar number to the correct colour number recognised by the computer. This number is called up at line sixty. Line 100 is merely a dummy statement which is

MISFITS

Richard Roscoe

Well over half the sets that come my way turn out to have more than one fault. In line with the modern mania for giving everything a fancy name I call them MISFITS (Multiple Independently Situated Faults in Television Sets). You know the type of thing I mean. The set finally packs up and after you've been called in to replace the tripler or whatever and got it going you find that the tuning drifts, the volume control crackles, or there's a bad hum bar. When you tackle the owner about it you get something like: "Well it's been like that for a while but I didn't think it was worth bothering about, not at today's prices anyway. Mind you, now you're here . . ."

In many cases these secondary faults are the work of moments to put right. On the other hand some can take much longer to fix than the fault you were actually called to see – and woe betide you if you try to charge for this extra work. "How much?? – the whole set's not worth that!" I recently had a concentrated burst of these MIS-FITS. They made a complete mess of an otherwise perfect summer's day.

The Thorn 3500

It started first thing in the morning. Everything was bright and clear – except in the back of a Thorn 3500 where things were decidedly wintry. According to the owner the set had gone off without any warning the previous night. The thermal cutout hadn't tripped and none of the fuses had blown, so I switched on. Meter checks showed that power was getting to the chopper transistor and that the 30V line was working. Further checks soon revealed that the chopper driver transistor was without collector voltage due to R607 being opencircuit – it's part of the "dropper". Well, it's nice to start the day with an easy one. Switching on after replacing the dropper produced sound and a good picture – but no colour. I turned to the owner who was hovering behind. jumped to at line 110: this is done to avoid the computer's prompt appearing - it would contaminate the graphics.

The u.h.f. modulated output can be plugged into the set's aerial socket just as for normal operation. In addition, the BBC microcomputer has a composite video output which can be connected to the video input socket of a VCR to enable the pattern to be recorded for future fault finding use.

Program

- 1 REM TV COLOUR BAR GENERATOR. G.J. PHILLIPS
- 5 CLS
- 6 MODE 2
- 10 MOVE 0,1000
- 30 PLOT 85,0,0
- 40 FOR bar=1 TO 8
- 50 IF INT(bar/2)=bar/2 THEN colour=(8-bar)/2 ELSE colour=(8-bar)+INT(bar/2)
- 60 GCOL 0,colour
- 70 PLOT 85,(bar*160),1023
- 80 PLOT 85,(bar*160),0
- 90 NEXT bar
- 100 REM
- 110 GOTO 100

"Ah" he said, "it does that. If you twiddle the tuner it'll come back."

I could see the set was on tune so I ignored that. Instead I concentrated on the decoder board. Tap, tap on the top of the board and R312, one of the small presets in the burst detector circuit, fell apart. I prodded the rest of the presets but they remained intact. So far so good, out with the remains of R312 and in with a new $47k\Omega$ preset. Colour was now present but was unsteady: the hue was correct but the saturation was going up and down like a yo-yo. I was beginning to wish I'd not started on the set.

I took a deep breath and tried to think. If the hue was correct, most of the decoder circuitry would be in order (burst channel, reference oscillator, etc.). Obviously the gain of the chroma amplifier was varying, which could have been due to a fault in the colour-killer department. The colour-killer action depends on the operation of the ident amplifier (no ident, no turn-on bias, no colour). Voltage checks took me back to the ident amplifier but the d.c. conditions here were correct. So, lacking a scope, I tried bridging the decoupling capacitors. First time lucky: the transistor's emitter decoupling capacitor C321 (0.22μ F) was faulty. A replacement restored good, steady colour: so much for the easy ones.

The GEC C2110

I headed for the next patient on the list, a GEC C2110 (plastic) series, with high hopes. It's one of my favourite designs though getting a little long in the tooth now and the fault on the card, picture rolling, is a stock one – C452 (4.7 μ F) in the field sync circuit. I always go equipped with replacements for the other electrolytics on the field timebase panel, C455 47 μ F, C457 47 μ F, C458 22 μ F and C462 220 μ F. These usually cure the sagging height and bottom cramping the customer didn't bother to mention. My foresight was well rewarded – they were all well past their best in this particular set.

"Super" said the customer as I set up the picture. "I don't suppose you can stop the hum while you're here?" "Hum?"

"Yes, in the quiet bits you get this hum. It's not too bad but I thought, you know, while you're here" Turning down the volume control (noisy, so out with the trusty Servisol) I found that there was indeed a definite background hum. Another electrolytic showing its age? Bridging C195 (100 μ F) which smooths the 24V supply to the audio output chip made no difference, but bridging C121 (150 μ F) which smooths the 12V supply to the intercarrier chip did. In went a spare 220 μ F, the nearest value I had.

Amidst smiles all round – i.e. the customer smiled, having got two repairs for the price of one; I had more of a fixed, glassy grin – I set off for a Sanyo CTP3101 colour portable. By now I was feeling that this was not my day, and though the reported fault was uncontrollable volume I feared the worst. I was not disappointed.

The Sanyo Colour Portable

As I approached the house I could hear Play School, accompanied by a chorus of blood-curdling screams. The door was opened by a haggard mother who greeted me with obvious relief. Apparently the opportunity to watch tele with the volume at full blast without getting whacked for it was too good for her offspring to miss – and they'd asked all their friends around to join in the fun.

Like most modern sets this one uses a variable d.c. voltage for volume control, acting on a voltage-controlled amplifier within a chip, in this case IC161 (AN340). The voltage at pin 4, from the volume control, was o.k., so in went a new chip. The sound was now under control and the lady of the house cheered up enormously, which is more than I did when I caught sight of the picture. All the faces were green.

"The ident's wrong" I squawked.

"Pardon? Oh you mean the tuning." She twisted the rotary tuner and brought it back with perfect colours. "It sometimes comes on with funny colours but I can always get it right. I shouldn't bother about it. Now how much do I owe you for the new volume control?"

It was an emotional moment. Was I to leave this longsuffering paragon of virtue with a faulty set? Of course not! It seemed likely that the flip-flop controlling the R - Yswitching was not being synchronised by the ident signal. The relevant circuitry is contained in IC252 (TA7161P), and since Sanyo kindly fit holders for their chips it was easy to verify that this was indeed the culprit.

The GEC Series 1

I managed to get back to the van before the kids could let my tyres down. Things were looking up, or so I thought. The next call was to another GEC set, this time a 20in. monochrome one (Series 1 chassis). The fault on the card was the opposite to that with the Sanyo – almost nonexistent, very distorted sound. I realised that I was in for my fourth consecutive MISFIT when the picture came on – rolling badly. The owner cleared his throat, but I got in first.

"Rolls, does it?"

"For a bit, then it stops. I thought, while you're here \ldots "

I wearily opened the valve case. Into the set went a new PCL805 and a PCL86. This stopped the rolling but the sound was as bad as ever. Voltage checks then revealed that the audio output pentode's screen grid was without voltage, due to R152 ($6.8k\Omega$) being open-circuit. Replacing this brought the sound up to the normal level with no distortion. Finished, I thought. Not a bit of it. Now the

picture wasn't rolling I could see that the bottom was cramped.

The usual causes of bottom cramping with a valve field timebase are the components in the output pentode's cathode circuit. The resistor can change value and the decoupling capacitor can dry up. In so doing they put more strain on each other and the valve, so that the process is cumulative. The cramping in this case wasn't too bad and the owner hadn't noticed it. Nevertheless the resistor (R208) had fallen in value from 390Ω to 200Ω and the capacitor (C207, 250μ F) appeared to be on its last legs. So both were replaced.

The Rank Z718

The final MISFIT was a 26in. Bush Model BC6438 with the Z718 chassis, touch tuning and remote channel change. There'd been a loud crack (damp in the e.h.t. section) after which the set had stuck on Ch. 1 with only snow and noise. This one couldn't be dealt with in the field, so I whipped it back to the workshop where I could dismantle the difficult-to-get-at Z916B touch tuning unit in safety.

The heart of the unit is an ETT6016 i.c. which performs the channel-switching action. There are two associated transistors, 9VT1 (BC157) which acts as a shunt stabiliser for the i.c.'s supply and 9VT2 (BC147B) which is used to ensure that Ch. 1 is selected when the set is first switched on. In view of the fact that the set was stuck on Ch. 1, 9VT2 seemed a likely culprit. A replacement restored channel selection but a couple of channels were faulty. So in went a new chip. Finally 9VT1 was leaky, pulling down the tuning line but not the supply to the i.c.

After all that plus drying out and cleaning the e.h.t. stick and its holder I set about tuning in a picture. Up it came – with very bowed sides! No one had mentioned this of course. So over to the EW modulator circuit.

None of the controls had any effect, while the modulator diodes 5D5/6 and the driver transistor 4VT19 all read o.k. on the meter. Voltage checks took me right back to the first transistor in the control circuit, 4VT15, which was off due to lack of base bias because 4R58 ($82k\Omega$) was open-circuit. This resistor is used to provide the basic width/e.h.t. stabilisation in the set, being fed from the 260V line.

All I had to do after this was to resolder the deteriorating joints on the line timebase plugs and set up the field linearity – about par for the course – then return the set to its owner.

What a day!

Book Notice

A new edition (the third) of **Beginner's Guide to Colour Television** has been published by Newnes Technical Books at £4.50. The first edition of this book was published as long ago as 1964. This latest edition, revised by Eugene Trundle, is thoroughly 1984 however. Much of the material in earlier editions has been condensed and a great deal of new material has been added. Thus we get for example single-chip decoders, the latest types of colour tubes, teletext developments (CCIR levels 1–5), MAC, high-definition TV and worthwhile sections on satellite and cable TV. A good introduction to current TV technology.

VHS Hi-Fi Sound

Both VHS and Betamax machines with hi-fi sound, based on the use of f.m. and recording with rotary heads, are now available in the UK. This article deals with the system used in VHS machines, with particular reference to the Panasonic Model NV850B.

Principles

First the principles involved. The stereo hi-fi sound is recorded on the tape as f.m. by two heads mounted on the video drum assembly. The signals are recorded beneath the normal video signal – or to be more accurate the video signal is recorded on top of the sound signals. The left and right carriers are at 1.4MHz and 1.8MHz. The arrangement of the head drum is shown in Fig. 1: the audio heads are mounted 60° round from the video heads and have an azimuth of $\pm 30^{\circ}$ (this compares with $\pm 6^{\circ}$ for the video heads). In addition, the sound head track with $+30^{\circ}$ azimuth is laid down beneath the video head track with -6° azimuth, thus giving a 36° difference to minimise crosstalk.

The sequence in which the tracks are laid down is shown in Fig. 2, starting with audio head 1 which lays down a 26μ wide track. The next head around is video head 2 which lays down a 70μ track on top of the audio one. The audio track is more strongly laid down however, using a higher record current and lower frequency. The f.m. video signal erases the upper part of the audio track but the audio is still present at a deeper level in the tape, as shown in Fig. 3. Audio head 2 next lays down a track, erasing the edge of video track 2. Finally video head 1 records its track, further erasing the edge of video track 2 and the upper part of audio track 2. We end up with 49μ wide video tracks that have 26μ wide "buried" audio tracks at their centres. Note that audio tracks 1 and 2 are not left and right: both audio signals are recorded by each head. The audio tracks are laid down at the centre of the video tracks to avoid crosstalk - if the audio track was to stray on to the adjacent video track the azimuth difference would be reduced from 36° to 24°.

The audio f.m. level on playback is lower than the video f.m. level, because of the lower frequency and the fact that the video is recorded on top. As a result, there's a danger that drop-outs may occur. To overcome this problem the f.m. detector is followed by a hold circuit which keeps the signal at the same level until the drop-out has passed. By passing the output from the hold circuit through a low-pass filter to smooth out the "kink" effective drop-out compensation is achieved – see Fig. 4.

A problem with having two rotating heads is that you must be able to switch from one to the other. For video switching the PG pulses are used. The same pulses are



Fig. 1 (left): Positions of the video and audio heads in the drum. **Derek Snelling**

used for audio head switching after being shifted by 60° to allow for the different positions of the heads. A further problem arises however because the switching point introduces noise. For video, the switching is arranged to occur off screen during the field blanking period. You can't do this for audio, so the hold circuit is used to maintain the audio during head switching, the head switching pulse being applied directly to the circuit.

Practical Aspects

So much for the theory. Now for a few details of the Panasonic NV830/NV850. The sound is also recorded on the standard linear track for compatability with other VHS machines/tapes but the linear track is mono only. The f.m.



Fig. 2: Sequence in which the tracks are recorded on the tape, starting with audio head one.





Fig. 4: Overcoming the effect of an audio drop-out.



Fig. 5: Drum assembly, Panasonic Model NV850.

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sound signals are passed through record level circuits that have a ganged level control with a "click" normal position: left and right record-level meters are provided. The linear audio circuit is the same as with ordinary machines. Recording can be done from the off-air TV or an external source – straight audio, a camera or a simulcast transmission (simultaneous TV and radio broadcast).

It follows from this that the machines can be used as high-quality sound only recorders. This raises a problem in that without video there's no field sync pulse to which the heads can be locked, so in this mode the field sync input to the servo is earthed and a 50Hz signal counted down from the 4.43MHz oscillator is used instead.

During record the TV set can be used to monitor either the f.m. or linear sound track – when monitoring the f.m., the E-E sound level varies with the setting of the record controls. A noise reduction system is used during both record and playback to achieve a dynamic range of 80dB. Audio dub is available but operates with the linear track only: this means that you can have a tape with a stereo track and a separate commentary on the linear track or three separate mono signals – useful perhaps for multilingual recordings. Ch. 1, 2 or linear can be separately selected during playback, which can be either via the TV set or an external sound system.

If a non hi-fi tape is played on the machine or the f.m. output from the heads drops below 50 per cent an f.m. mute circuit switches the machine to linear sound.

The f.m. sound will be affected by the tracking control of course: as the track width is narrower than that for the picture the setting is more critical – because of this one of the record-level meters doubles as a tracking meter during

Table 1: Performance comparison.

Characteristic	Linear operation	Hi-fi operation
Relative speed Dynamic range Frequency	23.99mm/sec 50dB	4,850mm/sec more than 80dB
response Wow and flutter	80Hz-8kHz 0·2%	20Hz-20kHz* less than 0·005%

* The hi-fi frequency response is deliberately limited to 20kHz by bandpass filters.

the playback of f.m. sound (the f.m. output is fed to the meter via an a.c. to dB converter). As the audio track is in the centre of the video track, optimum audio tracking should correspond with optimum video tracking.

One of the differences between the NV830 and the NV850 is that the latter has an extra video head for super fine stills etc. Because of this the mechanical arrangement of the video/audio head assemblies used in the two machines differs. The NV850 has a separate rotating transformer mounted above the video heads for sound pick-up – see Fig. 5: the NV830 has them all combined beneath the video heads. This is probably because with five heads (NV850) crosstalk could be a problem with a combined transformer whereas with four heads (NV830) the windings can be "spaced out" more so that the problem does not arise.

Performance Characteristics

Table 1 compares the performance figures for conventional linear and hi-fi sound operation.

CAPACITORS	68 Grundig 3010/15003.09	179 TDA2532 2.40 180 TDA2540 1.85	030 GEC 2100 Hybrid 4.00	SPECIFIC COMPONENTS	390 G8 Metal Mains	460 ELC1043/06 Tuner	
Chessis 1.50	70 Thorn 8500 5.40	181 TDA2541 2.67	Chass. 14.50	351 Thorn 1591	391 G8 Line Stor/Eol	461 U321 New Tuner 7.95	
92 10 × 220MFD 16V	71 Philips G8 6.30	182 TDA2560 3.28	033 Philips KT3 8.00	252 Thorn 1600	Coi 2.25	462 U322 New Tuner 7.95	
Elect 0.50	72 Pye 731 4.50	183 TDA2571 2.15	034 RRI T24 Chess. 14,00	Dropper 0.50	392 G8 R/G Symetry	463 98003 Posister 0.99	
Mul Pol 0.90	Can 200	185 TDA2593 2.23	037 Split Diode FHT	353 T × 10 Preset	Coil 3.33	465 Muli 0150 Delay	
94 5 × 4.7/100V C514		190 TDA2600 4.00	Leed 1.35	Drawer 3.00	397 20 × 3.15A A/S	Line 0.95	
T3500 1.25		191 TDA2611 1.24		354 T × 10 CRT Base	200 μ 1.30 μ 1.30 μ 2.00 μ 2.	466 5 × VA1104 2.70	
95 5 × .47/1000		192 TDA2640 2.35		Asay 4.39	20mm Fuse 1.50	469 CUT UUT Metal GEC	
97 10 × 01/2000V	÷	210 ET INDIG 2.20	PUSH BUTTON UNITS	355 3" Round &R	399 20 × 2.5A A/S 20mm	470 5 × GEC2100 3 Lap	
W/E 2.00	INTEGRATED CIRCUITS	212 BTT6018 2.28	110 Pye 713 4 Way 7.87	Speaker 1.30	Fuse 1.49	Thermist. 1.00	
98 5 × 1/250 Supp ITT	141 5 × TBA120AS 1.80	220 SL901B Int Circuit 5.00	111 Pye 715 6 Way 11.55	358 5 × Thp/3500 200	400 20 × 2A A/S 20mm	479 5 × Gen. Purp. Ro-	
etc. 1.30	142.5 × TBA540 4.00		113 Phil G8 Sloping 14.98	260 E V The 2600 Emp	401 20 × 1A A/S 20mm	480 5 × Gen. Purp.Push/	
ENT TRAYS	143 5 × TBA5400 4.00		114 Thorn 9000 2.50	Conv Pot 100	Fuse 1.40	Swtch. 3.75	
51 Decca 1730/1830 5.00	146.5 × TBA360 3.50	LINE OUTPUT TY	115 Thorn 1615 4 Way 7.87	360 5 × TCE3500 A1	402 20 × 1.25A A/S	481 20 × Neons GEC	
52 Decca 60 Series 4.50	147 5 × TBA9200 4.50	ODI Philipe G8 750	117 Decca & Way 550	Rectifier 0.75	A03.5 × RRI T20 Tube	AR2 5 v Univ Aerial Skt	
53 GEC 2040 Hybrid 3.89	148 5 × TBA990 3.25	002 Decca 30 Series 7.80	118 GEC 2110 6 Way 7.95	362 T9000 Rem. Receive	Base 4.35	Kit 5.50	
54 11500 5 Stick 3.50 55 Thorn 9000 7.00	149 5 × 164520U 4.00	003 Decca 100 Series 6.59	119 GEC 2136/7	Assy 5.30	410 Phil G11 E/W Load/	483 10 × Metal Coax	
56 Thorn 1400 2.00	151 5 × TBA950 4.50	004 111 CVC 25/30/32 7.68	1apered 7.55 120 000 0.005 0.35	363 13500 Mains TX 338	A11 Phil G11 Bridge	ABA Focus Linit T20	
57 Philips G9 3.50	154 10 × TCA270SQ 4.00	006 RRI T20 9.92	121 JTT CVC8 11.45	365 T8500 (Plastic) Cut	TX 1.50	Type 125	
58 Universal ITT Type 4.50	155 5 × MC13270 2.50	007 RRI A823 7.80	122 ITT 6 Way with	Out 1.50	412 Phillips G11	485 Foc/Unit Thorn 8500	
PTVs 1.00	161 TDA1190 1.90	008 RRI Z718 18" 18.95	V.C.R. 7.95	370 Pye 731 Thick Film	Speaker 1.00	Type 125	
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JVC HR3300

I cannot resolve a locked picture in the E-E mode and when a known good tape (made on another machine) is played back there's a negative colour picture with heavy hum on sound – the TV set has to be retuned to get a little sound with the negative picture.

The overloading on playback and E-E points to either the circuitry on the luminance/chrominance board common to both or the r.f. converter (modulator). Try another converter if possible. Should the converter turn out to be o.k., reduce the playback luminance level (R37 on Y/C board). If the converter is at fault, try adjusting it – remove its cover, plug it back into the machine, then adjust the preset farthest from the small coil can.

PHILIPS G11 CHASSIS

There's intermittent cramping at the bottom of the picture – the lower lines of the frame rise by one-two inches though the rest of the picture remains fairly stable.

The trouble could be due to poor regulation of the 33V or 37V lines – greatest current consumption occurs at the end of the field scan. Try scoping the LT3 rail and pin 15 of the field timebase i.c. If any significant 50Hz ripple is present, check C3144 or C2097/8 respectively. If all is well here, look for dry-joints on the convergence panel and the output filter coil L2092 then suspect the field scan coupling capacitors C2099/2100, also C2083.

PANASONIC NV8600B

This machine plays prerecorded tapes faultlessly. In the E-E mode and when recording however there's persistent flashing on the screen while the brightness fluctuates between very high and very low.

First check the record/playback switches on the thin hinge-open board beneath the machine. Clean or preferably replace them. If the switches are o.k., there's almost certainly a dry-joint in the r.f./i.f. stages. You can check by feeding a video signal in at the video input socket or by scoping TP301 on the luminance panel to see if the waveform here varies with the fault.

SONY KV1810UB Mk II

When the set is first switched on a grainy picture appears. The set keeps trying to produce a normal picture and eventually does so, but may alternate between grainy and normal several times. The problem is not present once the set has warmed up. Also the height occasionally fluctuates when the set is cold.

First check the tuner a.g.c. action by applying an external source of 3V d.c. to the tuner's a.g.c. pin, i.e.

across C133. If this restores normal operation from cold, check the tuner a.g.c. transistors Q211/212 and the associated components as necessary. If not, replace the tuner. Height fluctuations are generally caused by thermistor Th501 in the field output stage. Also check that the field timebase presets are not noisy.

FERGUSON 3V22

The picture has a horizontal wobble, as if there's a tape speed variation. The capstan and other parts in contact with the tape have been cleaned but this has made no difference.

Almost certainly the pinch wheel requires replacement. Be careful not to bend the arm on which it's mounted. Less likely causes are defective ball races in the lower drum or the relay pulley – usually audible – or a defective drum motor (the ripple on the positive side should be less than 0.2V in pause).

PHILIPS N1700

The fault on this machine occurs only when playing back one of the longer tapes. The picture momentarily goes to monochrome, with vertical white lines equally spaced but tending to zig-zag superimposed. Horizontal bands of colour flash can also be seen at times in this condition. The time between the "drop-outs" can vary between a few seconds and several minutes.

As the fault appears only with longer tapes, i.e. when there is a greater weight of tape on the reels, it would seem that there's either a lack of capstan drive torque (clean the capstan and pinch wheel and check the latter for wear) or more likely the back-tension brake is defective. To gain access to this, remove the reel disc assembly, noting the positions of all shims. Examine the two neoprene brake pads attached to the chassis under the lower reel disc and the felt friction clutch. Clean with alcohol.

NATIONAL PANASONIC TC86G

When the set is first switched on the sound is normal but the picture is very snowy. A clean picture can be obtained by turning the a.g.c. delay control fully anticlockwise then fully clockwise. The set will then operate normally until switched off. In the fault condition the voltage at the tuner's a.g.c. input pin is 1.5V but when the gain is restored the voltage rises to 5.5V. There's a corresponding change at pin 4 of the AN331 jungle i.c. The latter has been changed along with the various electrolytics in this area.

We suspect that the trouble is in the tuner's gaincontrolled stage where there's some sort of leak to chassis. A new tuner would cure this but you might be able to overcome the problem by permanently biasing pin 1 at $5 \cdot 5V$. Try connecting a $5 \cdot 6k\Omega$ resistor between pins 7 and 1 and a $4 \cdot 7k\Omega$ resistor from pin 1 to chassis, disconnecting the a.g.c. line.

JVC HR3300

This machine plays back its own recordings correctly, and they are all right on other machines, but when a prerecorded tape or a tape recorded on another machine is played back there's no colour.

It seems that the colour a.f.c. loop is slightly out of adjustment. Try slight adjustment of R249 on playback – return it to its original position if this has no effect. In the absence of a scope and frequency counter, suspect IC204 (AN236) and IC202 (AN305) in that order.

SANYO CTP5101

The fault is tuning drift, with low sound and caption buzz. The voltages around the tuner seem to be o.k. and the a.f.c. and i.f. i.c.s have been replaced.

If the fault can be cleared by retuning it's likely that the tuner itself is defective – we've had trouble with this type of tuner on several occasions. If the trouble is confined to the sound, the picture remaining in colour during the fault condition, concentrate on the intercarrier sound circuit – use of heat and freezer should help pinpoint the culprit.



265

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

The Decca 30 was one of the better hybrid chassis, though most of these old sets must by now have been consigned to the scrapheap – after long and honourable service. As with all equipment that's approaching the end of its useful life, the decision whether to repair or scrap is a difficult one. So often it happens that a repair is carried out only to have the set fail, due to quite another cause, within a short time.

Such were the circumstances that attended our dealings with a Model CS2230 recently. On its first visit to the workshop we found that the BY127 h.t. rectifier D600 was short-circuit, taking with it the 3.9Ω surge limiting resistor R603. After replacing these items we returned the set to the customer – the picture was reasonable in view of the age and condition of the set. All went well for a couple of weeks, then the set reappeared in our out-patients' department, with a cryptic "same again, recent repair, no charge" label. The symptoms were the same – dead set. The cause was quite different of course, and the "no charge" bit became something of a bone of contention!

This time the h.t. fuse F1 (500mA) had blown. When we replaced it the anode of the PY500A boost diode glowed cherry red within a few seconds of switching on. The PL519 line output valve remained quite cool. New valves produced similar results. Lack of line drive was discounted because the result of that is generally overheating in the PL519, which remained cool beside its throbbing neighbour. It appeared that there was a short from the cathode of the PY500A to chassis, and an ohmmeter check produced a reading of just a few ohms. The short remained with both top caps removed (measuring from the PY500A's top cap to deck), so the valves were o.k.

The fifth-harmonic tuning capacitor C435 is connected directly from the PY500A's top cap to chassis – it sits on the line output transformer's pins. Disconnecting this item

proved its innocence, so a less direct short-circuit path was sought. The boost capacitor C436 lives down on the timebase panel – it links the transformer's primary winding to chassis via a secondary winding. We confidently snipped it out, but the short-circuit still remained! C431 (feedback to the width control circuit) had no leakage, and disconnecting plug PT/B (timebase panel) made no difference to the short-circuit reading. Continuing along these lines, we disconnected the plugs associated with the scan yoke and the convergence coils, again with no effect on the reading. The tripler connection was next removed, and a careful inspection of the connections and leads to the transformer was carried out. No burn or arc marks were visible, and still the short was there.

At this point the tube was tested to see whether the case was worth pursuing. The emission was reasonable, so after a telephone conversation with the owner the decision to carry on was taken. The culprit was found soon after. What was it? – see next month.

ANSWER TO TEST CASE 264 – page 105 last month –

We were embroiled in the vision detector/video driver/ sync separator/a.g.c. section of a Thorn 1590 monochrome portable last month – no wonder this part of the circuitry was called the jungle when it was put into i.c. form. In the jungle and up the creek without a paddle we were – until we got that scope trace at the collector of the video driver transistor VT6.

When we looked at the waveform at VT6's emitter we were confronted with huge negative-going line pulses. They were larger still at the other end of R1, which links the video signal to the preset contrast control in the a.g.c. detector/amplifier circuit. They were coming through the a.g.c. detector/amplifier transistor VT1, whose emitter was open-circuit and whose collector-base junction was leaky. The a.g.c. gating diode W1 was also leaky, so that there was a clear path from pin 7 of the line output transformer via W1, VT1, the preset contrast control and R1 to the emitter of VT6, where the flyback pulses used to gate the a.g.c. circuit were playing havoc with VT6's operating conditions.

We stuck to our estimate of $\pounds 16$ (supply and fit two transistors and one diode!) though the true cost of the time spent on this one would have bought a handsome new monochrome portable! It's fortunate that this is not too common an occurrence ...

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TELEVISION JANUARY 1985

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IN 914 3p IN 914 3p IN 2069a 10p	R2738=TIP41 R2738=TIP41 R2775=TIP41c	40p 30p 40p	+18V/MC78M18 20p +24V/78M24 30p MC 7724cp 40m	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	V/Cap tuner, after Series	r 1979 £8	K.F. power modules VHF. BGY33 £15
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	5×3 8 ohm 70p	245V 10 for £1.00	G11 focus £2.00	0.047/1000	100	GMA 90	£5.00
	/×3 16 ohm £1.00 6″ dia 16 ohm £1.00	G11 100K tuner pots 12 for £1	ITT Small for use with Split Diode 50a	0.1/1000	10p	GMC 120 GMR 64	£2.50 £5.00
	5" dia 8 ohm £1.50	K13 IF panel £6.00 K13 line OSC transformer £1	TV11 50p	.15/1000 .47/250V A.C.	20p 10p	TMN 2 VCA 20	£2.00 £10
	51" dia 3 ohm £1.50	KT3/K30 infra-red receiver	TV13 50p	.001K/1250 0.0047/1500	10p	VCA 21 VMC 26	£10.00
	עז" dia 8 ohm 75p ש" dia 8 ohm 75p	K30 drawer unit with IC's	TV14 50p	.005/1500	10p	VMC 34	£5.00
	4∦″ sq. I5 ohm 75p	(home) £10 K 30 drawer unit with 16"s	TV20 £1.00	1n8/1500	15p	VMC 44 + 45 VMC 51	14.00 £5.00
L	3" dia 15 ohm 60m	(export) £10	1 v45 50p Thorn 14/1500 rec stick 5m	2n0/1500 2n2/1500	10p 15p	Hand Est.	
	K30	K13 AE Sockets 25p KT3 receiver panel £8	16 Button Key Pad 1 to 0 + * + #+	G11.11000/1500 .01/1600	15p	Transducer Hand Set Inser	t, crystal,
	OF-550 E.W. 10p OF-513 correction 10n	KT3 line driver transformer 50p	G7000 Philips Video Games Packs	G11.8200/2KV 0.1/2KV	15p	B C.H. Ultrasonic GEC Ful	ad £3.50
F	Diodes	NPN PNP 80V 6 Amp TO66 O.P.	11 types £8.75 each	10n/2KV	15p	C2014H/C2219H	£15.00
	BY 127 10p	1 rans. pair 25p 5 button touch tuner BBC1/2	G11 drawer ASS 3 pots Mains switch	0.0015/2KV	15p 10p	Full Remote	£12.00
	BY 134 10p	ITV1/2 video with ic SAS 56017	Line O/P panel GEC 2217/2218/	5n2/2KV 6n2/2KV	10p 15p	Thorn 4000 insert with 7 h Decca RC 11	uttons £5.00 £14.00
	BY 164 50p BY 176 25n	Control panel 5 sliders + mains	2213/2214/2226/2227/2228 £10	2n0/2KV 2n2/2KV	15p	Decca RC 12	£14.00
	BY 179 40p	lead £1.50 G11.8 touch button unit replaces	3500 thick film £2.00	7500pf/2KV	10p	GIT Intra-red full teletext CIT Ultrasonic full teletext	£19.00 for G26c
	BY 187 25p	old 6 P.B.U. £24	PYE 731 thick film £2.00	8n2/2KV	15p	674/02 and G22c 66/02	£14.00
	BY 190 40p	Tube base + base unit for 820 Euro chassis £4.00	DISPLAYS	0.0082/2500 150/3500	15p 10p	G9 Philips R/C Transm.tter	£8.00
	BY 198 10p	GEC Line O/P Trans. & Rec Stick	7seg Red LED 50p	1800/4KV 4.7nf/5KV	5p	Kank, Infra-red Dynatron-Full remote CTV	£10.00 / 62, 63.
	В Y 204/4 8р В Y 206 8р	CVC 20/25/30/35/40 decoder	2 digit LED 8.8 50p 2 digit LED ÷1.8 with papel +	170/8KV	100	64 Hitachi infer and harder	£19.00
	BY 208/800 8p	panel £10 CVC 20/25/30/35/40 decoder	MCI4511 £1.00	210/8KV	10p	Philips full remote KT3, 16	C928/
	BY 210/800 10p	panel (untested) £5	4/00/03 £1.5%	Decoder Panel	10p £30	20C934; 7228/7324; K12 2 1ST 66K 1826	26C 797/ £12.00
	BY 223 60p BY 224/600: 4.8A/600v bridge.50n	40K Transducer 50p	RANK & ITT Mains Remote On-Off S	witch (720R)	£1.50	G11, Full remote top butto	 m
	BY 226 15p	PHILIPS NE511N £1.20	RANK & ITT Mains Remote Switch 2865 ohm RANK & ITT Remote Switch 2800 ohm		£1.50 £1.50	assy. G11, Full remote repair se	£12.00 rvice
	BY 228 20p	20 GEC Black Spark Gaps £1.00	G11 Mains Switch 54 amp Mains Switch 7		50p	(exchange unit) Philips infra red full remote	£12.00
	BY 229/400 30p	GTT Line Driver Transformer 35p KT3 Front Panel Control	GEC Mains Switch 4 amp		2.5p 30p	for 60 CP2605	2.9 channel £6.00
	BY 254 10p	Assy. £2.50 BTW 30/50	KT3 Mainswitch £1.0 THORN Rotary Mains Switch 50			Philips infra red full remote channel for 60 CP2605	£12
	ВY 255 30р ВY 298 10л	TELETEX DECODER	G8 Mains Switch 500 Thursing 600/4 amp C105/2			Philips Key Pad set KT3/K	.30 £3.00
	BY 299 10p	I.C. SAA 5051	Ihyristor 600/4 amp C106/224pG11 Preh Red LED P/Button for C.H. Change20p			KT3/K30 Full remote	£15.00
	BY 527 20p	I.C. SAA 5030	RANK TOSHIBA Transductors TPC-2011 CVC 5 Mains on/off		50p	KT3 Power supply Hitachi 8 button unit with r	£4.00 esistor
	BY 407a 10p	I.C. SAA 5020 etc. £12.00	CVC 5 Mains on/off +250K+100K+500K+500K+500K Pot on Panel		£2.00	unit. Last year mod.	£7.00
	international Rectifier EHT Diodes (6A/600V Stud Diodes 20p	BTW 92/800R £3	Thorn 12 or 24 volt battery convertor fo Tape Heads R/Play/Back Mono/Sterco	r portable colour 17V	£12,00 £1.00	GEC mira-red 2236-2026 GEC push pad hand set bu	£4.00 tton blobs
L	6A/1000V Stud Diodes 20p	25A473 PNP C/P 10p					10p each

Iuner Units GEC 6 Push Button Unit £6 If I 6 Push Button Unit £6 Ub(CA 6 Push Button Unit) £6	SENDZ c	OMPONENTS	SAA5000A £1.50 SAA5012A £5.00 SAA5020 £3.50	SN76110N £1 SN76115AN 50p SN76131 50p	MJE2801 30p MJE2955 50p MJE13005 30p Sanikron Diode
G8 Funer £7 63 Bishopstei GEC or Hitachi 6 push button and 2110 Commany 512		teignton, SSEX SS3 8AF	SAA5030 £5.00 SAA5040 £3.50 SAA5040A £4.40	SN76141N £1.00 SN76226 £1.00 SN76227N 60p	SKE2G2/04 30p Transistors
GEC 2110 V/Cap £6 ELC 1043/06 (AEG) £6 EL C1043/05 Mullard £6.00	All items subject	to availability.	SAA5050 £3.50 SAF1032p £2.50 SAF1039 £2.00	SN76228N £1.00 SN76270 £1.00 SN76532N 50p	A1222 15p A1223 15p AC106 15p
ELC1043 (Ex Panel) £3.75 ELC1042 _ £5.00	Postal Order/Che Add 15% VAT, th	que with order en £1 Postage	SAS560 £2.00 SA5660 £1.00	SN76544N £2.00 SN76545 £3.50 SN76546 £1.00	AC121 15p AC124 15p
ELC2004 £10.00 ELC2006 £10.00	Add Postage f Callers: To shop at	or overseas 212 London Rd.,	SAS670 £1.00 SL901B £5.00	SN76550 30p SN76552 30p	ACI28 15p AC137 15p AC151 15p
GEC Tuner V/Cap Hitachi After 1979 E1548, F1547 £10.00 U322 (UHF) £4.00	Southend. Tel. Open 9-1/2.30-6. GVMT + schoo	0702-332992 orders accepted on official	SL918 £6.20 TA7122 £1.15 TA A320A 50b	SN76570 £1.00 SN76620 50p SN76650 50p	AC131 15p AC138 15p
V314 (VHE) £5.00 U321 £6 U341 (HF £7.00	THORN 1400 4P.B. Mech. Tuner	MR1366 - 20p BRC-M-200 - 40p	TAA470 £1.50 TAA570 75p	SN76660N 40p SN76620AN 50p	AC152 15p AC153K 15p
U411 £7.00 UV411 1000 EUC1043/05 1000	THORN 1590 4P.B. Mech. Funer THORN 3500 4P.B. Mech. Funer	BRC-M-300 50p BRC 1330 75p	TAA611B £1.50 TAA621 £2.00	SN76705N £1 SN76705N £1 SN76707N 75p	AC142K 15p AC169 15p AC176 15p
Small V/Cap Mitsumi	FHORN 8000 4P.B. Mech. Tuner THORN 8500 Mech. Tuner	BRC 3064 £1.00 BTT822 £1.00 BTT6016 £1.20	I AA661 £1.75 TAA641 £1.50 TA7117 \$00	SN76708AN 75p SN76720 £1.00	AC176K 15p AC178K 15p
G8 Funer £6.00 Portable & rotary Tuners Sanyo &	Delay Lines D1.20A 80p D1.600 £1.00	ВГ16018/ML237В £1.50 ВТГ6218 £1.50	TA7120P 50p TA7315AP 50p	BT100A/02 40p BT138/10A 70p	AC177 13p AC186 15p AC187K 15p
6003 Bush V/Cap Iuner £10.00 NSF-UHF/VHF Varicap (old	G8 (Old Type) £1 DL600 £1.00 D1 700 £1.00	BT18124 £1.00 BT18224 £1.00 CA270AE 50p	ГА7607АР 40р ТА7609Р 50р ТВА120А 40р	BT146 30p TBA540Q £1.50 TCA270 £1.00	AC188 15p AC188K 15p ACY21 25n
type) £8.00 Mosfit UHF/VHF (new type)£8.00 SONY 1400KV Tuner unit £3.50	DL710 £1.00 UDL11 30p	CA270CW 50p CA270CE 50p CA920AE 51 00	ТВА120А 40р ТВА120АS 50р ГВА120SA 40р	TCA270Q £1.00 TCA640 £1.00	AD143 50p AD149 50p
Thorn Tuner PANEL with 6×100K pots + cursors NO TUNER £1.00	Luminance Delay Line (CVC 45) 10×630ma fuse 25m	CA1310 50p CA3065Q 50p	TBA120B 40p TBA120SB 40p	TCA560 £1.00 TCA270S £1.00 TCA270SQ £1.00	AD161/162 pair 40p AF139 25p AF181 £1.00
HILACHI 20 Turn Pot 40p U 321 on panel £6.00	10×2A fuse 50 10×3.15 fuse 50	CA3089Q 50p CA3094AE 50p CA3123 40n	TBA120SQ £1.00 TBA120U 75p TBA120O 30p	TCA740 £1.00 TCA800 £2.00	AF239 25p AF367 25p
Videon MIS 900 £2.50 Mullard Video Modulator.	10×500mA 80 10×1 amp 80 10×1.6 amp 80	CA3146 £1.00 CA3189 40 p	IBA120C 40p IBA1441 £1.00	TCEP100 £2.25 TCE120CQ £1.00	BC161 30p BD507 50p
Application, video tape recorders, IV cameras, video games, closed circuit I/V, C C.I R system Data	20.3.15 AS Fuses £1.70 Co-Ax Joint 15p Co-Ax Balling Lao Plug 12p	CBF16848 50p CD4510 30p DM7492 50p	IBA231 75p IBA395Q 50p IBA395Q 51p	TDA440Q £1.00 TDA1003A £1.00 TDA1010 £1.00	BD509 30p BD510 30p BD517 30n
Supplied. £10.00 VT 100 Sound Tuner Kit TV Viosound The latest design in low	Co-Ax Splitter £1.00 UHF Modulator CCIR £3.00	HA1196 40p HA1370 £2.00	TBA396Q £1.00 TBA396 75p TBA440P £1.00	TDA1060A £1.50 TDA1072 £1	BD519 30p BD534 30p
noise fitted with DNR, RF output and audio £30.00 Sylvania UHE VHE F6013 (Fits	Intra Red Emitting Diode 20p NE286H Small Neon Lamps GEC & Philips 5r	HEF4001 10p HBF4011AF 10p	TBA1440C £1.00 TBA480Q £1.00	TDA1151 30p TDA1170 £1.00 TDA1190 £1.00	BD535 30p BD544D 30p BD562 30p
Rank) £6.00 Svivania F6003 £6.00 Svivania F6003 £6.00 Svivania F6003 £6.00	Mullard 5 Watt Amps. 1.P1162 New 75	HEF4053B 30p M913 £2.00 M1024=SAA £2.00	1BA520 £2.00 TBA530 £2.00 (BA530 £1.00	TDA1200 75p TDA1327A £1.00	BD610 40p BD646 50p
Sylvania VHF 900 £6.00 Decca Bradford Tuner 5	L.V. Lubes 12" A31/300 Hitachi £10 15" A38/170W Hitachi £8	M1025=SAA £2.00 MC476p £1.00	IBA550Q £1.00 IBA550Q £1.75 IBA560CQ £2.00	TDA1412 50p TDA2003 80p TDA2004 £2	BD678 50p BD681 25p
Small Funer DX 175-220MHz Auto Changeover £5.00	18" Hitachi PIL tube with scan coils 470 KCB22-TC03 £25	MC1307 75p MC1312 MC1330 75p	IBA570 £1.50 IBA625 50p TBA611 53 00	TDA2010 £1.00 TDA2140 £3.50 TDA2030 £2.00	BD807 20p BD826 50p BD948 30n
D.P.D.F. switch Black knob Chassis or PCB mount 4p	AC76003 £1.50 AM25US23PC 10	MC1349 50p MC1352 £1.00 MC1358 51.00	TBA651 £2.00 TBA651 £2.00 TBA673 £1.00	TDA2525 £1.00 TDA2640 £2.00	BDX75 20p BDX32 £1.25
each or 40 for £1.00 BF694 10p 2SC7350	BAV40 401 150 BC414 10	MC1358 2100 MC14002 15p p MC14013 25p	TBA720A £1.50 TBA750Q £1.50	TDA2522 £1.00 TDA2530 £1.50 TDA2532 £1.00	BF115 20p BF121 20p BF127 20p
BF758 30p 2SD180 1 BF760 30p 6A BF731 15p 2SD200	1O3 80v/ BC416 10 15p BC440 30 €2.00 BC454 10	p MC14016 25p p MC14066 30p n MC14514 50n	TBA780 £1.50 TBA800 50p TBA810AS 60p	TDA2540 80p TDA2541 £1.00 TDA257140 £3.60	BF137 20p BF157 20p BF150 20p
BFT43 10p 25K30A BF184 8p BC107	10p BC455 10 10p BC456 10	p MC1748 80p p MEM4956 £1.00	IBA810S 60p TBA820 60p	TDA2575A £1.00 TDA2581 £2.50	BF161 20p BF164 60p
BFW11 20p BC108 BFX29 30p BC109 BFX84 25p BC113	10p BC460 25 5p BC462 10 10p BC463 10	p M1.231 £2.50 p M1.236E £1.50 n M1.237B £1.50	TBA890 £1.00 IBA900 £1.50 TBA920 £1.50	TDA2590 £1.00 TDA2593 £1.00 TDA2560 50n	BF179 30p, BF180 20p BF181 20n
BFY50 15p BC114 BFY52 20p BC115 BFY52 20p BC115	10p BC478 10 10p BC527 10	p ML238B £4.00 p ML239 £3.00 ML239 £3.00	TBA920Q £1.50 IBA950 £1.50	TDA2600 £5.00 TDA2611 £1.00	BF182 20p BF184 20p
BL 170 Zrp BC116 BL Y49 Z5p BC:17 BPW41 Z5p BC119	20p BC532 10 20p BC546 10 20p BC547 10	p MM5611 £1.00 p MM5840 75p	TBA990Q £1.00 FMS1000NL £2.00 TMS1943	TDA2653 £1.00 TDA2002 £1.00 TDA2640 £2.00	BF194 10p BF195 10p BF196 10p
BRC116 25p PC125 BRX43 15p BC126 BRX48X 10p BC139	10p BC548 10 10p BC556 10 10n BC557 10	p MR1366 20p p N64100 £1.00 o NE545B (Dolby) 75p	(clockchip) £1.00 TMS9980 £4.00 TMS9901 £1.00	TDA2680 £1.00 TDA2690 £1.00 TDA2593 £1.00	BF197 12p BF198 10p BF199 10m
BR Y56 30p BC137 BSS68 10p BC140 BSY79 10p BC141	30p BC558 10 25p BC559 10	p NE555P 60p p NE555 60p	TMS9901 £1.00 TMS2716JL £1.00 TMS3529 £1.00	TDA2595 £1.00 TDA3190 £1.00 TDA3560 £4.00	BF200 20p BF222 10p
BSY95a 14p BC143 B1Y80 20p BC147 BSX19 17p BC148	25p BC635 10 10p BCX31 25 10p BCX32/36 Pair 75	p IL-1 20p p OPT600 20p p OPT601 20p	TMS3720ANS £3.00 1MS4014 70p IX-012 £1.09	TDA3571Q £1.50 TDA9403 £3.00 TDA3651AO £3	BF224 15p BF238 20p BF240 16p
BSX20 17p BC149 FT3055 30p BC153 ICE82 30p BC154	10p BCX32 25 10p BD116 25	p SAA611 50p p SAA661 £1.75 SAA1020 £4.00	TMS9902 £1.20 ULN2216 75p	SN74LS 125AN 30p SN74LS 248 50p	BF244 40p BF245b 20p
2N930 5p BC157a 2N2221 8p BC158 2N2221 8p BC159	10p BD124 (metal) 60 10p BD130Y 25	p SAA1021 £4.00 p SAA1021 £4.00 p SAA1024 £2.50	SN29848 50p SN29770BN £1.00 SN29771BN £1.00	SN16861NG 50p SN16862AN £1.00	BF256 10p BF257 20p BF258 25p
2N2906 10p BC160/16 2N3055 40p BC171 2N3554 10p BC171	6 25p BD131 30 10p BD132/238 30 10p BD135 25	p SAA1025 £2.50 p SAA1073 £3.00 n SAA1074 £3.00	SN29772BN £1.00 SN7402N £1 SN7472N £1	SN16964AN 50p SN29764AN £1.00	BF262 15p BF263p 25p BF264 16p
2N3506 10p BC.72 2N3702 10p BC.72 2N3711 10p BC174	10p BD136 30 10p BD136 30 10p BD138 30	p SAA1075 £3.00 p SAA1124 £2.00 SAA1120 550	SN74107 £1.00 SN74167 70p	UA7300 40p RGP30G 10p	BF271 10p BF273 10p
2N3583 50p BC183 2N3904 15p BC184 2N4355 10p BC204	10p BD176 25 10p BD182 £1.0 10p BD183 70	p SAA1130 £2.50 0 SAA1174 £3.00 p SAA1176 £3.00	SN7472N 20p SN75108AN £1.00 SN76001 £1.00	MPSA14 10p MPSA43 10p MJ13005 30n	BF274 10p BF324 25p BF337 50n
2N4442 £1.00 BC207 2N4444 £1.00 BC212 2N5296 40 p BC213	10p BD202 60 10p BD204 60 10p BD221 20	P SAA1250 £3.00 P SAA1251 £4.00 P SAA1272 £3.00	SN76003 £1.00 SN76013ND £1.50	MJE51T 25p MJE340 28p	BF355 30p BF362 20p
2N5983 30p BC214 2N6099 40p BC237 2N6109 40p BC238	10p BD222 30 10p BD228 30 8n BD226 20	P SAA1276 £3.00 P SAA5000 £1.50	SN76018 £1.00 SN76008 £1.00 SN76023N £1.50	MJE660 25p MJE661 25p MJE3055 £1.00	BF363 15p BF367 15p BF391 15p
2N6130 50p BC239 2N6133 20p BC250 2N6348 20p BC251	10p BD233 30 8p BD235 30 10p BD239 15	p	SN76033 £1.50	TV Crystals	BF394 10p BF419 30p BF422 15p
2N6399 10p BC252 2X 2N6099 on BC262 beat sink 50p BC263	10p BD243c 30 10p BD244 50 20p BD250a 30	p 5-5MHz 15 p 6MHz 30 BEL/155K 5	p BLY49 50p P I.C. Heat Sink 20 for £1	4MHz 4.433-619	BF423 15p BF448 30p
25A437 25B407 Sanyo T()3 10 10 10 10 10 10 10 10 10 10 10 10 10	30p BD252 20 10p BD253B 50	P Thyristors BT151/800R 80	P 120×105 Heat Sink £1.00 CVC 9 power supply p board £1.50	6MHz 8.867238	BF450 20p BF458 30p BF459 30n
10p BC300 2SB474 30p BC301 2SB566 10p BC303 2SC301 BC303 BC303	30p BD351 20 30p BD352 20 30p BD373b 20 7	P TD3F800 £1.5 P BT106 Plastic 30 P BT106 Metal £1.20	0 CVC 20/2 mains p panel £2.00 9 ITT Mains Filter 1/2500	GEC Power Panel	BF468 30p BF469 30p BF470 20-
25C351 10p BC307 2SC458 50p BC308 2SC515 10p BC309	7p BD416 25 7p BD433 25 10p BD437 25	P B1119 £1.00 P B1120 £1.00 P BRC4443 75	CVC 20 to 45 chassis 50p Pots 10 k with Switch 25p	TV106 Thermistor PT34 New £1.00	BF480 50p BF594 10p
25C/32 10p BC327 2SC733 10p BC328 2SC1030 £1.00 BC328/33	10p BD439 50 10p BD501 30 38 pair 15p BF761 30	P G11 Ihvistor 60 P Decca 80-100 60 P 283444 61	Pots +1 k with Switch 25p Mullard Surface Wave Filter RW 153P Colour	I.C. Ho	BF59/ 10p Iders
2SC1172A 10p BC337 2SC1173 10p BC338 2SC1419 20p BC347	10p BF858 30 10p BF871 30 10p BFR39 15	p Thermistors p VA1104 50	TV Filter 40p Mullard Surface Wave Filter DW 154 Colored	DIL - DIL 40 Pin × 4 £1.00	DIL – QIL 16 Pin × 10 £1.00
2SC1546 20p BC349b 2SC1725 20p BC350 2SC2068 20n BC365	10p BFR52 7 20p BFR79 15 10p BFR81 15	p 11TP7266312 15 p P1H451 AOR 15 p PT37P Fits Pye & PT34 20	p TV Filter 40p G11 Line Scan		$\begin{array}{cccccccccccccccccccccccccccccccccccc$
2SC2073 8p BC384 2SC2122A £1.00 BC394 2SC2229 15p BC413	10p BFR87 10 10p BFS60 10 10p BFT42 20	p Degausing Thermistor (fits p most sets) 20 p GEC Double Thermistor 75	P.C.B. £1.00 G11 Power Supply P.C.B. £2.00	24 Pin × 5 75p 14 Pin × 10 70p 18 Pin × 10 80p	16 Pin G11 each 10p AB Mains Switch u/v 30p

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