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Steve Beeching checks out a new high-tech soldering station that's ideally suited to work on high-density PCBs. It fulfills all standard workshop soldering needs as well.

## Satellite Workshop

Jack Armstrong's column on satellite receiver servicing.

## Test Case 431

## Digital Satellite TV

Hugh Cocks on reception problems, upgrades and set-ting-up procedures.

## 3

6

TV Fault Finding ..... 30
Service Casebook ..... 34
John Edwards reports on servicing problems and pro-cedures - and the occasional difficulties with cus-tomers.
Digital TV Processing ..... 48Cedric Applewright on the processing carried out toprovide video compression and error correction withdigital TV transmissions.
VCR Clinic ..... 52
Portable Appliance Testing ..... 54Russ Phillips describessafety testing to meet theElectricity at WorkRegulations. It can providea useful source of extraincome.

DX and Satellite Reception ..... 56Terrestrial DX and satellite TV reception and news.A new satellite uplinking band, and a potentialsource of yet more interference. Roger Bunneyreports.
Monitors ..... 60Hints and tips on dealing with monitor faults, in par-ticular the power supply in the Acorn A4000.
What a Life!62Bores and other problems, mainly with tellys. DonaldBullock's monthly commentary.
Help Wanted64
Next Month in Television ..... 65

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# Digital TV is here! elcome all to the age of digital <br> rate, stable conversion from one to the 

WTV, the latest stage in the fascinating development of TV technology - from Nipkow's disc, patented in 1884 as "a television machine", to Boris Rosing's proposal to use a CRT as the receiving display device and his demonstration of a TV system in 1907, also in that year Dieckmann's demonstration of a CRT for TV reception, to Zworykin's patent application for an electronic TV system in 1923, to Baird's experiments in the midTwenties and the work by EMI and RCA in the late Twenties and early Thirties that led to practical, all-electronic TV, to the start of electronic TV broadcasting in the midThirties, then to the development by GE and RCA of colour TV systems in the Forties. Colour TV transmissions in the USA started in 1954, using basically the system developed by RCA. It took rather longer for colour to be added to TV in the UK, until December 2nd 1967 to be exact. Our December 1967 cover featured the famous test card F with Carol and her blackboard, and announced that "colour is here". I thought it would be appropriate to head this leader similarly.

Things were not to stand still. As soon as the first stage of the conversion to colour broadcasting at UHF had been completed, the IBA's Experimental and Development Department was given the task of undertak ing a study of the likely impact of digital techniques on television. The studies began in 1968-9 - the IBA was interested in the control of unattended networks, developments in studio technology, and the problem of standards conversion. At this time the studios were originating signals in 625-line form, but broadcasting had to be at both 625 and 405 lines. This meant the need for accu-
other. There was also the need to convert US 525 -line signals to 625 -line form.

Development was incredibly rapid. A line-rate digital standards converter was developed in 1970-71 - stimulated by a significant fall in the price of relatively fast digital storage devices. It used four-line interpolation, and was demonstrated to the broadcasting industry in March 1971. The next step was the development of a fieldrate digital converter, which came to be known as DICE (Digital Intercontinental Conversion Equipment). Work on it started in November 1971. One year later an experimental converter was in operation. It was used to feed a converted broadcast of the US presidential election to the whole of Europe in November 1972. At the time it was the fastest computer in the world - it needed to be to handle in real time the amount of data involved. By early 1973 it was in full oneway use, and by the spring of 1975 it was in full two-way (525-625, 625-525) use. There were demonstrations at the IBC in 1974, Montreux in 1975 and the NAB in 1976.
Digital TV had arrived, but not as a consumer electronics prospect. There were what appeared to be insuperable problems here. For a start the transmission bandwidth problem: the more information you transmit, the greater the bandwidth required, and all those digital samples amount to far more data than a simple analogue waveform. Then there was the fact that the cost of a digital decoder would have been prohibitive. So there things rested for a while as far as consumer digital TV was concerned, though advances in studio equipment, in particular image manipulation, continued.

Work that was relevant to the prospect of digital transmission was nevertheless car-
ried out. What was required was data compression. NTL, as the IBA's engineering division had become, established that with some programme material - not just still pictures - the video redundancy rate is as high as 98 per cent. The next step was to try to establish an international standard for TV compression, hence the MPEG (Motion Picture Experts Group) which started work in 1988. By the early Nineties efficient compression algorithms had been developed. The MPEG-2 compression standard had been established by 1993, and the European DVB (Digital Video Broadcasting) project was set up to implement it. Two further developments made this practical - digital signal processing chips and memory devices at mass-market prices. The result - set-top receiverdecoders at a subsidised $£ 200$. Interesting that just as this latest development in TV depended on another technology, semiconductor devices, in an earlier era development of the CRT was held up until vacuum pumping technology had significantly improved!

What are we going to do with the multitude of channels that this latest chapter in the story of TV has brought us, and what comes next? It seems doubtful whether the broadcasters will be able to do justice to the possibilities that have opened up - how can you fill all that channel time with worthwhile material? And even if you could, how much viewing can be fitted into a 24 -hour day? The future seems to be flat screens (expensive at present, and of questionable longevity) and all that multimedia business - the internet, interactive TV, home shopping and so on. Are we to become total slaves to the screen? Probably, hopefully not.

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| 2SA933 | 0.60 | ${ }_{2 S D 1548}$ | 5.95 | BC141 | 0.36 | BD244C | 0.43 | BUT11 | 0.65 | KBU602 | 2.18 | STK4142l\| | 9.40 | TDA2030H | 0.91 | TIC 106 D | 0.82 |
| 2SA940 | 0.82 | 2 SD1554 | 3.25 | BC182 | 0.14 | BD317 | 1.78 | BUTIAA | 0.95 | K146210aH | 6.15 | STK4152III | 10.95 | TDA2030V | 0.00 | TIC246D | 1.54 |
| 2SA950 | 0.18 | 2 SD1555 | 2.65 | BC182L | 0.14 | BD433 | 0.29 | BUT11AF | 1.18 | KSR1004 | 0.21 | STK4192II | 15.63 | TDA2050 | 4.56 | TICP106D | 0.72 |
| 2SA952 | 0.18 | 2 SD1556 | 5.11 | BC184L | 0.06 | BD434 | 0.31 | BUT12A | 1.17 | LA4282 | 5.11 | STK5332 | 2.82 | TDA2541 | 1.12 | TIP110 | 0.35 |
| ${ }_{2}$ SA966 | 0.69 | 2 2S1650 | 2.48 | BC212 | 0.12 | BD435 | 0.38 | Buti2aF | 1.87 | LA4705 | 6.41 | STK5342 | 4.07 | TDA2577A | 3.45 | TIP111 | 0.57 |
| 2 SA970 | 0.19 | 2 SD1651 | 2.38 | BC212L | 0.18 | BD436 | 0.52 | BUT18AF | 1.37 | LA6324 | 3.25 | STK5372H | 6.84 | TDA2578A | 3.20 | TIP122H | 0.77 |
| 2SA984 | 0.38 | 2 2S1761 | 0.94 | BC237 | 0.12 | BD437 | 0.52 | BUT56A | 1.19 | LA7116 | 1.70 | STK5481 | 8.12 | TDA2579A | 4.91 | TIP120 | 0.40 |
| 2 SB1010 | 0.35 | 2 2S1815 | 0.86 | BC237B | 0.19 | BD438 | 0.38 | BUW11A | 1.54 | LA7830 | 1.88 | STK7253 | 10.51 | TDA25810 | 2.57 | ${ }_{T \text { TPP2955 }}$ | 0.89 |
| $2 \mathrm{SB1143}$ | 0.77 | 2501858 | 0.43 | вС238 | 0.11 | BD839 | 0.57 | BUW12A | 2.99 | LA7832 | 2.40 | STK730-060 | 11.65 | TDA2593 | 1.12 | TIP29E | 0.77 |
| $2 \mathrm{SB1243}$ | 0.69 | 2 2S1877 | 2.14 | BC238B | 0.16 | BD901 | 0.52 | BUX84 | 1.03 | LA7833 | 5.98 | STK7341011 | 6.82 | TDA2611A | 0.64 | TIP3055 | 1.08 |
| 2 SB560 | 0.43 | 2 SD1878 | 2.63 | BC239 | 0.04 | BD911 | 0.52 | BUZ71A | 1.03 | LA7835 | 3.51 | STK7348 | 5.74 | TDA2653A | 4.70 | TIP31A | 0.41 |
| 2SB649A | 0.77 | 2 2S1879 | 2.23 | BC258 | 0.09 | B0912 | 0.63 | BUZ778 | 4.27 | LA7837 | 8.53 | STK73907 | 10.48 | TDA2822M | 1.37 | TIP41C | 0.65 |
| 2 SB688 | 1.61 | 2 2S1884 | 3.35 | ВС307 | 0.06 | BDW94C | 0.60 | BUZ80 | 3.52 | LA7838 | 2.65 | STR10006 | 3.94 | TDA33018 | 9.12 | TiP42A | 0.35 |
| 2 SB774 | 0.99 | 2SD1887 | 3.56 | ВС3078 | 0.15 | BF199 | 0.18 | BUZ90A | 3.40 | LC7132 | 4.70 | STR11006 | 7.37 | TDA3505 | 2.40 | TIP42C | 0.52 |
| 2 SB793 | 1.71 | 2SD1889 | 2.14 | BC308 | 0.09 | BF240 | 0.11 | BUZ90AF | 3.30 | LED3G | 0.10 | STR50020 | 6.38 | TDA3560 | 6.13 | TIPL761A | 1.85 |
| 2SB892 | 0.35 | 2 SD2012 | 0.86 | вС309В | 0.10 | BF245A | 0.19 | BY127 | 0.14 | LN1203N | 3.25 | STR50103 | 4.48 | TDA 3561 A | 3.85 | TIPL791A | 2.48 |
| $2 \mathrm{CC1383}$ | 0.32 | 2 SD400 | 0.34 | BC327 | 0.10 | BF258 | 0.04 | BY133 | 0.08 | LM317T | 1.29 | STR 50103 A | 5.56 | tDA 3562 A | 6.62 | TL072CP | 1.03 |
| $2 \mathrm{SC1740}$ | 0.16 | 2SD400F | 1.20 | BC238 | 0.14 | BF324 | 0.18 | BY184 | 0.33 | LM324N | 1.48 | STR5142M | 13.25 | TDA3565 | 2.74 | TL082 | 1.04 |
| 2SC1740S | 0.84 | 2 SD467 | 0.57 | всзз | 0.14 | BF420 | 0.21 | BY227 | 0.13 | LM339N | 0.50 | STR54041 | 5.15 | TDA3576B | 10.31 | TLP731 | 1.95 |
| 2SC1815 | 0.17 | 250669 A | 0.79 | ВСЗ38 | 0.06 | BF421 | 0.24 | BY228 | 0.26 | LM358N | 0.52 | STR5412 | 4.55 | TDA 3592 A | 4.60 | TMP47C432 | P8189 |
| 2SC1815Y | 0.12 | 2 2S718 | 1.90 | BC368 | 0.18 | BF422 | 0.19 | BY229 | 1.34 | LM381 | 4.27 | STR58041 | 3.42 | TDA3603P | 5.62 |  | 21.84 |
| 2SC1846 | 0.52 | 2SD8378 | 1.12 | BC369 | 0.18 | BF423 | 0.14 | BY255 | 0.14 | LM386N | 0.57 | STR59041 | 8.11 | TDA3650 | 9.27 | TMP47C434 | 3555 |
| 2SC2023 | 3.18 | 2 2S856 | 0.79 | BC372 | 0.53 | BF458 | 0.31 | BY298 | 0.15 | M29381 | 21.34 | STR6020 | 6.07 | tDA3653B | 1.54 |  | 16.63 |
| $2 \mathrm{SC2120}$ | 0.69 | 2 SD965 | 0.26 | BC545A | 0.11 | BF459 | 0.43 | BY299 | 0.18 | M494B1 | 11.85 | STR61001 | 10.86 | tDA 3653 C | 2.82 | TOP204YAI | 4.19 |
| 2SC2229 | 0.35 | 2SD965R | 1.05 | BC546B | 0.12 | BF469 | 0.35 | BY399 | 0.16 | M5182L | 1.88 | STRD4420 | 11.17 | TDA3653C0 | 2.57 | U2829B | 3.40 |
| $2 \mathrm{SC2230}$ | 0.55 | 2SK1118 | 3.40 | BC547 | 0.11 | BF487 | 0.57 | BY448 | 0.30 | M54544L | 2.48 | STRD6008X | ${ }^{8.66}$ | TDA3654 | 1.44 | U46148 | 5.78 |
| 2SC2235 | 0.36 | 2 2K135 | 11.02 | BC547A | 0.04 | BF494 | 0.12 | BY476 | 1.00 | M58655P | 4.96 | STRD6202 | 12.89 | TDA36540 | 2.82 | UC3842 | 0.74 |
| 2SC2236 | 0.36 | 2SK1507 | 5.56 | BC547B | 0.11 | BF758 | 0.32 | BYD14J | 0.35 | MC13002P | 7.69 | STV5730ST | 4.00 | TDA4500 | 4.66 | UC3844 | 1.20 |
| 2SC2240 | 0.21 | 2SK241 | 0.69 | BC548 | 0.11 | BF759 | 0.38 | BYD33D | 0.12 | MC1310P | 0.85 | STV9379 | 11.12 | TDA4503 | 4.00 | UPC1365C | 1.95 |
|  |  |  |  |  |  | BF788 | 0.52 | BYD33J | 0.16 | MC34063API | 2.65 | T6071V | 2.99 | TDA4505E | 7.35 | UPC 1378 H | 15.33 |
|  |  |  |  |  |  | BF869 | 0.38 | BYD33M | 0.26 | MCR100-8 | 0.45 | T9053V | 1.35 | TDA4505M | 11.97 | UPC1394C | 1.92 |
|  |  |  |  |  |  | BF871 | 0.41 | BYV10-40 | 2.55 | M ${ }^{115003}$ | ${ }^{2.23}$ | T9066V | 1.87 | TDA4510 | 2.74 | UPC1488H | 2.99 |
|  |  |  |  |  |  | BF960 | 0.30 | BYV27200 | 0.43 | MJ2955 | 0.76 | TA7140P | 0.99 | TDA4600 | 2.14 | UPC1498H | 3.59 |
|  |  |  |  |  |  | BF970 | $0.43$ | BYv95B | $0.21$ | MJE13005 | 0.86 | TA7280P | $2.74$ | TDA4600/2/3 | $2.82$ | UPC574, | 0.30 |
|  |  |  |  |  |  | BF981 | 0.48 | BYV95C | 0.28 | MJE 18004 | 2.05 | TA7281P | 3.20 | TDA4601 | 1.46 | ${ }_{7}^{2 T K} \mathbf{T K} 658$ | 0.28 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



## Video Resolution

I endorse all that Eugene Trundle says about the MB-SWISS 4 test cassette (October issue pages 8423): it's a godsend. He appears to be a bit surprised at being able to see the cassette's 3 MHz gratings. Here's why I think he can.

First, a reminder of video resolution basics. Viewing tests carried out in the Sixties showed that with a typical screen size, viewing distance and a picture consisting of 500 or more lines most viewers didn't notice the line structure. With the system I 625-line specification, 50 lines are lost to field blanking. This leaves 575 active lines.

It's reasonable to assume that a TV system's horizontal and vertical resolution should be equal. So with a picture whose aspect ratio is 4:3, the video bandwidth should be able to cope with $1.33 \times 575=767$ lines, i.e. $767 \div 2$ black/white line pairs. The field rate required to avoid excessive flicker is 50 Hz , so the active line time is $52 \mu \mathrm{sec}$. On this basis it would appear that the video bandwidth should be $[(767 \div$ $52) \div 2] \mathrm{MHz}=7.4 \mathrm{MHz}$, yet the allocated channel bandwidth is 5.5 MHz .

This is because of the mysterious Kell factor, which was explained to me while I was a trainee engineer at the BBC's Engineering Department. The Kell factor is best illustrated by imagining a 'scene' that consists of a

## Letters

large card on which many horizontal black and white lines of equal, thin width are printed. When this is scanned by a camera and displayed on a monitor, one might think that - with careful adjustment of the camera's zoom, the camera-card distance, etc. - the monitor could be made to display 575 lines (say 288 black and 287 white). Even if this could be achieved, the slightest vertical movement of the camera or card would result in the lines of the simple test card falling between the camera's scanning lines, the result being a grey blur.

This theory was investigated, the net result being that the 'real' vertical resolution of a TV system was decreed to be less than the number of active scanning lines by what is known as the Kell factor. Various texts quote different values, but 0.75 seems to be a general consensus. When this is applied to the system I resolution calculation above, a 5.5 MHz channel bandwidth is adequate to maintain equal horizontal and vertical resolution.

With respect to the VHS system, Eugene is correct in saying that 3 MHz equates to 312 lines and $3 \cdot 2 \mathrm{MHz}$, the upper VHS luminance limit, to 333 lines. I suggest however that this is the theoretical maximum resolution. The oft-quoted 260 lines is, as far as I understand it, a 'real-world' resolution which is acceptably close to $333 \times$ Kell.

To summarise, for a 'real' 260line resolution a theoretical resolution of $260 \div 0.75=346$ lines is required. This is approximately equivalent to an upper luminance limit of $3 \cdot 2 \mathrm{MHz}$.
Andy Barkley, B.Sc., MIEE, C.Eng., Ufford, Suffolk.

## Bicycles

I hope Donald Bullock (September) isn't suggesting that bicycle repair is an easy option for the domestic electronics technician.

While not denying that safety is paramount when dealing with electricity, descending a hill in the dark at $40 \mathrm{~m} . \mathrm{p} . \mathrm{h}$. is hardly the time to discover a defect in the brakes.
Neither is complexity confined to VCRs etc.: try delving into a fiveor seven-speed hub gear or an integrated brake/gear lever - or how about building bomb-proof wheels for a camper plus his gear?

This sort of thing can be just as challenging as a system control fault. I know - I do both. And yes there are cowboys in the bicycle trade as well. I do however find building wheels very therapeutic and I can't remember when a TV or VCR fault had that effect!
Roger Burchett,
Hythe, Kent.

## Security System

One of my customers had a problem. He was having trouble with a neighbour and had installed a camera which was switched on by using an IR detector to apply the mains supply. The camera's output was fed to a VCR which was switched to record 24 hours a day. This worked all right, but he was getting fed up with having to wade through hours of tape to check on any wrongdoing, not to mention having to change the tape every eight hours. Could the VCR be arranged to record only when the mains supply came on?

This would no doubt be possible with considerable modification, but we came up with a much simpler solution. The only VCRs that will start to record as soon as the mains is applied are the old key-operated ones. So out came a 3 V 22 which had been destined for the tip. With a new set of belts and a new compatible drum I had a very satisfied customer who now has his modern VCR in normal use again.
Laurie Watkinson,
Telesonic Services,
Holsworthy, Devon.

## TELETOPICS

## ONdigital's Plans

ONdigital has unveiled its launch plans for the world's first digital terrestrial TV service, which will start on Sunday, November 15th - the 29th anniversary of the start of BBC-1 in colour. Two basic subscription packages will be on offer. One will provide six primary channels, of the viewer's choice, for $£ 7.99$ per month, the other the full set of primary channels (at least ten) for $£ 10$ a month. Premium channels, from BSkyB and others, will cost $£ 5-£ 18$ a month extra.

ONdigital expects about 70 per cent of the population to be able to receive its full service (three digital multiplexes) at the start of transmissions: the figure should rise to 90 per cent by the end of the first year. In areas where all three multiplexes are not receivable initially, the full range of programming will be available at homes that can receive multiplexes B and C. Those that can receive only multiplex B will get a more limited choice and be charged at $£ 19.99$ a month for the primary and premium channels available.

Set-top boxes are to be made by Philips, Pace, Sony, Nokia, Toshiba and Grundig, though only Pace and Philips are expected to have products available
at stores for the launch of the service.
ONdigital is to offer a free, next-day service to help viewers who have an installation and/or reception problem, and will install a new aerial if necessary - 5-15 per cent of subscribers are expected to experience problems, many because of faulty aerials. Installation will be for one set of the viewer's choice - multi-set installations and telephone line connections will cost extra. The installation work is to be carried out by a new Granada division, Digital TV Services. ONdigital has estimated that the average cost per customer will be about $£ 30-£ 50$ - some believe that this is rather optimistic

An e-mail service is to be added in mid-1999. Viewers will be able to buy an infra-red linked keyboard then send and receive messages across the internet from their TV set. The messages will be stored temporarily in the user's set-top box before being sent on their way. ONdigital is to offer a store-andforward service: messages can be stored at the company's servers before being sent to or from the user's set-top box. Early next year ONdigital is to introduce an information service news, weather, sport etc. This will be
free: additional payment may be required for the e-mail service. Next year ONdigital intends to offer pay-perview and impulse-view services requested by telephone or via a modem built into the set-top box.

ONdigital thinks that it may be possible to add a further six new channels across its three digital multiplexes within the next two-three years, once improved digital compression systems become available. To start with ONdigital will be transmitting five channels within each multiplex at an average data rate of $4-4.5 \mathrm{Mbits} / \mathrm{sec}$.

The company says that six-channel digital surround sound is possible, though users will probably require a plug-in module to extract the surroundsound signals from the transport stream and decode them.

Set-top boxes for ONdigital's DTT services are expected to be available at over 5,000 retailers before Christmas. They will cost about $£ 200$ when the viewer subscribes to ONdigital. Plug-in conditional access modules are not expected to be available until about six months after the launch of the service. They will cost about $£ 30$ each to produce but will be free to subscribers.


Pioneer has launched a 50in. widescreen plasma display panel, Model PDP501MX (see photograph above), which the company claims is the first XGA data display device in this size. The pixel arrangement is 1,280 (horizontal) $\times 768$ (vertical), giving a total pixel count of over 980,000 . This enables the display to provide bright, full-colour data and motion-picture images from a wide variety of sources, including computer-generated text and graphics. The depth is only 9.8 cm , while the viewing angle is over $160^{\circ}$ (horizontal and vertical). Power consumption is 555W.

## Motorola's Multimedia System

In a move aimed at establishing a consumer electronics standard, Motorola has launched the first system that brings together digital TV and audio, the internet, 3D computer games and other multimedia technologies all in one box. The system, code-named Blackbird, was demonstrated at the recent International Broadcasting Convention in Amsterdam and is now being offered to set-top box and other manufacturers. Motorola expects the system to appear in consumer products within six months.

Blackbird is described as an open, i.e. interoperable, exten-
sible multimedia architecture that combines the functions of a broadband router, a network computer and a digital home theatre system. It's the first to be able to handle interactive 3D graphics, Java, MPEG video, hi-fi audio, internet access, electronic commerce and broadband networking in a single unit.

Blackbird is based on a combination of the strengths of Motorola's PowerPC processor and communications capabilities with its ProjectX media architecture. Typical consumer products could sell for between $\$ 300-\$ 700$ ( $£ 175-$ £410).

## On show at Live '98

The Live ' 98 public consumer electronics exhibition was held at Earls Court at the end of September. Several companies had planned to demonstrate digital terrestrial TV live, but poor signal conditions in the exhibition hall led to either cancellations or inferior results. There were nevertheless plenty of digital TV receivers and set-top boxes on display.

Philips introduced two widescreen receivers that incorporate decoders for terrestrial digital TV, the 28in. Model 28DW6734 and 32in. Model 32DW6834. The photograph below shows the 28 in . model. Both models incorporate a Dolby Pro-Logic decoder - the 32in. model uses FM links to wireless speakers for the rear surround channels. The sets will receive the free digital TV channels and can be upgraded for ONdigital's

pay channels. Philips is discussing with SkyDigital how the sets can be configured for reception of digital satellite TV. There will also be terrestrial and satellite digital TV set-top boxes from Philips.

Sony is to market two digital TV sets under the Wega brand name, Models KV28DS60 (28in.) and KV32DS60 (32in.). They include 100 Hz scanning, a Dolby Pro-Logic decoder and SmartLink. The digital reception arrangements are the same as with the Philips models mentioned above. Sony also has a set-top box, Model VTXD500U, for digital terrestrial TV.

Nokia showed the new Mediamaster Model 9800S, which is designed to receive digital TV channels from a number of satellites. It incorporates Satscan software, has an electronic programme guide (EPG) with a 256 -colour menu, and can store up to 2,000 channels. The Nokia Mediamaster Model 9850T is designed for digital terrestrial TV. It includes a CI (Common Interface) slot and a built-in modem, and can handle data rates up to $15 \mathrm{Mbits} / \mathrm{sec}$. Nokia has been testing this receiver around the country to enable its software and hardware to be fine tuned. A vehicle was built for the tests, which were carried out in conjunction with Castle Transmissions, the BBC and ONdigital. There were tests of both 16:9 and $4: 3$ signals, and a sophisticat-
ed hi-fi system was used to monitor sound reception. Canal Plus, which is responsible for the DTT EPG, used the vehicle to test its system.

Several companies showed flatscreen TV sets. Sharp had on display a set with a prototype PALC (Plasma Addressed Liquid Crystal) screen that was 112 cm wide, 76 cm high and just 20 cm thick. The Philips Model 42PW9982C features 100 Hz technology and a 13 -speaker Dolby Pro-Logic sound system. Pioneer was showing its 50in. plasma display panel, Model PDP501MX - see page 7.

Sony launched its first portable DVD player, the DVD Discman Model DVPS715. It can handle DVD Video, Video CD and audio CD discs. Power can be mains derived or from a lithium-ion camcorder battery. Other features include PAL/NTSC playback and $S$ Video and composite video sockets, enabling it to be connected to most TV sets and many computer monitors. Pioneer showed a new DVD player, Model DV717.

Panasonic launched its first DV VCR, Model NVDV1000, which has 16-bit digital audio with $32,44 \cdot 1$ or 48 kHz sampling, also a 12 -bit, fourchannel mode with 32 kHz sampling. Connections include iLink, RS232 serial data and a 5 -pin editing terminal. Editing includes video insert, audio dubbing and timing control.
Sharp showed a prototype hi-fi system with a DAB tuner.

## Digital TV News

CWC has launched a low-cost cable pay-TV service that includes a telephone line and a basic channel package. It will be upgraded to digital free of charge and will cost $£ 9.99$ a month. NTL is to offer DTT and digital cable viewers an interactive, internet-based service that includes home shopping, banking and information.

SkyDigital has dropped two features from its electronic programme guide because of software problems. Favourite Programmes, which lets viewers create a list of favourite chan-
nels, and Personal Planner, which reminds viewers when a favourite programme is about to start, have been removed from the first version of the EPG but are expected to become available at a later date.

The DVB steering board has chosen Java as the standard programming language for the next generation of set-top boxes. A number of systems, including Open TV, MHEG and Mediahighway, were considered. Microsoft's Windows CE was not submitted for consideration. The board would like to see the development of plug-ins to enable other
systems to run on top of Java.
The ITC has warned digital TV broadcasters that the new services could suffer if customers find their campaigns confusing. It had also been trying to ensure full interoperability between DTT and digital satellite TV, but has been told by the government that its plans were too ambitious. The government seems to consider that interoperability should be a long- rather than a short-term goal. As a result the ITC has ruled that TV sets can be designed for specific services, but wants them to have a common interface slot.

## Internet News

Dixons has become an internet service provider, offering customers free access to the network apart from the usual telephone charges at the local rate. The Dixons service is called Freeserve and in addition includes a news service provided by the Press Association, e-mail addresses and 5MB of space to set up your own web site. The aim is to increase the number of internet users in the UK and thus sales of PCs, modems etc. At present about five per cent of householders use the internet though 20 per cent have a PC.

British Interactive Broadcasting has dropped plans to offer limited internet access as part of its interactive satellite TV service. The company wants to emphasise that its service is an alternative to the internet for TV viewers.

Direct Memory International is marketing the WebPal internet box. Designed by NewCom Inc., the box incorporates a world wide web browser and an e-mail service, using a TV set or VGA monitor for the display. There are outputs for $S$ video, composite video or VGA monitor connection. A built-in $33.6 \mathrm{kbits} / \mathrm{sec}$ modem provides the telephone line internet link. The WebPal comes with a remote control unit, and a remote keypad is available as an optional extra. For further details apply to Direct Memory Intenational, Strand House, Main Street, Cork, Ireland. From the UK phone 0035321841222 , fax 0035321842 232. In Ireland it's 021 etc. The email address is sales@dmil.ie

## Servicing Qualifications

An agreement between the Electronics Examination Board and City \& Guilds has established a new Progression Award in electrical and electronics servicing. The award, which will eventually supersede the present Course 2240, provides 'underpinning' knowledge for the sector's National Vocational Qualification (NVQ). C\&G will oversee the written examinations while the EEB will administer and assess the practical side. Colleges and training centres are expected to start switching to the new system in September 1999.

An agreement signed last year established C\&G and the EEB as joint Awarding Body partners for the Electrical and Electronics Servicing NVQ.

## Ross becomes Recoton

Ross Consumer Products is to move from Bolton to Walkden, Manchester and will in future be known as Recoton UK - Recoton is the name of its US parent company. The new address is Recoton UK, Towngate Business Centre, Lester Road, Walkden, Manchester M38 OPT, phone 0161702 5000, fax 01617025001 , e-mail

## info@rosscp.com

Recoton is a major electrical accessory company with over twenty consumer brands. These include Acoustic Research (computer accessories) and Jensen (automobile and home audio products).

## Free Advice

The advent of digital transmissions has prompted the BBC to revise its arrangements for providing technical information. A new reception advice service is available from 8 a.m. to 7 p.m. Monday-Friday on 08700100123.

Granada has set up a service to answer queries relating to digital TV. The number to call is 08000562772 .


CPC has released its latest catalogue, dated 1999 Over 72,000 products are listed in the 2,216 pages - the range includes electronic, electrical and mechanical spares and accessories. Aiwa, Philips, Sony and TDK are amongst the leading brands represented. Over 10,000 new products have been added.
Thousands of new cross-references have been added to the video heads and spares range, while layout improvements include a new calculator/watch battery chart with additional equivalents and a camcorder battery table with model and battery type cross-references. Various product ranges such as laboratory equipment, white goods and plumbing, have been removed from the main catalogue to their own separate brochures.
The new catalogue is available to CPC account holders free of charge. To open an account, phone 01772654455 or go to CPC's web site at www.cpc.co.uk
There is also a comprehensive, pocket-sized crossreference remote control booklet that lists over 10,000 models. It includes both manufacturers' original and compatible remote control units. Copies can be obtained free of charge - quote order code SUREMOTE.
CPC has reached an exclusive distribution agree ment with Akura. Over 5,000 spare parts for the full range of Akura products will be stocked. As with all original manufacturers' spares, CPC is offering a Partinder service to enable customers to check prices and availability without having to quote a part number - the make, model and a brief description enable the item to be identified.


Labgear has restyled its range of MultiSet signal boosters and has introduced new packaging to make clear to customers the uses and benefits of a signal booster. The I-way booster has been renamed Handyboost while the 2-, 3-and 4-way signal booster-distributors are now named Handylink 2, 3 and 4.
For further details of Labgear products phone 01223366521 or fax 01223316 483.

## STBs that Record?

It has been suggested that the next step in the development of digital set-top box technology will be to add a record facility. By incorporating a computer hard disc system, several hours of programmes could be stored for subsequent viewing. As the cost of hard disc storage is falling rapidly, this is a prospect that could well be realised within the next couple of years or so.

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\left.\begin{array}{r}
\text { What will be } \\
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\text { integrated digital } \\
\text { TV receivers start } \\
\text { to come your } \\
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$$ K.F. Ibrahim ${ }^{*}$ provides an introductory guide based on the technology in current use



## infrocturfionitio

 Digital TV Servicing*K.F. Ibrahim is a Senior Lecturer at the College of North West London.
This article is an edited extract from the forthcoming second edition of Mr Ibrahim's book Television Receivers, published by Longman.

Although we talk about digital TV, the signal picked up by an LNB (assuming a satellite transmission) is an analogue one. It consists of I (In-phase) and Q (Quadrature) modulated carriers. This is the signal handled by the tuner, which in addition to producing the IF signal incorporates synchronous demodulators to provide analogue I and Q outputs. See Fig. 1. These signals have to be converted to digital form before they can be passed to the digital processing and decoding section of the receiver. Hence the dual ADC shown between the tuner and the digital processing section. The final outputs, whether in UHF, composite video or RGB form, or multichannel sound, are of course again in analogue form.
Thus a digital TV receiver/decoder can, for the purposes of servicing, be looked at as consisting of separate analogue and digital sections. The analogue parts comprise the tuner at the front end and the PAL encoding and UHF modulator (if required) sections at the back end. The digital parts consist of the digital processing and decoding that's carried out in between, the software programming and control section, and the ADC and DAC converters.
Fault-finding in digital set-top boxes and integrated digital TV receivers will follow fairly conventional practice the use of a logic probe and/or oscilloscope to check data, address and control signal paths, and the use of a meter and oscilloscope to check the conditions at the pins of the various ICs used.

## Signal Tracing

Tracing the path of the signal is a logical way of locating a faulty stage. It involves checking both analogue signals and digital data streams at relevant points through the
decoder/receiver. The absence of a signal such as the I or Q modulation or a data stream will result in total failure of the picture, sound or both. Partial failure, such as a single data or address line fault, may result in total or intermittent picture loss, a broken up picture, loss of or distorted sound or both.
A logic probe can be used to check the presence of digital bit streams. It's a logic-state test instrument that indicates the logic state at the test point selected. Indication is given of logic 1 (high), logic 0 (low), an open-circuit condition or the presence of a data stream.
Two indicator LEDs indicate high or low. If there's an open-circuit or an indeterminate logic state, you get no illumination from the LEDs. The presence of digital activity (a bit stream) is shown by flickering LEDs or a special indicator. Use of a pulse stretcher will enable pulses as narrow as 10 nsec to be detected.
Although a logic probe doesn't enable waveforms to be examined, it nevertheless provides a fast and simple method of checking for digital activity. When you need to examine real-time waveforms, an oscilloscope has to be used.
An oscilloscope will display analogue and digital waveforms, enabling amplitude, frequency and time measurements to be made. The analogue signals in a digital TV receiver are not dissimilar to those in an analogue receiver, and can be displayed by a normal analogue oscilloscope that has adequate bandwidth. To examine data bit streams however a digital storage oscilloscope with a minimum bandwidth of 100 MHz and a sampling rate of 500 million per second or over is required. It can also be used to display and examine analogue signals.


Fig. 1: Simplified block diagram of a digital satellite $T V$ decoder, to show the analogue and digital sections. A digital terrestrial TV decoder follows the same lines, the main difference being in the form of the received modulation - QPSK with a satellite transmission, COFDM with a terrestrial transmission - and hence the type of digital decoder required.

A storage oscilloscope captures part of the data bit stream, stores it and then displays the waveform on its screen for examination and measurement. This is repeated for another part of the data stream and so on. Unlike analogue circuitry, in which a test point will have its own unique signal in terms of waveshape, frequency and amplitude, the sequence of ones and zeros in a data stream has the same general waveshape and amplitude regardless of its location in the overall circuit.

## Timing and Control

In a microprocessor-based system, failure can occur because of wrong or missing clock signals or incorrect timing of data and control signals. A timing/synchronisation fault can result in partial or total failure of the system. A multi-trace oscilloscope enables the timing and synchronisation of several data and control bit streams to be checked by displaying two or more data streams simultaneously. A typical multi-trace display, showing the time relationship between the chip select (CS) and output enable (OE) control signals, a data line and the clock input to a memory chip, is shown in Fig. 2.

## Checking a Suspect Chip

The absence of an output from a digital signal processing chip does not necessarily mean that the chip is faulty. In microprocessor controlled and based systems, the absence of an IC output could be the result of one of several factors. Clock pulses could be missing; a control signal could be missing or incorrect; there could be a software routine problem; errors could be present on data or address lines; an associated memory chip could be faulty; a reset state could be incorrect; and of course a DC supply could be low or missing.
In general, before a suspect IC is replaced the following should be checked:
(1) That the IC is receiving its DC supply voltage at the relevant pins. If not, trace the supply back to source to find out where it goes missing. There could be a shorted decoupling capacitor, a dry-joint, a print crack, an open-circuit filter coil, an open-circuit feed resistor or switching transistor or a fault at the regulated source.
(2) That the chip is operating at the correct clock frequency. Use an oscilloscope to check the clock pulses. A counter will check their frequency. Where the chip has
more than one clock input, they must all be checked.
(3) That the chip is receiving the correct instructions from the microprocessor or microcontroller chip or both. This involves checking control signals and data and address lines.
(4) That the software in use is valid and up-to-date.

The DC checks can be carried out using a digital voltmeter (DVM) to measure the voltage at the relevant pins of the chip. The clock signal can be checked using an oscilloscope with an adequate frequency response. The clock pulses must have:
(1) A fast-rising square shape.
(2) An amplitude of between $3 \cdot 5-5 \cdot 25 \mathrm{~V}$, nominally around 4.8 V (assuming operation with a 5 V supply).
(3) The correct frequency, which can be calculated from the periodic time of the waveform.
The control lines can be checked by using a logic probe to test for digital activity or a storage oscilloscope to examine the waveforms of the various signals, such as chip select (CS), acknowledge (ACK), read/write (W/R), strobe (STR) and interrupt request (IRQ). Use a logic probe or DVM to check the reset (RST) line. It's normally active low, i.e. when taken low it resets the chip, after which it goes high. Thus an active-low reset line should normally be high. The data and address lines can be checked for digital activity using a logic probe or an oscilloscope.

Fig. 2: A mulfitrace oscilloscope enables the fiming and synchronisation of various data and control bit streams to be checked. The pulse streams shown here relate to a typical memory chip.



Fig. 3: Block diagram of the channel decoder section of the receiver, incorporating the digital demodulator and FEC.

## Software

Faulty software, i.e. out-of-date, deleted or corrupted, may interrupt a data stream. Software processing routines are usually stored in a flash memory chip. Rewriting or upgrading can be carried out by using a PC linked to the receiver via an RS232 port - the PC loads new software in the flash memory. The alternative is to replace the flash memory with a newly programmed one.

## Checking the Tuner

The tuner carries out the usual functions, i.e. frequency conversion, amplification and filtering, plus synchronous demodulation of the input to produce analogue IF outputs that carry the digital modulation. Synchronous demodulation is similar to the demodulation of the chroma signal in a PAL decoder. The local oscillator is controlled by an AFC voltage that's obtained from the subsequent digital demodulator. Fig. 1 shows the basic inputs and outputs.
When the tuner switches on it attempts to lock to a default known as the 'home channel'. If it fails to do so, a search sawtooth waveform appears at the AFC input pin. At the same time the AGC input produces maximum tuner gain. A DVM can be used to check the LNB supply/switching voltage.

## Checking the Channel Decoder

This is the section that follows the dual ADC, see Fig. 3. The signal inputs consist of the digital I and Q QPSK (Quadrature Phase Shift Keyed) carriers in the case of a


Fig. 4: Block diagram of the transport stream demultiplexer section of the receiver. The demultiplexer sorts out the transmitted MPEG data packets, selecting the ones required for the programme being received.
satellite transmission or, in the case of a terrestrial transmission, the band of I and Q COFDM (Coded Orthogonal Frequency Division Multiplex) carriers.
The function of this section of the receiver is to convert the incoming carriers to a digital data stream known as the transport stream, i.e. digital demodulation, and to carry out forward error correction (FEC). The former operation is carried out by a QPSK or COFDM processor chip. Forward error correction compensates for errors in the received signal.
The general procedure for testing data processing/decoding chips is to check:
(1) The input and output data streams.
(2) The processing and other clock signals.
(3) The microprocessor control and communication signals.
(4) Any memory data/address bus and control signals.

To test the channel decoder section of the receiver, check the output data lines that provide the transport data stream (TS) one by one for digital activity, using a logic probe or an oscilloscope. The transport stream consists of packets of MPEG data (compressed video and audio).
The sampling clock output to the dual ADC is normally set at twice the symbol (modulation) rate. With a symbol rate of 27.5 Msymbols per second, the sampling clock will run at 55 MHz . This clock pulse stream should be present even when there is no input to the receiver.
If there are no transport data signal outputs, check the I and Q inputs, the operation of the sample and reference clocks, then the control signals and the microprocessor data and address communication buses. Some of the control signals and their characteristics are as follows:

MPEGSTART output: Goes high for the first byte of each transport stream MPEG data packet.

MPEGFAIL output: Goes low if the packet contains errors (despite the FEC).

DATAVALID output: Goes high for the 188 bytes of the packet and low for the following 16 checksum bytes.

SYNC output: Goes high when the data synchronisation is correct.

RST (reset) input: This is normally high if 'active low' (to reset) and vice versa.

SCL: The $\mathrm{I}^{2} \mathrm{C}$ control line clock pulse input.
SDA: The $\mathrm{I}^{2} \mathrm{C}$ data line.

## Checking the TS Demultiplexer

The inputs to the transport stream demultiplexer chip, see Fig. 4, include the MPEG data packets and the MPEGSTART, MPEGFAll and MPEGCLOCK signals from the channel decoder. Its function is to sort out the MPEG data packets as required, reassembling the video and audio packets for the selected programme in the correct order. The packets are then passed to the MPEG video and audio decoders.
If any video or audio output data line is inactive, check the control inputs from the channel decoder then the 25 MHz demultiplexer and the 27 MHz pixel system clocks. If a clock signal is missing, check back to source.

The conditional access module (CAM) is connected to this section of the receiver. To test it, check the input and output data streams to and from the CAM interface, first with an encrypted programme then with a 'free' (unencrypted) programme. The CAM control signals should also be checked, using a logic probe or an oscilloscope. These are as follows:

BCLOCK (byte clock): Provides the delay required to unscramble data.

DSTARTIN: Goes high for the first byte of a data packet.

DVALIDIN: Goes high when the data is free of errors.
Check the demultiplexer control lines for digital activity - CS (chip select), R/W (read/write), IRQ (interrupt request), RST (reset), SCL ( $\mathrm{I}^{2} \mathrm{C}$ bus clock) and SDA ( $\mathrm{I}^{2} \mathrm{C}$ bus data). These lines are only occasionally active of course.
Absence of video data output could be the result of a faulty VSTROB (video strobe) output or a faulty VREQ (video request) input from the MPEG video decoder. Data transfer between the demultiplexer chip and the MPEG video decoder chip occurs only when the latter activates VREQ to indicate its readiness to receive data. The MPEG data is then strobed through by the VSTROB signal.
Similarly for the audio output, which is a serial data line. In this case the MPEG audio decoder activates AREQ and the data is strobed by ASTROB.
The associated SRAM memory chip can be tested by checking for digital activity on its data and address lines and the read/output enable (OE) and write enable (WE) control lines. The chip enable (CE) line, being active low, should normally be low. A faulty SRAM memory chip will result in total video and audio failure.

## MPEG Video Decoding and Digital PAL Encoding

These sections of the receiver are shown in block diagram form in Fig. 5. The MPEG video decoder converts the received data packets into multiplexed luminance (Y), red chroma (CR) and blue chroma (CB) digital data. The input and output data streams can be checked using a logic probe to test for digital activity or an oscilloscope to display real-time waveforms.
Check the 27 MHz pixel system clock and the decoder processing clock, then the two lines VREQ and VSTROB that control the transfer of data between the MPEG demultiplexer and decoder chips. Also check the microprocessor bus and control signals.
The associated DRAM chip can be tested by checking its data, address and control lines. A faulty DRAM chip will result in total video collapse. Partial memory failure, such as a single data or address line failure (open-circuit, permanently high or permanently low) could result in no picture or an intermittent or broken-up picture.
The video input to the PAL encoder chip is still in digital form. This chip converts the input to conventional analogue RGB and composite video outputs.

## MPEG Audio Decoding

The MPEG audio decoder chip (see Fig. 6) receives serial PCM (Pulse Code Modulated) data from the demultiplexer chip and converts it to digital stereo left and right audio outputs. Two control signals, AREQ and ASTROB, regulate the transfer of the compressed data from the demultiplexer to the MPEG decoder chip.
The decoder is followed by a digital-to-analogue con-

verter which has sampling clock and audio data inputs. These can be checked by logic probe or oscilloscope as previously outlined. A simple analogue oscilloscope can be used to check the outputs.
The decoder chip has an associated DRAM chip which can be tested in the normal way. A faulty audio memory chip will normally cause loss of the audio signals. Partial faults cause loss of sound sync or intermittent or brokenup sound.

## Start-up Sequence

A set-top box is normally never switched off: it remains in the standby mode when not in use. Its microprocessor, microcontroller and the processing chips remain set and ready to receive and process data.
When a receiver/decoder is switched on from cold however it goes through a comparatively lengthy process of setting, initialising, configuring and programming the control and signal processing chips. This involves the downloading of software routines from a flash memory chip to the microprocessor, DRAM memory and other chips. The process is known as the start-up or boot-up sequence.
The main stages of the start-up sequence are as follows:
(1) The power supply voltages build up to the operating levels.
(2) The microprocessor and microcontroller chips are set by taking their respective RST pins to 5 V .
(3) The other processing chips are set in the same way.

Fig. 5: Block diagram of the MPEG video decoder and digital PAL encoder sections of the receiver.


Fig. 6: Block diagram of the MPEG audio decoder and DAC sections of the receiver.

Fig. 7: A simple logic circuit, with four NAND gates, used for pulse steering. See testing logic devices.

(4) Software is downloaded in two stages. The first relates to the microprocessor and microcontroller chips, with digital activity present on the micro bus and control lines only. The second stage involves initialising and programming the channel decoder, the transport signal demultiplexer and the MPEG video and audio decoder chips.
(5) The sampling frequency generated by the digital demodulator is set.
(6) The channel decoder begins to search for the default channel, known as the home channel. If a signal is detected, the channel decoder locks to it and data is received, processed and decoded. Picture and sound are then produced.
If the home channel cannot be detected, the channel decoder searches for other default channels. Failure to lock to any incoming signal is indicated by a "no signal" message on the screen.
The start-up process, which takes up to two minutes to complete, is made known to the user by means of coded

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So if you buy your issues of Television from a retailer and want to make sure that you get every issue, just ask at the counter.

[^0]symbols on the receiver's LED display and messages on the screen.

## Testing Logic Devices

Digital TV receivers incorporate a large variety of logic devices such as gates, flip-flops, counters and inverters. These can be checked for stuck-at faults (stuck at one when a pin is shorted to the supply line, or stuck at zero when a pin is shorted to chassis) and open-circuit faults. Such faults are usually caused by a failure within the IC. Stuck-at and open-circuit faults can be detected by using a logic pulser in conjunction with a logic probe.
The logic pulser will change the logic state at an IC or test point then change it back again, i.e. it drives a low pin high then low and a high pin low then high. Testing a logic device such as a gate consists of using the pulser to alter the conditions at an input pin and checking the effect at the output with the logic probe.
Consider for example the simple steering network shown in Fig. 7. It's used in a Pace receiver-decoder to set the read (RD) and write (WR) control signals fed to the modem controller chip. A 7400 quad NAND chip is used to provide the steering. Gate A can be checked by placing the pulser at pin 2 and using a logic probe to monitor the output at pin 3 . Since the other input (pin 1) is at 5 V , changing the state at pin 2 should result in a change at the output pin indicated by a flicker on the probe. No probe indication suggests a fault in the circuitry connected to pin $2, \operatorname{pin} 3, \operatorname{pin} 10$ or pin 12 . Repeat the process at the other gates until the source of the stuck-at fault (if one is present) is found. It can be confirmed by placing both the pulser and probe on the suspect pin. The diagnosis is confirmed if pulser operation doesn't result in a flicker from the probe.
Once an IC pin is identified as being stuck at zero or one, the cause of the short-circuit to earth or the DC supply voltage respectively must be established. If pin 8 (Fig. 7) of the chip is found to be stuck at zero for example, either this pin or pin 55 of the following modem controller chip is shorted to chassis. Identifying where the fault lies can be done by checking with a very sensitive ohmmeter or by using a current tracer in conjunction with a pulser.
A current tracer senses the magnetic field created by a flow of fast-rising pulses, giving an indication of their presence by means of an indicator light or a constant-tone sound. The power must be switched off when a current tracer is being used. Place the pulser at one of the suspect pins, say pin 8 . If the short-circuit is at pin 55 of the modem control chip, pulses from the pulser will flow from pin 8 to pin 55 . The tracer will detect the presence of the current at pin 55. If the short-circuit was at pin 8 however there would be no current pulses at pin 55 .

## In Conclusion

The chip function divisions assumed in this article relate to the current generation of digital TV processing chips. It's likely that increasing numbers of functions will be integrated into fewer chips as the technology develops. See for example the article on pages 698-701 of the August issue of Television.
So there we are, for the moment anyway. Good hunting!

For course information on digital television servicing see advertisement on page 74 of this issue.

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Vann Draper is offering over 30\% discount to readers of Television on two professional-quality hand-held multimeters.
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## Key specifications

| DC volts | $200 \mathrm{~m}, 2,20,200,1 \mathrm{kV}$ basic accuracy $0.25 \%$ |
| :--- | :--- |
| AC volts | $200 \mathrm{~m}, 2,20,200,750 \mathrm{~V}$ basic accuracy $1.2 \%$ |
| DC current | $200 \mu, 2 \mathrm{~m}, 20 \mathrm{~m}, 200 \mathrm{~m}, 20 \mathrm{~A},(2 \mathrm{~A} \& 10 \mathrm{~A}$ LP310 $)$ |
| AC current | $200 \mu, 2 \mathrm{~m}, 20 \mathrm{~m}, 200 \mathrm{~m}, 20 \mathrm{~A},(2 \mathrm{~A}$ \& 10 A LP 310$)$ |
| Resistance | $200,2 \mathrm{k}, 20 \mathrm{k}, 200 \mathrm{k}, 2 \mathrm{M}, 20 \mathrm{M} \Omega,(2000 \mathrm{M} \Omega \mathrm{LP} 310)$ |
| Capacitance | $2 \mathrm{n}, 20 \mathrm{n}, 200 \mathrm{n}, 2 \mu, 20 \mu \mathrm{~F}$ |
| Frequency | $(\mathrm{LP} 310) 2 \mathrm{k}, 20 \mathrm{k}, 200 \mathrm{k}, 2 \mathrm{M}, 20 \mathrm{MHz}$ auto range |

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AC \& DC current to 20A
Resistance \& capacitance
Diode, continuity \& transistor tests
Overload protection
Protective rubber holster
Features of the LP310
3.5 digit 44-range dmm

AC \& DC volts
$A C \& D C$ current to 10A
Resistance \& capacitance
Diode, continuity \& transistor tests
Frequency to 20 MHz
Logic test
Overload protection
Input warning beeper Auto power off, data \& peak hold Gold-plated switch contacts
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## Test Report

> New soldering equipment is required to deal with digital circuitry on high-density PCBs. Steve Beeching tries out an advanced system designed to meet the need and also cope with standard soldering requirements

## The JBC

 Advanced Soldering Station

At the RETRA Servicing Conference in Solihull last summer I gave a live demonstration of surfacemounted IC removal. While many of my peers probably thought this a little foolhardy, I was confident that the job could be done with little difficulty - because of the excellent performance of the soldering/desoldering equipment I would be using. The most up-to-date soldering and desoldering equipment was on show and being demonstrated in the foyer of the hotel where the conference was held. Amongst the equipment there was a new soldering station.
The JBC Advanced soldering station is a third-generation design whose soldering iron uses a new temperature-control system. A single, 50W maximum power unit provides heating for one or other of two types of soldering pencil. One is rated at 10 W and has a selection of small tips. The other is rated at 40 W and comes with a selection of slightly largersized tips. Both are lightweight, the 10 W iron weighing 15 g while the 40 W weighs 25 g . But there's more to it than that!

## Tip Heating

With the advent of digital technology arranged on very high density PCBs, component removal and replacement presents an accessibility problem. The need is for a very small tip, in the region of $0 \cdot 2-0.4 \mathrm{~mm}$, conical or chisel shaped. If a large, tapered tip that's heated from the rear is used, see Fig. 1(a), there will be heat loss throughout the length of the tip, with inadequate temperature control at the sharp end.
Solder reflow depends on the thermal mass of the tip to provide enough heat. When a tip relies on thermal conduction through its mass, this must be reasonably large if adequate heat is to be generated. It is difficult getting adequate heat conduction to the tip when there's a long taper that ends in a very small tip. As the taper narrows to 0.3 mm or so, the cross-section through which the heat travels is reduced. This restricts thermal flow.
If the soldering job consists of a component lead that's connected to a large print land, or a very small component connector with metal tags, it's difficult to maintain the reflow temperature. As the end of the tip cools, because of thermal loading, heat replenishment is required. But with the small cross-section, insufficient heat is delivered to the end. At best you get a 'cold' joint of semi-crystalised solder; at worst the iron may adhere to the PCB as the tip rapidly
cools. There's a trade-off with the temperature setting: either too hot, with the result that burning tarnishes the tip, inhibiting solder 'wetting'; or too cool with the result that the solder at the joint doesn't reflow. You can get round the problem by applying additional liquid flux and having a very small reservoir of solder on the tip, but this calls for experience and skill.
Burning much reduces tip life when an iron is left powered during idle periods - the heat then has plenty of time to travel to the end of the tip. This means high tip costs. The iron can obviously be switched off when not in use, but switching off can be very frustrating for a technician who wants to complete a quick resolder. The reheat time may be 90 seconds - even a minute can seem a long time!
The solution adopted by JBC is to use the tip itself as the heater element, see Fig. 1(b). Tip design can then be tailored to control the heat directly, where and in the quantity required.
A demonstration of the high power that can be provided in this way by a small tip was given by Willow Vale Electronics: a 2p coin was heated and solder was flowed on to it. This is made possible by tight control of the power delivery and thermal flow.
When Darron and I saw this we realised that the JBC Advanced soldering station promises the sort of performance required for delicate work on the tiny circuits used in digital camcorders. The tip also takes just two seconds to reach its working temperature, which can be closely controlled to within a few degrees during constant use. We tested the equipment by soldering tiny connectors on digital PCBs. In the photo opposite the elbowed tip's diameter is 0.3 mm and the ruler markings are 0.5 mm - this sort of work is always carried out using a binocular microscope.

## JBC Model AD2000

Use of the JBC Advanced tip, which incorporates the heater and temperature sensor, enables the heat to be delivered exactly where and as required. The tip heating time has been improved from around 90 seconds to two (see Fig. 2). There is also improved tip temperature control while in use (see Fig. 3). And by delivering the heat directly to the tip, the working temperature can be reduced. Whereas a rear-heated tip power unit would be set to $350 / 400^{\circ} \mathrm{C}$, the JBC unit
can be set to just over $300^{\circ} \mathrm{C}$ for the same task using an 0.3 mm tip.

A further advantage, for tip life, is the intelligent soldering iron stand. When the soldering pencil is docked in the stand its presence is sensed and the tip temperature is reduced to about $120^{\circ} \mathrm{C}$. This prevents tarnishing and burning of the fine tips, extending their life.
Part of the stand is used for tip changing. The tip is placed in the extractor's V-shaped grove and the pencil-type holder is retracted, leaving the tip. In this position, power is removed. The holder can then be moved to an adjacent tip and pushed on. When the soldering pencil is moved away from this position, power is restored and the new tip quickly heats up. The pencil can be docked in the tip extractor position to 'power off'.

## Use

In use I found that there was a very short but noticeable delay when alternately picking up and putting down the soldering pencil. I had to solder some small cables to a connector: each cable had to be positioned then soldered. Although the pencil heats up in two seconds, there was a noticeable 'pause' between picking it up and soldering the cable. It was a very short pause, in fact less than a second. With a continuously heated tip you would dock, use, dock, use, dock, use etc. With the JBC pencil it's a case of dock, pause, use, dock, pause, use etc. This is not a criticism, just something you notice.
For continuous soldering of a through-hole IC there was plenty of heat capacity from joint to joint, with no delay. This despite the fact that the tip is very small, too small for the job by normal standards.
The soldering pencils are well suited to continuous use and occasional use, with their quick heat-up time and enough heat capacity for tuner case lugs. The close temperature control means that the pencils are ideal for high-density PCBs with small, surface-mounted ICs.
Dry-joints at the tiny IC connectors in digital camcorders were resoldered more easily than with a conventional tip, and the heat at the end of a microfine tip will deal with metal tags. A 168 PQFP IC with three legs per mm was successfully removed and a replacement soldered to the PCB. Leg-to-leg soldering with 0.3 mm solder was improved. Where space is tight, we found that the legs can be fluxed and solder then applied, using the tip as a reservoir. I was able to wipe solder two-three legs at a time using the tip as a reservoir.

## JBC Tips

The sizes of the JBC Advanced tips range from $0.3-2.3 \mathrm{~mm}$ for the 10 W pencil, with straight or elbow versions. The smaller tips are not available for the 40 W pencil, the sizes ranging from $1-4.8 \mathrm{~mm}$. There are two special tips for the 40 W pencil, a straight spoon and an elbow spoon: spoon refers to a hollow tip indentation that acts as a reservoir for solder when wipe-soldering the legs of QPF and PLCC ICs.

## Summary

The advantages of the JBC Advanced Soldering Station are: lower tip temperature; reduced tip burning; longer tip life; improved 'wetting'; less heat reduction from components or the PCB acting as a heatsink. The single power unit will drive either a 10 W or 40 W soldering pencil.
The system is available from Willow Vale Electronics Ltd., 11 Arkwright Road, Reading, Berks RG2 0LU. Phone no. 01189876444 , fax 01189867 188. System AD2000 is available under order code 23800 AS at $£ 157$. This includes a 10 W pencil and two tips.
The 10 W pencil type AD 2010 is available separately under order code 23800 AQ at $£ 29$; the 40 W pencil type AD2045 is available under order code 23800 AR at $£ 36$.


Fig. 3: Comparison of the heat control of the tip with a JBC Advanced and a conventionaltype tip.

Below: Use of an 0.3 mm tip with elbow to reflow the soldered connections to a small surface-mounted chip.



## Amstrad SRD400

Why do public houses have the oldest systems? Maybe because the Amstrad SRD400 has proved to be a reliable workhorse and publicans know how to be careful with money! Bert Wetherill, who runs the Horse and Hounds, is no stranger to thrift.
"It won't cost more than a tenner?" he said forcefully, "'cause I can get another at the car boot sale on Saturday. Only it would be real nice to have it back for the match tonight. Plus, you don't want the price of your pint to rise, do you?"

He didn't smile either. So I decided to get on with the repair immediately!

The problem seemed to be a low LNB supply. My meter showed that it switched between 10.6 V and 13.4 V . Of course I wasted half an hour messing with the regulator circuit before I realised that there was a dry (corroded) joint on the big $4,700 \mu \mathrm{~F}$ reservoir capacitor. If I'd plugged the TV monitor in I'd have seen the hum bars immediately - but I'm far too clever for that! I had to measure voltages first and confuse myself by assuming that I was measuring smooth DC. I've known other

## Workshop

competent repairmen be caught out by supposedly 'low secondary voltages' from power supplies. I always recommend using an oscilloscope to check the outputs from the power supply, since it will show instantly whether a voltage is smooth or has sawtooth spikes on it. One day I'll take my own advice.

Once this had been put right another problem was evident: although the channel number changed when I pressed the 'up' button, the picture didn't. It alternated between just two programmes one each for horizontal and vertical polarisation. Measurement showed that the tuning voltage was low at only 3V. Replacement of TP504 (2SK301) and IP504 (AN431) cured the problem.

## Flashing Lights

"The power went off and now the red light is flashing. I'm afraid to turn it on in case it goes bang!"

Now Jimmy is a timid person at the best of times. He's been a gardener all his life and still prefers gas mantles to electric lights, so his fear was understandable. All modern Grundig-based receivers and BT receivers flash an LED when first connected however. They do this simply to remind you to set the internal clock, in case you decide to use the timer function to record a programme. Even the old Amstrad SRD5 10 flashes its lights after a power cut if the timer had been set. It never ceases to amaze me how many dealers phone me about this type of "fault". Am I the only person in the world who reads user manuals?!

I stuck a piece of black tape over the offending LED and handed the receiver back to Jimmy. He doesn't own a VCR, so he won't be setting the timer.
"Thanks, Mr Armstrong. I'll cut your grass, shall I?"

## Grundig GRD150

These Grundig receivers apparently had an incredibly low failure rate during the warranty period. They are making up for it now!

When Derek, a local installer, brought me a GRD150 and described the fault as "horizontal line on picture" I wondered whether he meant a hum bar and plugged the
mains lead in at arm's length.
A horrendous buzzing noise came from the power supply, so I pulled the plug out quickly. I didn't need a magnifying glass to see that C201 $(47 \mu \mathrm{~F}, 400 \mathrm{~V})$ was bulging.
"Wow" Derek breathed, "it was giving quite good pictures before it cooled down. Just that line across and occasional scrambling. Is it repairable?"

I assured him that it was, and quickly replaced the offending capacitor with one I'd previously taken from a beyond-economicrepair Minerva. The result was perfect pictures and no more buzzing.

Derek paid up with good grace and drove off to fleece his customer.

## Early Pace Receivers

A common problem with very old Pace receivers such as the SS9000IRD and its clones is that contact between the internal decoder connector and the main board pin connector can fail. The result can be faint decoder messages and intermittent operation. This is almost certainly the cause of the trouble if the decoder messages on the TV screen shift when the receiver is tapped. A quick but temporary fix is to spray a little WD40 on to the connector and work it up and down a few times. Do this with the receiver unplugged. But beware: an old Pace receiver may destroy its power supply when you plug it back in . The cause of this is degradation of the electrolytic capacitors in the power supply - as a result of heat over a number of years. For this reason it's best to deal with the problem in the workshop, and to replace the capacitors (you'll find them in Relkit 2 - phone 01270753 311 for details) before the receiver is plugged in for test.

With these 60 -channel models the decoder must be selected and stored in the channel menu for each scrambled channel - unlike later models, they don't recognise a scrambled channel automatically. So the symptom "no decoder messages on some channels" usually means that the factory reset sequence has been pressed or there has been a mains brown-out. "Reprogram each channel to read "decoder INT" and "AV INT".

If you get a similar problem with
the later PRD and MSS series receivers, check whether the contrast value has been set at less than 4 in the installation menu.

I am often asked whether an enhanced LNB can be used. This shifts the frequency of all channels 250 MHz higher to bring the Astra 1D channels within the tuner's range. If the receiver can be tuned high enough, it will receive all the available channels - but each channel will have to be individually tuned in 250 MHz higher than its listed frequency. As 60 -channel receivers won't tune high enough, most Astra 1B chanels will be lost. Most 90-channel receivers will tune high enough to obtain CNN International, but only a few make it as high as Sky Sports 3.

As a rule of thumb: 60-channel receivers won't tune high enough; 90 -channel receivers might if they are fitted with the Hitachi BF9 tuner, not if they are fitted with the later Sharp tuner. If a replacement tuner kit has been fitted (this lies on its side) the tuning range will usually be adequate.

Early PRD receivers might tune high enough. In my experience they will definitely do so if a small modification is carried out beneath the tuner. A different microcontroller IC can be fitted to provide a menu
option for an enhanced or standard LNB. PRD receivers with this IC and all later models can be used with an enhanced LNB. Upgrade kits are available.

So the answer is to try the receiver with an enhanced LNB. If the receiver won't tune high enough, it might be possible to modify it in the workshop. If it will tune high enough, you can probably sell the customer a new LNB plus installation. Some owners will prefer this to buying a complete new system. Always ask if you can upgrade a receiver that's brought in for repair. The work is often so minor that it can be done at little extra cost.

If all else fails, you can use an enhanced LNB in conjunction with a Global ADX-Plus channel expander. This unit has an internal switch to select between shifting the frequency band up (standard LNB) or down (enhanced LNB) by 500 MHz .

## Pace PRD800

This unit arrived by carrier. I do contract work for a chain of public houses, and receivers often arrive unannounced! The VideoCrypt decoder message bars on screen were brilliant white, without any text, though the decoder worked perfectly.
$\square$
Jack Armstrong is willing to try to sort out readers' satellite TV receiver problems via e-mail. You can reach him via the internet at:

## jack@netcentral.co.uk

One model per message - state make/model and fault symptoms. If you have no e-mail facilities you can write to him c/o Television, Room L302,
Quadrant House, The Quadrant, Sulton, Surrey SM2 5AS. Please enclose two first-class stamps.

I replaced the decoder's graphics generator chip U27 (type TCE-
VCT01), but this made no difference. A helpful young man at Pace told me that the decoder messages are added to the video signal in U19 (4053). I found that pin 1 of this chip was permanently high at 12 V . The IC was faulty, a replacement restoring normal operation. Even the lads at Pace were surprised, as the fault had not been reported before.

By the way, if you use Pace's friendly help line and subsequently find the cause of your fault, please take the trouble to fax them back with details of the original symptoms and your cure. It helps everyone.

## Test Case 431

Most of the repairs carried out in the Test Case workshop are for our rental customers. The rental sets are mostly basic models which are hired out at rock-bottom prices, often as a package with a VCR. Despite our low prices, the customers expect first-class service - and they get it. Loss of a rental contract is regarded as a major disaster. So when Mrs Harrison rang up to say that her set was displaying a greenish picture Doc Colin was dispatched pronto to put things right.

The set concerned was a Tatung Model T21TD60. It uses the D series chassis, a simple and straightforward design first introduced about five years ago. Colin found that the picture was very much on the yellowish-green side. He advanced the setting of the blue background potentiometer on the tube base panel, and reduced the green potentiometer's setting. This restored good colour.

A week went by, the rain stopped, then Mrs Harrison was back on the phone. The picture was drifting towards yellow once more - could we call again? Of course!

This time Doc Colin brought the set back to the workshop for attention, leaving a loan set in its place. Because of summer holidays, the workshop staff was rather depleted. So it was that the job came to be assigned to Cathode Ray. He hoped that another tweak of the presets would be all that was required, but despite the fact that the picture lacked blue content the blue background potentiometer RV927 was almost at maximum setting. The red control RV917 was at near centre while the green control RV937 was about two-thirds advanced.

Perhaps the tube's emission had fallen? A check with the

CRT tester/rejuvenator showed otherwise, so it was now time for some real diagnosis! Ray started by measuring the voltages at the tube's cathodes. He found that the blue voltage was higher than the others. That would account for the lack of blue. When Ray set all three background controls to their mid-points the display was even worse: the screen became very yellow, and the blue cathode voltage was way above that of the red and green cathodes. There's no point in quoting a reading here, because it depends on picture content: Ray was using the workshop test pattern. From this commendable start, the diagnostic process went steadily down hill ...

Ray interchanged the BF869R and B output transistors. This made no difference to the symptom. He unsoldered the $4.7 \mathrm{k} \Omega$ background potentiometers and measured their resistance. They were all close to the correct value. Then he moved over to the main chassis, where the big TDA8361 jungle chip IC503 carries out colour decoding. He noticed that three BC547 transistors, TR301/2/3, are connected to its RGB outputs as buffers for the text and OSD signals. Could they be the cause of the problem? It didn't take long to disconnect their emitters from the board. It took even less time to see that this had no effect on the symptom. Ray reconnected the transistors and thought again.

He carried out scope checks at IC503's RGB output pins 20/19/18. With a colour-bar input the waveforms looked fine. There was a difference in their DC levels, but this didn't seem to be enough to cause such a large disparity between the blue display and the others. Was the IC to blame? Or had some other part failed? For the solution, turn to page 65.

# Digital Satellite TV 

## Hugh Cocks on reception problems, upgrades and setting up for digital satellite TV

## Nokia 9600 Software Upgrade

The Nokia 9600 digital receiver caters for both scrambled and unscrambled MPEG-2 DVB signals, but won't be able to decode the Sky Digital transmissions from $28 \cdot 2^{\circ}$ E unless an external conditional access module and card are made available by Sky (they are located inside the Sky digibox). As with most things in the digital and computer world these days, software upgrades that give the receiver more functions are available.
The current software version is CI (Common Interface) 2.3, though receivers often come with version 2.1 loaded. To confuse matters, version 2.2 was never officially released, though a Scandinavian customer of ours is convinced that his new 9600 at home is loaded with this software! The 9600 helpfully displays the version it has inside during the self-test procedure at switch on.

## Improvements

The latest software version allows favourite channel editing, which was not available with version 2.1. The 4:3 and 16:9 picture dimensions change also works. If you have an internet connection facility, go to www.nokia.com where the link to the mediamaster pages will be found, or enter

## www.nokia.com/products/multimedia/sw2info.html

The 9200 free-to-air only model (no conditional access module or card slot) also has an upgrade available, but I haven't a receiver to try it on. The upgrade is from FTA 1.0 to FTA 2.0 - the same internet page gives information on this model as well.

Table 1: Free-to-air services at $13^{\circ} \mathrm{E}$.

| Service | Frequency | Polarisation |
| :--- | :--- | :--- |
| RAI (Italy) | 11.804 GHz | vertical |
| Mediaset |  |  |
| (Italian commercial) | 11.919 GHz | vertical |
| NTV (Russia) | 11.938 GHz | horizontal |
| Fashion TV | 12.245 GHz | horizontal |
| NBC Europe | 11.021 GHz | vertical (see text) |
| Hungary | 12.149 GHz | vertical |
| Travel TV | 12.188 GHz | vertical |
|  |  |  |

It's possible to do the upgrade directly over the internet via a PC - connect a serial null modem cable between the PC's RS232 socket and the Mediamaster's socket. You first have to download the serial download server software, plus the new mediamaster software, and store it on the computer's hard disc. Full information is available at the Nokia web pages mentioned above.

## Off-air Procedure

The upgrade is also available over the air from the $1^{\circ} \mathrm{W}$ satellite position. This is easier to do provided you have access to the $1^{\circ} \mathrm{W}$ Nordic satellite grouping. When looking for this satellite, it's approximately due south in the UK. An 80 cm dish should provide enough signal. Key in 11.174 GHz horizontal polarisation and adjust the dish for the maximum red-bar display in the receiver's search menu.
Once the channel search has been done, store the NRK (Norway) International signal as channel 1 on the receiver's channel listing. It's at 11.174 GHz horizontal, symbol rate 22,500 and FEC $2 / 3$. At the time of writing this signal is unscrambled, because of a complication with subscriptions, but if it is scrambled this won't affect the upgrade process and the NRK INTERNATIONAL identification will be present to confirm the channel. Make sure that enough signal strength is present, and if possible that there won't be a heavy downpour of rain to attenuate the signal during the upgrade process!
Next, go to the installation menu and select the SOFTWARE UPGRADE option. Press the remote control unit's OK button. The receiver then checks to see if an upgrade is available. If there is, it will come back with an on-screen message of confirmation and will ask whether you wish to proceed. Press OK again and the upgrade starts!
The screen will go blank and the display will first display SELF TEST followed by OTA (over the air) UPGRADE. Within a minute or so the OTA disappears and UPGRADE starts to flash rapidly. The whole process takes around seventy minutes: the square block display to the right of the alphanumeric display will increase in height during the process. It's very important to ensure that the signal and power aren't likely to go off during this time!
When the seventy minutes are up the receiver will be ready for use - orice it has gone through the self-test
once again. Interestingly, the channels previously stored in the memory as a list are still present.

## Free-to-air Services

Eutelsat at $13^{\circ} \mathrm{E}$ has a number of non-scrambled services available, including Italian, Russian and the Fashion TV package - even Thailand TV!
Try entering the frequencies listed in Table 1. Enter all symbol rates as 22,500 and the FEC as $2 / 3$. If no results are seen, enter these parameters in the advanced channel search menu. The receiver should then automatically adjust its receiving characteristics to those of the incoming signal. I found this facility a great help recently when trying to locate NBC Europe's digital transmission now that the analogue one has ceased. I keyed in 11.010 GHz , vertical polarisation, symbol rate 22,500 and FEC $2 / 3$. Within a short time NBC was found - with actual characteristics 11.021 GHz , symbol rate 6,110 and FEC 3/4.
Note that the red signal-strength bar display at the bottom of both channel search menus seems to read the tuner's AGC. As NBC is a very low symbol-rate (and hence bandwidth) signal, the display reads between poor and medium though the received picture is fine. A signal like RAI at 11.804 GHz or even an analogue signal reading such as BBC . World at 11.618 GHz produces a much higher red-bar display.
A good future upgrade feature would be to indicate, prior to searching, whether a digital QPSK signal is present at the intended search frequency - the red-bar signal display happily deflects with an analogue signal present, and much time can be wasted searching for nonexistent signals. Once the receiver has started its search procedure, which can take several minutes, it can't be stopped manually.
If you've internet access a good source of digital signal information is www.satcodx.com - it's updated daily and also tells you whether the signal is scrambled.

## Swedish Reception

SVT has a Europe-wide service, called SVT Europa, via Sirius 2 at $5^{\circ} \mathrm{E}$. This satellite's horizontally-polarised signals can be received throughout Europe using a dish of no more than 80 cm . You need a universal LNB, as the signals are in the $11.7-12.5 \mathrm{GHz}$ band. The satellite's vertically-polarised signals cover only Scandinavia at high power, though the UK is within the 'fringe-area' of the beam as far as DX interest is concerned. Yet a third footprint covers NE Europe.
The SVT Europa service is encrypted, so a smart card and 'common interface module' (otherwise known as a conditional access module or CAM) are required. One of our customers wanted the service, so we obtained for him a Nokia Mediamaster Model 9602S. There are, at the time of writing, three models in this range - the 9600,9602 and 9610 . The latter has a telephone modem (for pay-per-view options) and an SCSI socket (for connection to a CD-ROM player). The 9602 has only the modem socket, while the 9600 has only the SCSI one. We didn't require either of these options however.
When you come out of standby the front panel display shows the software programming version that's loaded. This particular one had version 2.0. You can download more up-to-date versions from Intelsat at $1^{\circ} \mathrm{W}$, see above. There's also a lot of unofficial software for this model (and the 9500 series), but I've no experience of it.

## Subscription

TVX Connova (see later) supplies both the viewing card


The Nokia 9600 digital satellite receiver.
and the CAM for the SVT Europa service, for which the customer can apply by fax. They turned up within a couple of days by express delivery. The contract application form is in Swedish, and is therefore best left for the customer to fill in! TVX Connova handles a number of subscription TV services throughout Europe.

## Installation

The front of the Nokia receiver has a slot, slightly larger than a standard smart card one, where you slot in the CAM. This is a 'PCMCIA'-style device that's identical in size and connection to the Psion Gold card modem used with laptop computers. The viewing card slots into the CAM - it sticks out from the front panel in the conventional way.
There's no UHF modulator, but three scart sockets are fitted, one each for TV and video and one labelled 'sat'. If an analogue receiver is switched on (scart pin 8 going high) its signal is routed to the video and satellite scart sockets. The front panel, somewhat confusingly, says 'sat'. Normally the digital station name and channel number are shown.
Inserting the CAM proved to be a bit difficult, as not much is left exposed at the front of the receiver for the final hard push into the multiway connector inside. If this turns out to be a problem, it would be best to take the lid off the box. A diagram shows clearly which way up the CAM goes into the receiver and which way the card slots into the CAM (unusually, contacts upwards).

## Picture break-up and loss

As the quality of a digital signal decreases, the errors increase and the correction circuitry has to work harder. When it can no longer cope and overloads, mosaic squares appear in the picture. These are MPEG macroblocks that are held in the frame DRAM and haven't, because of the signal errors, been updated. If the errors increase, the picture will freeze and then be completely lost.
An MPEG macroblock is the digital signal segment used by the decoder for movement estimation and compensation.

## Locating the Satellite

Fortunately Sirius 2 transmits Cyprus TV in analogue form at 12.265 GHz with horizontal polarisation. So you can use an analogue receiver to find this. I used a current Pace receiver, set the LNB selection to 'universal' and the band to 'high' in the tuning menu. Other receivers may just display the IF, which is $1,665 \mathrm{MHz}$ with the 22 kHz tone on. This is important: if the LNB doesn't see a tone it will select only the low 10.711.7 GHz band and there will be lots of fruitless searching. Cyprus TV has the identification PIK at the top of
the screen, which helps, and colourful pictures of Cyprus are shown when programmes are not being transmitted.

## Setting Up

Once the dish has been aligned the Nokia box can be connected. This is fairly conventional, and a guided installation menu is provided. A universal LNB is the default setting, and Sirius 2 is satellite option 4 (though in practice this could be left on the Eutelsat or Astra name with no problem).
The Swedish TV parameters are entered in the 'antenna adjustment' menu. The frequency is 12.380 GHz , with horizontal polarisation, a symbol rate of 27,500 and FEC 3/4. These can be left in 'auto' if you wish.
The red-bar display at the bottom of the screen should indicate between 'medium' and 'good'. If the display shows 'low' when the Swedish frequency has been keyed in, check the dish alignment. This is only an AGC reading. If the Cyprus TV analogue frequency is keyed in the red bar will again deflect. The display could be used as a dish alignment check: key in both frequencies and see if the signal-bar deflects. If you enter a frequency below 11.7 GHz there should be no deflection as the satellite doesn't transmit in this range.
Once you are happy with the signal strength, press the OK button to start the channel search, indicated at the bottom of the screen. The receiver will start its search and, after a short time, should indicate that it has found SVT and also BET on Jazz - this is an unencrypted US jazz channel transmitted with SVT. Swedish radio international will be displayed in the radio listings.
The receiver is now ready to show pictures. Without the CAM and card, Swedish TV will be displayed as a name on the screen and on the front panel and there'll be a "No CA module" on-screen message. You will be able to receive the jazz station and Swedish radio however.
There's a small rectangular box to the right of the station name at the front of the receiver. It increases in height to become a square when a good-quality, low error-rate digital signal is being received. In practice reception is possible with a rectangular-shaped box!

## Other Stations

Other stations can be found at the same time in the search, listed after SVT. You can start a second search and enter different parameters - it won't result in loss of the original stations. An editing menu enables the station order to be altered and unwanted ones deleted.
Information on and parameters for digital services are available on a per satellite basis at web site www.satco.dx.
Further information on subscribing to Swedish TV can be obtained from TVX Connova, Box 304, 59124 Motala, Sweden. Telephone no. 0046141 56060, fax 004614156061 . E-mail tvx @connova.se. There’s an internet site at www.connova se.

## Dutch Problems

The Dutch digital package via Astra had a slight frequency change around in early August. Most viewers wouldn't have noticed, as over-the-air information told receivers how to retune themselves - provided they could detect the new frequencies. This has led to a problem with some DIY installations in our neck of the woods.
Several calls came from perplexed Dutchmen who had lost Netherlands 1, 2 and 3, the main channels, while RTL4, 5 and some others were still present. Just to confuse matters, the channel/programme identification was
still at the bottom of the blank screen.
I knew that Netherlands 1, 2 and 3 had previously been transmitted via Astra IF in the $12 \cdot 1-12 \cdot 5 \mathrm{GHz}$ band with vertical polarisation. What I needed was quick information on possible new frequencies. This was obtained from what's commonly known as the Satco DX internet site - www.satcodx.com. It lists satellites on a channel/frequency basis and immediately told me that Netherlands 1,2 and 3 plus some other channels had moved to Astra 1 G , at just above 11.5 GHz , and were now horizontally polarised.
Astra 1G's horizontally-polarised signals are available here in Portugal, but are at a much lower level than its vertically polarised signals. Horizontal Astra signals in the $11.7-12.5 \mathrm{GHz}$ band are not available here.
With this information it was easy to deal with the problem. The dishes at the DIY installations weren't accurately aligned. Before the change, a keen satellite viewer watching the receiver's on-screen signal-strength display (some receivers even produce an audio tone that increases with signal strength) could point the dish in more or less the right direction and get the signals. Now, spot-on alignment is required and the LNB's skew angle must be exactly correct.

## Skew Angle

As the vertically-polarised signals are much stronger, the LNB skew angle is critical. If, with an analogue signal, there's breakthrough of the vertically polarised signal you get a slightly inferior picture with the odd sparklie or two. But with a digital signal the result can be no picture at all or, at best, the picture being degraded, with jerky movements and a lot of pixel/square blocks on the screen.
Another effect, mentioned a lot less, is audio break up. The audio often doesn't go off quietly: it produces a nasty, loud unstable squeal - loud enough to wake up anyone asleep in front of the telly!
A simple check for LNB skew alignment where the vertical and horizontal signals are of widely different strengths is to select the weaker polarisation and then, with an in-line satellite peaker, turn the LNB for the lowest display/lowest audio note - the exact position is easily found.
Some universal LNBs have different horizontal/vertical skew settings at the low-band ( $10.7-11.7 \mathrm{GHz}$ ) and high-band ( $11.7-12.75 \mathrm{GHz}$ ) frequencies. This is probably because the wide range of microwave wavelengths in this 2 GHz block of signals rotate slightly differently as they propagate down the LNB's feed tube prior to being picked up by the $90^{\circ}$-spaced low-noise amplifier probes. Some makes appear to be more prone to this effect than others!

## LNB Switching Problem

This was a new installation for the reception of Dutch digital TV. The complaint was no signal, though the dish produced good results with Astra analogue signals and the universal LNB had been changed.
The 22 kHz switching tone from the receiver, which was of Far East origin, appeared to be OK in level but there was a very long run of coaxial cable to the dish. I fitted a 22 kHz Global tone generator in the coaxial feed, adjacent to the receiver. This increased the tone level and the LNB then switched to high band perfectly.
Since the dutchman didn't want to receive the Astra analogue signals, the simplest and cheapest solution was to leave the added generator in circuit - with instructions that its switch must not be put in the off position.

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# Confessions of a Lecturer 

## Phasor describes what it is like to be on the podium as a manufacturer's training officer

Training is an essential part of most people's working lives. This is especially the case with a job like electronic servicing, where the technology keeps changing. For the past twenty five years I've been conducting seminars for service engineers, covering in particular TV, VCRs and CD players.

## Types of Seminar

There are three types of training seminar: those that are free, held at a hotel during the working day; those that are held in the evening and are also free; and those for which a modest charge is made - they might be held during the day or in the evening.
Each has its particular type of trainee. The free all-day ones are attended by engineers whose employers can afford to let them go for the day, or self-employed engineers who decide to take the opportunity of a day away from the whingeing public. Amongst the daytime trainees we occasionally find youths told by their employers to attend in the hope that they may learn something.
The evening free sessions are attended more by the self-employed who cannot afford the possibility of losing custom, and by the employees of the more financially cautious retailers - basically by engineers who are interested enough in what they do to want to learn more, in their own time. Finally, the ones who come along to the evening or day sessions for which a fee is charged are the really keen ones,
who are undaunted by the cost and time required to gain new knowledge.

## A Typical Day Session

Here's how a typical day session might go. It's due to start at 09.30 hours at the Hotel Splendide, Gungemouth. I arrive at 08.30 to find that the room I've hired for the day is still full of the remnants of last night's after sales conference binge, a scene of some devastation.
While I am still trying to find the hotel manager, the first trainees arrive at 08.45 . They have bulging briefcases, a dazzling array of ballpoints in their top pockets, and a barrage of questions to ask before I've even put up the projection screen and discovered that the projector's lamp has burnt out.
After six or seven journeys to the car to get equipment, course notes, giveaways and the slides and cribcards, I'm perspiring profusely. I need to find the lavatory quickly, and am trying to answer several hostile engineers demanding to know why our latest chassis is so unreliable. I finally retort that it "gives you fellows something to do" and flee to the toilets.
A start like this is usually the precursor to a very fraught day. But I begin well and am into the stuff that Sales have told me to say first. This is heard in silence, and the disbelief on the trainees' faces is my signal to get on with the technical stuff as quickly as possible.
By 10.30 the temperature in the room has risen some ten degrees and
the first break is due. There's not been too much in the way of barracking, soft-fruit throwing or anyone passing out. My explanation of the finer points of a switch-mode power supply has gone down well, and today's crowd seem eager to absorb the information.
In the semi-darkness however a small knot of engineers has been scanning the course notes to look for mistakes. They think they've found one or two, and declare their findings loudly as I'm about to down my first half litre of cold orange juice. Why do people come to lectures when they know it already?
We restart with an assault on the use of a phase-locked loop for tuning, and I immediately fall foul of those who want to know the precise contents of the integrated circuit that contains the programmable divider and comparator. With this out of the way, I'm running ten minutes behind schedule and decide to skim over surface acoustic-wave filters and balanced-input IF amplifier/demodulator chips. No doubt I will pay for this at some point during the hours to come.
Three at the back are now talking audibly and incessantly about a rival brand that does things differently and, in their view, rather better. I make a mental note to put these characters down at the first opportunity. This comes whilst dealing with the raster correction circuitry when, without mentioning their apparently favourite brand by name, I criticise its engineering in this part of the chassis. The ruse works, but I've


Why do people come to lectures when they know it all already?
made three implacable enemies and need never bother to apply for a job with their favoured manufacturer.

## Lunch Time

Lunch time arrives and I am now half an hour behind schedule. The trainees stampede for the toilets, then the restaurant, and after that the bar. At five minutes to two the lecture room is still empty and I have to resort to prising them away from their pints.
We start off again. Field output stages, line scan generators, afterhours sync and audio fall one by one. My knot of three are silent. Until the tea break, when they launch their assault on the design of the latest teletext decoder, something I intend to discuss in the last part of the session.
I am cornered by these paragons of engineering virtue. Their leader, a tall, bald and very precisely-spoken man of about forty, drives his criticisms home by stabbing the space between us with a yellow Biro whose cap has been badly chewed. Knowing that this is the result of one of his habits, I totally disrupt his flow with the comment "I say, your dog has an odd appetite, hasn't he?" He regards the chewed pen darkly and, totally deflated, steers his cohorts away to refill their tea cups.

## Last Lap

It's three forty five and the last lap is about to start. I've galloped through some of the more mundane circuitry and come, at last, to the final bit the teletext decoder. Crossing from the analogue to the digital domain has its moments of terror for some,
and I can see unease on a few faces as I describe the data stream retrieved from the slicer circuit and the structure of each row of text.
The concept of a graphics ROM seems to be beyond a good many, and the talk is of pigeon holes and numbered boxes, the number of the box being derived from its horizontal and vertical co-ordinates. The orienteering devotees nod their heads knowingly and smile at the mention of maps. Others look dazed and lost. I change my analogies and all come on board. Whew!

## End of Session

It's 16.30 and the session comes to an end. The last questions are asked, and a few stragglers manage to leave before it's time for me to carry what's left of the course notes, goodies and equipment back to the car.
I make a last check on the room to ensure that I've left nothing behind but dirty cups and hot air. The bill has to be signed at reception, which always takes at least half an hour. I wait as they sort out a gentleman who wants to change his room for one on the ground floor because he's afraid of lifts and his heart is afraid of stairs.
With the car loaded up ready for the journey home, and the bill paid, I visit the gents before my 150 -mile drive. As bad luck would have it, two of my trainees have been having a jar at the bar before going home. They trap me with "just a little point we are not quite clear about". Nor am I, but never mind. I do my best to get round it.
At five thirty the rush hour has
started and I head out into a succession of traffic jams before joining the M25 and the biggest jam of them all.

## Smiles

There have been many humourous moments during the training sessions I've conducted over the years. I was once told that a group of engineers employed by a well-known retail group wouldn't repair a certain receiver because it had digital circuitry in it. Their union had told them to boycott any sets with ultrasonic remote control until they'd received training on the subject.
After I'd provided the training required I asked the service manager what was wrong with the receiver at the centre of the trouble. "It has a faulty on/off switch" was the reply. Oh well, I suppose a switch could be classified as digital! I often wonder how those militant engineers would respond to today's domestic electronic equipment.
I was once asked to give a talk to a group of dealers. It was to be an evening event. The idea was to outline, in simple terms, the advantages of a low component count, greater integration and an accelerated soak test before packaging the receivers.
Half way through I was interrupted by a fellow who had enjoyed a good measure of my firm's hospitality that evening. "I got a workshop full o' they sets an' 'em all faulty" he alleged. I asked him how many were defective. "Over two hundred" he replied, "I got 'em all lined up along the walls!"
Another dealer immediately stood up and said "if you've got that many

I'll take some off you, dead or alive!" The model was on limited availability at the time, supplies being allocated on an account size basis. The guy who made the claim was later found to be a freeloader who was not even an account holder.
On one other notable occasion I invited twenty five engineers to a daytime talk on a new chassis. They told all their mates across several counties, and 108 turned up to hear me. The hotel manager had a panic attack and spent the morning telephoning his reserve staff to get them to come in and cope with the catering

## Digital TV

Training appears to have slipped into calm waters for the present. The advent of digital TV doesn't seem to have produced the big increase one might have expected. But traditional analogue technology will remain with us for a long time yet, and of course this takes in timebases and power supplies which aren't going to alter to any great extent.
Much of the excitement at present relates to the coming together of
digital TV and the internet. The action here could mostly be in the software field. Future training is bound to be affected by this changing technology. Maybe classes of students will sit in front of internetconnected TV sets in their own homes. They'll do it in their own time - and make their own tea!

## Evening Meetings

Evening seminars are in some ways more relaxed affairs. The lecturer can be sure that those who come in their own time are bound to be keen. With an 18.30 kick-off, it's possible to be through by 22.00 and actually packed ready to depart - either home to bed or your hotel - by 23.00 .

Recent company clamp-downs on expenditure have had me using a swish hotel for the seminar, thereby maintaining the quality image, then retiring to a boarding house some miles away for an overnight stay. After a couple of nights of nylon sheets and plastic lampshades singed by over-size bulbs I make the effort to go home if at all possible.
Subjects have to be dealt with in a
more condensed manner at an evening meeting, what you cannot put over in the time available being printed in the course notes. The trainees are very eager, and the quality of the questions and level of understanding tends to be higher than those with daytime sessions. Being bombarded with questions on and off the lecture stage is something to which you have to become accustomed.

## In Conclusion

Training lectures are very rewarding. For the lecturer there's the build-up of mutual respect between yourself and your trainees. It is surprising what a wealth of engineering talent there is 'out there'. For trainees there is the opportunity to meet someone from a major manufacturer, ask questions that may have been nagging for some time, and establish a link with a source of information and knowledge.
Despite the occasional idiot, failing projector bulbs, catering arrangements that go wrong and the sheer hard work involved, training is a worthwhile occupation.

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## Reports from <br> Hugh Cocks Chris Watton Adrian Spriddell and Nick Beer

## Shorted LNB F Socket

The owner of an old Alba satellite receiver complained that it was dead. It was fed from a shared dish system via a magic switch. The only other active receiver, a Pace PRD800, also failed to produce any signals, though the display was alight. The Alba receiver's mains fuse had blown: its non-switchmode mains transformer's thermal fuse was also open-circuit. A bad sign if ever there was one!

The PRD800 receiver didn't provide an LNB supply because R543 (1 $\Omega$, located beside the tuner assembly) was open-circuit, obviously because of excessive current flow. Time to head for the dish.

The LNB's vertically-polarised output read short-circuit, though the horizontally-polarised output read OK. I naturally thought that the LNB was to blame. But the cause of the trouble was revealed when its F plug was removed. A piece of swarf from what looked like the F plug's thread was touching both the inner and the outer coaxial conductors. There was no sign that the plug had been removed in recent times, so why the short had suddenly occurred remains a mystery.

Replacement of R543 in the Pace receiver restored normal operation. But replacement of the thermal fuse in the Alba set lead to a rapidly roasting transformer. Fortunately the owner bought a new receiver from us!

I've noticed recently that some F plugs have a thread which is rather coarse in comparison with the finer one that most connectors have. They usually screw up all right though you can encounter
some resistance, which calls for the use of a small spanner for the final tightening. If I come across this situation I undo the connector again to see if any loose swarf is visible. Nothing has been found so far! H.C.

## LNB Fault

The owner of a fixed installation for Eutelsat at $13^{\circ}$ E reported an odd fault. When it was very hot BBC World, Euronews, RAI and some other channels disappeared. Several channels, including Eurosport, Onyx and Spanish TV, remained.

The missing signals were all vertically polarised, and a replacement LNB restored normal reception. The faulty LNB, a Continental Microwave model, would switch between polarisations but, when it was hot, there would be no vertically-polarised signals at all just no output. As soon as the temperature fell, the signals came back. It's the first time I've come across a problem like this: normally a faulty LNB is stuck on one polarisation or produces little or no output at all. H.C.

## No Horizontal Signals

A Pace PRD800 installation produced no horizontal signals from Astra. The vertical ones were OK, though Sky Movies Screen 1 was marred by some white sparklies that couldn't be tuned out. I initially suspected an LNB problem, but it transpired that a room extension had recently been carried out. The builder, "who knew a thing or two about satellite TV", had extended the IF cable from the dish.

When I traced the path of the IF
cable back through a loaded bookshelf I found that it went into a Belling-Lee coaxial wall socket via a nasty brand of coaxial plug with a large locking screw to secure the inner conductor of the cable. Whether the large diameter of the screwhead is deliberately used to assist impedance matching across the terrestrial TV band is doubtful: at the satellite IF band it's definitely a source of trouble!

I removed the plug and the wall socket, which had dubious DC coupling to provide the LNB power, and replaced them with two F plugs and a back-to-back socket. This restored normal signals with no more sparklies on Screen 1. A voltage drop at the plug and socket contact had prevented the highervoltage horizontal channels from being received, while the coaxial plug's large screw had helped notch out some of Screen 1's IF signal.

The cosmetic appearance was maintained by fixing the back-toback connector in the plastic cover of the original wall socket and using a hot-glue gun to fix the cover over the hole - it was previously secured by a screw that went into the wall socket assembly. H.C.

## Matsui OP10

There was intermittent picture loss with both clear and encrypted channels. The picture would flash back overloaded, then return to normal. The cause was C53 ( $10 \mu \mathrm{~F}$, 50 V ) on the decoder panel.

Various decoder problems have been encountered with these units - decoding only when cold and loss of the on-screen messages are
common. The cause is glue. On resonator XT2, around pins 1 and 2 of U 1 , and below U 4 on the underside of the PCB where about half a tube of glue holds a $1 \mathrm{k} \Omega$ resistor in place.

You can get this glue off by spraying it with freezer and prodding it with a meter probe. Remove XT2, clean the area around it, then refit it. Replace C45 ( $1 \mu \mathrm{~F}, 50 \mathrm{~V}$ ) with a $105^{\circ} \mathrm{C}$ type.

Most of the electrolytic capacitors fall in value, especially those in the decoder and the power supply.

The BT Model SVS250 uses the same chassis. C.W.

## Amstrad SRD510

The customer complained that there was no remote control operation, but the receiver was actually dead. After replacing the usual culprits, R602/3 (both 47kS), C612 $(220 \mu \mathrm{~F}, 25 \mathrm{~V})$ and $\mathrm{C} 611(1 \mu \mathrm{~F}$, 50 V ), the power supply was back in operation. But there were lines on the picture - it looked like cochannel interference. The cause
was lack of 12 V supply smoothing C305 ( $470 \mu \mathrm{~F}, 16 \mathrm{~V}$ ) had fallen in value to $140 \mu \mathrm{~F}$. A.S.

## Philips STU3601/Grundig GRD300

There was no audio response apart from an odd click or two and that vague feeling of DC through the speakers you sometimes get when working on a dead amplifier. Scope checks at pins 42 and 43 of IC1 displayed only a thin line with occasional random spikes: at FM input pin 24 there was 200 mV of something - maybe a carrier, maybe noise.

As luck would have it I'd just been fitting some heatshrink sleeving to a dimmer rack and the gas torch was still cooling on the bench. In an inspired moment I decided to treat the suspect chip with a shot of white-hot air. Never have I been so glad to hear an American voice, as the CNN commentator burst forth from my workshop speakers. A blast of freezer shut him up again, and a new chip (STV0030) cured the
fault. Fortunately there's plenty of space around it, so replacement is not too difficult. A.S.

## Pace PRD900

After repairing a power supply fault I found that there was no VideoCrypt operation - no unscrambling and no decoder messages. The cause was traced to the SP973T8 video ADC chip U20. As with all Pace parts, it's worth shopping around for the cheapest source - with so many differently badged versions, prices can vary substantially.

The power supply fault had resulted in poor regulation, with the outputs over thirty per cent high. N.B.

## Pace PRD900

This unit couldn't be brought out of standby when you tried to start it at the front panel, but was OK when operated with the remote control unit. Loss of power on/off operation was caused by a break in the print at J13, which sits just in front of the card reader. N.B.



Reports from Philip Blundell, AMIIEelec Michael Maurice Chris Watton Michael Dranfield Bob Longhurst Richard Flowerday Graham Richards M.J. Cousins, MIIFelec Keith Evand and Pete Gurney, LCGI

## Philips G90AE Chassis

This set was dead though there was some power supply activity - there was an HT output but it was low at 50 V . With a dummy load connected and the input to the set via a variac, the HT was correct at 95 V with an input of 120 V AC. As the input was increased towards 220 V the HT gradually fell. Cold DC checks on the secondary side of the power supply revealed that D6653 (BAS32) was short-circuit. P.B.

## Grundig G1000 Chassis

If the set is dead with the power supply making a clicking sound, check whether D301 (BA157) is short-circuit. It's the rectifier for the 26 V supply derived from the line output transformer. P.B.

## Mitsubishi CT25B3STX (Euro 12 Chassis)

Excessive HT (it should be 145V) is often the cause when the field IC fails. Replacing C906 (47 $\mu \mathrm{F}, 50 \mathrm{~V}$ $105^{\circ}$ ) in the chopper transistor's base drive circuit usually solves the problem - but not this time!

The next step is to check the values of R961, R972 and R960 in the HT sensing network and replace C905, C909, C906 and C920. In the past this has solved 90 per cent of power supply faults. Again, not this time.

## TV Fault Finding

To check whether the fault is on the primary or secondary side of the power supply, scope the output waveform at pin 3 of the TEA5170 chip IC950. Use a variac to reduce the mains input so that the voltage at TP91 ( 145 V ) falls below 140 V . The pulses should widen as the voltage falls below 140 V , and narrow if the voltage rises above 145 V .

On this occasion the pulses were at their narrowest by the time 145 V was reached. They couldn't narrow further even when the voltage rose above 145 V .

This suggested a fault on the primary side of the circuit. D907 (RD3.0), which is connected in parallel with C906, was found to be short-circuit. P.B.

## Philips G90AE Chassis

"No sync, TDA2579 replaced" it said on the job card. When I looked at the weak, broken up display on the screen a video problem appeared to be more likely. Checks around the TDA5850 video switching chip showed that the normal 1.5 V peak-to-peak input waveform was present at pin 8 but only 0.5 V peak-to-peak emerged at pin 5. A new TDA5850 chip cured the problem. P.B.

## Grundig P37-440 <br> (CUC4401 Chassis)

If the set is dead with only low output voltages from the power supply, replace C633 ( $100 \mu \mathrm{~F}, 25 \mathrm{~V}$ ). P.B.

## Ferguson TX91 Chassis

If you cannot gain access to the tuning menu by pressing the tuning button on the remote control unit, try this: switch the set to standby and turn the mains switch off; wait till the standby light goes out, then turn the mains switch on while holding down the remote control
unit's standby button. The lock menu will appear, and you can then remove the lock. P.B.

## Mitsubishi CT25A2STX

## (Euro 12 Chassis)

Here's a question for you. What's the cause of the following symptoms: excessive width with bowed verticals; no on-screen menus; and the picture is shifted to one side?

The answer is a low-amplitude H SYNC feedback pulse from the line output stage. D559 (1N4148) in the clipper network was found to be short-circuit.

Dry-joints at the pins of the line output transformer also required attention - they could well have been the cause of the diode's failure. P.B.

## Panasonic Alpha IW Chassis

This set was dead apart from the fact that the channel numbers lit up and changed. There were no squealing noises from the power supply. Quick checks confirmed that there was 330 V across the mains bridge rectifier's reservoir capacitor and that the $560 \mathrm{k} \Omega$ startup resistor R803 was OK. The only other likely cause was the STR54041M chopper chip. When you replace it, always replace C808 $(10 \mu \mathrm{~F}, 63 \mathrm{~V})$ as well. It's the reservoir capacitor for the -4 V supply at pin 1. After doing this the set was back in action again. M.M.

## Thorn CT5122T

I was told that the customer's children had been playing with a highpowered water pistol and that some water had got into the set. It hadn't occurred to them to unplug the set!

Close inspection showed that there was slight corrosion around the memory and text chips. I removed the board and cleaned the affected areas with a liberal dose of
video head cleaner and a toothbrush. After drying the PCB thoroughly, followed by reassembly, I was relieved to find that the set came on. But the memory had become corrupted, with the loss of all tuning and RGB or EXT video on some channels. Reprogramming cured this. M.M.

## Crown CRP14 (SMI Mono Chassis)

This set was dead. I found that the 5N90 chopper FET was short-circuit and the $5 \cdot 6 \Omega, 5 \mathrm{~W}$ surge limiter resistor R101 open-circuit. The TDA4605 chopper control chip IC101 had also failed, and the associated resistors R108 ( $220 \mathrm{k} \Omega$ ) and R109 ( $330 \mathrm{k} \Omega$ ) were open-circuit. Once these items had been replaced the set sprang back to life. M.M.

## Mitsubishi CT14MVIB

This TV/VCR unit, a Philips clone, was dead. I found that the mains bridge rectifier diodes D6313-6 and the $2 \Omega$ surge limiter resistor R3337 had failed because the chopper FET Tr7330 had gone short-circuit. Diodes D6332 and D6337 had also gone short-circuit. These items were replaced, along with the MC44603 chopper control chip IC7310, but the unit still failed to start up. R3338 ( $39 \Omega$ fusible), in the drive to the FET's gate, was open-circuit. All was well once this item had been replaced. M.M.

## JVC AV28FIEG

This German set was sent to me by another dealer "because it needed a field chip". The symptom was flyback lines at the top of the picture. There was a very simple cause: the field output chip's pins were dryjointed. Resoldering them, also the pins of the two regulators in the power supply, put matters right. M.M.

## JVC AV25SD4

When this set was switched on the green light showed but there was no picture or sound. Another dealer had resoldered the pins of the line output transformer. But he'd missed the connection to the line output transistor's collector. It often becomes dry-jointed in this and other JVC models. Resoldering this one pin and its rivet restored normal operation. M.M.

## Akura CX24 (Nikkai TLG0909 Chassis)

Text data lines covered most of this set's screen. The cause of the fault was in the field output stage, where
$\mathrm{C} 310(4.7 \mu \mathrm{~F}, 250 \mathrm{~V})$ had failed. C.W.

## Hitachi CTP2568

This set would sometimes refuse to come out of standby. When it did it worked well. To cut a long story short, the cause of the problem turned out to be the 1.2 V memory back-up cell. You will find it on the mains input panel, to the left as you look in at the back. Curiously, the set didn't loose its channel memory. C.W.

## Tarung $\mathbf{1 4 0}$ Chassis

The pictures were very streaky when captions were being displayed, with dark bands the full width of the screen. This looked like video output stage trouble, so I dobed a $10 \mu \mathrm{~F}$ capacitor across the 200 V supply on the CRT's base panel. This cleared the fault but when, instead, the reservoir capacitor for the 200 V supply was replaced the fault was back. Its cause turned out to be the BA159 rectifier diode D403. C.W.

## JVC C2155EM

This multi-standard set was very reluctant to come out of standby and had to be plugged in for a few hours before it would start. Two $220 \mu \mathrm{~F}$ capacitors in the standby supply, C13 and C33, were found to be low in value. Replacements restored normal starting. C.W.

## GoldStar CIS4441 (PCO4X Chassis)

If there's flat-out brightness, the picture appearing briefly with loss of brightness control when the set is switched off and on, replace the three $680 \mathrm{k} \Omega$ resistors on the tube base panel. C.W.

## Toshiba 145R7B

One of these 14in. sets had very low, distorted sound. I found that the audio mute transistor Q680 was conducting slightly, hence the distortion. A rather unusual muting circuit is used in this chassis, with a link to the RGB drives via three 1N4148 diodes D201-3. One of these had a $200 \Omega$ leak. Because of the unusual circuitry, I don't think I could have sorted out the fault without a circuit diagram. M.Dr.

## Tatung 190 Chassis

If the mains fuse or the surge limiting resistor is faulty and you cannot find the cause using a multimeter, you will probably find that R812 ( $33 \mathrm{k} \Omega$ ) in the snubber network connected to the collector of the chop-
per transistor is too close to the heatsink. In this condition it will tend to flash across. M.Dr.

## Philips G90 Chassis

Intermittently from cold this set would lock up with no sound and wouldn't change channels. In addition error code F7 would be displayed on the screen. The manual says that this indicates a teletext fault. Some scope checks showed that there were line-frequency pulses on the text 8 V supply. The cause of the problem was $\mathrm{C} 2843(220 \mu \mathrm{~F}$, 25 V ) which had dried up. M.Dr.

## Hinari CT4 (Nikkai tLG0101 Chassis)

This set's picture was smeared to one side, as if the first anode control had been set far too low. When I checked the voltages at the collectors of the RGB output transistors I found that they were low at only about 100 V . The supply to these transistors comes via L501 ( $10 \mu \mathrm{H}$ ), which had 200 V at one end and 100 V at the other. A replacement, obtained from a scrap set, cured the fault. M.Dr.

## Saisho CT144R

This set had an intermittent fault. When it was present there was a three-inch band of noise bars across the screen with a crackle on the sound. The cause was traced to dryjointed chassis-bonding lugs at the regulator's heatsink. When these had been resoldered a tap test showed that all was well. B.L.

## Ferguson TX98 Chassis

Circuit protector ICP1 was opencircuit for no reason that could be detected. So we fitted a replacement and left the set on soak test. Shortly after this there was a firework display from the line output transformer. Would a replacement transformer reveal that other faults were present? Fortunately all was well. B.L.

## Mitsubishi CT28AVIBS (EE3 Chassis)

This TV/satellite receiver wouldn't power up: it just flashed pretty green and red LEDs. Some voltage checks showed that there was only 7 V instead of about 11.5 V at the cathode of D952 on the secondary side of the chopper circuit. Its $1,000 \mu \mathrm{~F}, 16 \mathrm{~V}$ reservoir capacitor C955 had dried up. A replacement rated at $105^{\circ} \mathrm{C}$ cured the fault. B.L.

## Ferguson ICC7 Chassis

At switch on all this set produced
was a short squeal. The HT voltage was OK, but there was no 24 V supply. Surge-limiter resistor RP62 $(0 \cdot 1 \Omega)$ was open-circuit and a resistance check showed that there was a short-circuit across the supply. The culprit was the TDA8178 field output chip IF01. Fortunately all was well once IF01 and RP62 had been replaced. B.L.

## Panasonic $\mathbf{Z 4}$ Chassis

This set had a dead power supply. IC801 had gone short-circuit, taking R802 with it. When these two items had been replaced the set still didn't want to know: it just sat there flicking its standby LED.

Voltage checks around IC801 revealed that pin 2 was at 0 V . This led me to transistor Q801, which was short-circuit collector-to-emitter. Normal service was resumed once this transistor had been replaced. B.L.

## Ferguson ICC9 Chassis

This set's screen would frequently become bright red: the protection circuit would then switch it to standby.

The CRT and its base socket were eliminated by disconnecting the red cathode's feed resistor RB31. I then discovered that the cathode drive was only 15 V instead of the more usual 140 V .

Since the red drive input to the TEA5101 RGB output chip was almost double the 3.5 V it should have been, I decided to check the video circuitry on the main PCB. The culprit turned out to be the BC858B emitter-follower transistor TV71. It was going open-circuit intermittently. R.F.

## Hitachi C2146TN

This set might remain totally dead or the EHT might rustle up then die. Occasionally the set would work. For this sort of thing check for dry-joints at the 8 V regulator IC951 and the 5 V regulator IC952. If you don't find any, resolder IC901, the line driver transistor Q701 and its transformer. Soldering all these items cured this set.

For intermittent standby operation resolder IC950. G.R.

## Panasonic TX25T2

Severe field instability and line pairing is a common fault with these sets. It happens when the filter/snubber resistor R469 associated with the field scan coils goes opencircuit. The value seems to vary. We had two sets in with this fault recently. In one R469 was $150 \Omega$, in
the other it was $470 \Omega$. It goes opencircuit because of dry-joints at the scan coil plug/socket.

To check for this fault, connect a $220 \Omega$ resistor across the field scan coils to see if the symptom clears. G.R.

## Ferguson IKC2 Chassis

After fitting a new on/off switch we found that the set tripped, with the HT pulsing to 112 V . A fault in the protection circuit seemed likely. Replacing transistors TV01, TV02 and TV17 cured the fault. G.R.

## Toshiba 216T9B

There was excessive height. Close examination of the field timebase section of the PCB drew my attention to C303 $(2 \cdot 2 \mu \mathrm{~F}, 63 \mathrm{~V})$ which looked decidedly poorly. It's the field ramp generator capacitor, which is connected to pin 31 of IC501. A replacement cured the fault. G.R.

## Sony KVMI6TU

The customer's complaint was that on the odd occasion this set would not start up - he was convinced that the on/off switch was the culprit. When the fault appeared we quickly established that the mains rectifier was working, so the switch was OK. When we checked the start-up resistor R602 we found that it had risen in value from $560 \mathrm{k} \Omega$ to $660 \mathrm{k} \Omega$. But the basic cause of the fault was the BC637 current-limiting transistor Q601, which was short-circuit. It's connected in series with R602. M.J.C.

## Hitachi C2118T (G7PS Mk 2 Chassis)

Intermittent field collapse was the complaint with this set. So I replaced the LA7835 field output chip IC601 and the $100 \mu \mathrm{~F}$ flyback boost capacitor C603. A nice quick one I thought. Half an hour later there was field collapse again. A check with the scope showed that drive was present at pin 1 of IC601, and a quick blast of freezer on it restored the field scan. Time for some voltage checks, which I should have carried out in the first place.

The supply at pin 7 was high at over 30V, while the HT voltage was 128 V instead of 112 V .

In fact the cause of the trouble was R909 in the power supply. It had increased in value from $39 \mathrm{k} \Omega$ to $45 \mathrm{k} \Omega$. As a result the HT voltage was just below the level at which ZD903 (P6KE130A) would short across. M.J.C.

## Mitsubishi CT2125TX

There was no picture though the on-screen graphics could be called up and the sound was present. I spent some time on a wild goose chase in the video and text circuitry, then decided to check that the receiver's supply lines were all present and correct. The 5 V regulated supply to the control, VIP and CCT chips turned out to be missing. Z951, a 630 mA circuit protector on the power supply panel, was opencircuit. No reason for its failure could be found. K.E.

## Ferguson ICC8 Chassis

The picture was mainly red and green, with the blue content evident only on highlights. The tube's voltages seemed to be about right, and drive waveform checks didn't reveal anything seriously amiss. Perhaps the TEA5101A RGB output chip was faulty? Before fitting a replacement I decided to check the values of the resistors in the output stage feedback circuits. This led me to RT64 which had risen in value.

We've now had the same fault on two more occasions. K.E.

## Samsung Cl348Z (P50 Chassis)

Intermittent field roll was the customer's complaint. After checking that his signal was OK we took the set back to the workshop, put it on the soak test bench, and waited for the fault to appear. Sure enough the field unlocked momentarily. But when we took the back off the set the fault cleared. So we set about checking the components in the field sync circuit. Coupling capacitor C351 ( $0.47 \mu \mathrm{~F}, 50 \mathrm{~V})$ turned out to be leaky. K.E.

## Mitsubishi CT2525TX

There was a strange moiré-type patterning over the whole picture, also slightly reduced height and colour saturation. A sharp tap on the side of the cabinet seemed to restore normal operation, so I felt that the cause of the problem was probably to do with dry-joints. Close examination of the main PCB revealed some very suspect-looking joints in the power supply section, but the cause of the trouble turned out to be the 12 V regulator chip IC902. K.E.

## Matsui 20R1 (Grundig G1000 Chassis)

The customer complained that there was "no operation". In fact the set was tripping. Some checks showed
that there was a short across the HT rail, but disconnecting the line output transistor made no difference. Disconnecting pin 4 of the line output transformer did however. This pin is connected to the collector of the output transistor, so we were definitely in the right area. The culprit turned out to be the BY133 efficiency diode D304. P.G.

## Sony KVD2912

Intermittent crackling on Nicam and loss of the picture were the complaints with this set. The sound problem took a bit of time to show up. Its cause was traced to bad joints in the IF can, particularly at the video tank coil and the AFC coil. When it eventually occurred we traced the cause of the loss of picture to a bad crimp at the heater supply plug on the CRT base plate. P.G.

## Decca D25NEE5 (Tatung E Series Chassis)

The power LED came on but the set refused to start. On investigation I found that the power supply was running, with all the LT rails
intact and 150 V present at the line output transformer. But there was no drive at the base of the line output transistor. There was drive on the primary side of the driver transformer T401, but its secondary side appeared to be open-circuit.

When I removed the transformer I saw that the ends of the windings had never been tinned during manufacture. As a result they had become dry-jointed. Resoldering cured the problem. P.G.

## Mitsubishi Euro 12 Chassis

The customer complained that there was an intermittent field fault, the symptoms being lack of height and foldover. In fact when the symptoms did eventually appear the cause was obviously low output from the power supply - the HT line was at only 87 V . The voltages were correct in standby however.

Quick checks while the set was in the fault condition revealed that the set-HT control was inoperative and that there was no supply at pin 2 of the TEA5170 master regulator chip IC950. This supply comes from the collector of the power
switch-1 transistor Q951, which was switched off. This led us to the power switch-2 transistor Q952, whose collector should be at 0 V when the set is working. In fact there was a rather excessive 29 V here, which returned to normal in standby. The cause of the trouble turned out to be an invisible hairline crack in the print between the base of Q952 and the junction of R956/7. The confusing 29V came from the sound switch-1 transistor Q954 and its bias resistor. The base of this transistor should also go low when Q952 switches on. P.G.

## GoldStar CIT9172 (PC11A Chassis)

The cause of very intermittent loss of the picture, the sound remaining OK, was eventually traced to the TDA8214A timebase generator/ field output chip IC401. When the tinplate screen beneath the PCB was removed, the IC was seen to be badly dry-jointed. In fact it had not been inserted far enough into the board during manufacture. The bad joints were sensitive to heat, not vibration. P.G.

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## 简 <br> John Edwards' Casebook

## JVC AV21HIEK

"It don't work since I connected my old Rogers amplifier to it" the old gent said, once we'd reached the sitting room where the set lived, "all's I got was this smell of burning, then it packed up." It seemed obvious to me that the audio output IC had probably been damaged, but before I could utter a word his wife started pumping at the on/off switch.
"There" she said, "listen." Not unexpectedly, the set issued a faint squeak then returned to the relative safety of the standby mode, whereupon she started to thump the top of the set with vigour while drawing my attention, with pointed finger, to the blank screen. "See" she said, "nuffin."
I switched the set off and removed the back cover Then I disconnected plug $Q$ at the top of the large, ver-tically-mounted PCB, thereby removing the 28 V supply to the audio output stage. When I switched the set on again it came to life with a perfect picture, but no sound of course.
"Nice one" he blurted out, "didn't take long. Knew it weren't anything much. What does I owe ya?"
"Nothing" I said, "unless you want sound as well." After agreeing a price, in truth after a lot of haggling, next day I fitted a new TA8216H audio chip - in the workshop. The original one had a pin hole through its case. When I returned with the set I explained that the external speaker sockets were for speakers only. But I'm not sure that he got the message.

## Fisher FVHP725

When mains power was applied the loading motor whirred continuously and the clock flashed zeros. Pressing the power button made no difference: there was still no channel indication or light from the poweron LED.
I thought I was in for a 'nasty', but decided to investigate the mode motor assembly. I removed it, carried out thorough degreasing, cleaned it and applied fresh lubricant. When I'd refitted it the machine powered up normally. A new forward/rewind idler completed the repair.

## Sony KV2092 (XE4 Chassis)

The fault symptom could best be described as very fine ragged edges to the picture content. The slightest movement of the field output IC's heatsink would instigate or stop the effect. I carried out scope checks at the pins of the IC while the symptom was present, but there was no interference other than a very low $2-4 \mathrm{mV}$ peak-
to-peak HF 'noise' at the earth pin. When I resoldered the heatsink to PCB mounting lugs the fault cleared

## Ferguson TX10 Chassis

I don't see many of these old-timers nowadays. Those I do come across have usually seen better days as far as the tube is concerned. This one produced a nice, clear picture however, so I decided to tackle the no red in the text mode problem. The obvious thing to do was to replace the TDA3560 colour decoder chip, which in fact cured the fault.
I was less keen about agreeing to a three-month guarantee on such an old set. My experience is that in the customer's mind a repair guarantee tends to cover everything in the cabinet, no matter what's written on the invoice.

## Goodmans 2043 (GoldStar PCO4A Chassis)

This set's power supply was working but there was no 106 V output at the cathode of the HT rectifier diode D803 and thus no line output stage operation. One leg of the fusible resistor FR803 (4.7 ), which is in series with the rectifier, was badly dry-jointed. Resoldering was all that was needed to bring the set back to life.

## JVC HRD540

The deck was jammed, with the loading motor struggling fruitlessly to shift the half-loaded mechanism and jammed carriage tray. I unplugged the machine and removed the carriage. After placing it in the eject position I put it to one side. I then rotated the loading motor by hand until the hole in the main cam aligned with the hole in the chassis, at approximately the twelve o'clock position. As I did so I saw that the tape guides and halfloading arm returned to their stop positions.
The mechanism seemed to be quite free and there weren't any tight spots. So I refitted the carriage and powered up. Numerous tests - running through all the modes, including eject, after inserting a tape - proved that all was now well.

## Saisho CM2080T

This set wasn't completely dead: the power supply produced an HT output of about 33 V . A check on the 2SD1555 line output transistor Q402 showed that it was leaky. Once this and the STR50103A chopper chip IC501 had been replaced the set worked normally. But as a precaution I also replaced the two $330 \mathrm{k} \Omega$ start-up resistors R502 and R503.

## TRANSISTORS/LINEAR ICs

| Part | Price | Part | Price | Part | Price | Part | Price | Part | Price | Part Price | Part | Price | Part | Price | Part | Price | Part | Price |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| BC107 | 8 p | BD434 | 30p | BU126 | 65 p | BUV | 325p | M | 30 | 4N35 50p | LINEARICs |  |  |  | BA335 | $55 p$ | BA7004 | $\overline{200 p}$ |
| BC108 | 8 p | BD435 | 31 p | BU128 | 12 | BU | 250p | M 310012 | 300 |  | AN203 | 210 p | AN6341 | ${ }^{200 p}$ | BA338 BA 340 | 80p | BA7007 BA 7021 | 180p |
| BC109 | 8p | BD436 | 30p | BU133 | $125 p$ | BUV50 | 425p | MJ11015 MJ11016 | 250p | RECTIFIER | AN210 | $165 p$ | AN6344 | 440 | BA343 | 60 p | BA7022 | 350p |
| ${ }_{\text {BC140 }}$ | 20p | BD238 | ${ }_{36 p}$ | BU180 | 100p | BUV70 | 200p | MJ11032 | $800 p$ |  | AN2110 | $150 p$ $170 p$ | AN6345 | ${ }_{300 p}$ | BA336 | 175 | BA7025L | 100p |
| BC142 | 20p | BD439 | 40p | BU184 | 100p | BUV90 | 175p | MJ11033 | 800 p | BY127 8p | AN217P | 95 | AN6346 | $350 p$ $610 p$ | BA401 | 60p 50 p | ${ }_{\text {BA }}$ BA7107 | 475p |
| BC143 | 20p | BD440 | $40 p$ | BU204 | $65 p$ | BUV93 | 375p | M 15003 | 250p | BY133 8p | AN228 | 280p | AN6352 |  | BA511 | 145p | BA7252S | 150p |
| BC147 | 8p | BD441 | 40p | BU205 | 70 p | Buw11a | 200p | MJ15004 | 300p | BY164 40p | AN252 | 150p | AN6356 | 3500 | ba514 | 160p | BA7604N | $100 p$ |
| BC149 | 8p | BD533 | 50 p | BU206 | 100 p | BUW1AF | $225 p$ | MJ15015 | 250p | BY179 35p | AN259 | 250 p | AN6359 | ${ }^{300}$ | ${ }^{\text {BA5 }} 16$ | 150p | BA7751LS | 150p |
| BC159 | 8 p | BD534 | 38 p | BU207 | 150 p | BUW12 | 125 p | M M 15016 | $350 p$ $400 p$ | BY184 32p | AN262 | 140 p | AN6360 | 320 p | ba518 | 150p | BA7752 | 250 p |
| BC160 | ${ }^{30}$ | BD535 | 38p | BU208 | 70 p | BUW12A | 150 p $\mathbf{2 5 0 p}$ | M J 15022 L | 400 p 400 | BY206 | AN271 | 230 p | AN6362 | 400 p | ba521 | 100p | BA77 | 150p |
| BC171 | $10 p$ | BD536 | 38p | BU208A | \% 75 | BUW 12 F | 250 p 2000 | M $J 15023$ $M J 15024$ | 400 P | BY207 20p | AN274 | 250p | AN6363 | 375 | bas24 | $240 p$ | BA7767AS | $155 p$ |
| BC172 | 10p | BD537 | 40 p | ${ }^{\text {BUL208AT }}$ | 200p | BUW32A | 500p | M J 15025 | 700 p | BY227 19p | AN277B | 400 p | AN6367NK | 400 p | BA526 | 180p | BA8504 | 350p |
| $\mathrm{BC177}$ $\mathrm{BC178}$ | 14 p | BD538 BD643 | 40p 50 | BU208B BU208D | 200p | BUW32A | 550p | M ${ }^{\text {M } 15340}$ | 209 | $\begin{array}{ll}\text { BY228 } & \text { 28p } \\ \text { BY298 } & 15 p\end{array}$ | AN278 | ${ }^{60}$ | AN6368 | 275p | BA527 | 95p | BA15218 |  |
| BC179 | $14 p$ | BD645 | 50 p | BU209 | 90 p | BUW49 | 550p | MJE350 | 80 p | BY299 18p | AN302 | 650 p | AN6371 | 350p | BA532 | 100p | CA3140E |  |
| BC182 | 7p | BD647 | 50p | BU225 | 120 p | BUW50 | 400 p | MJE520 | 30p | BY329-1200 150p | AN303 | 250 p | AN6387 | 480 | BA534 | 150 | CNX82A | 60p |
| BC 182L | 7p | BD649 | 50 p | BU226 | 120 p | BUW81A | 150 p | MJE2955T | $65 p$ $65 p$ | BY448 20p | AN304 | 360p | AN6551 | 100p | ${ }^{\text {BA546 }}$ | 160 p | CNX83A |  |
| BC 183 | $7 \mathrm{7p}$ | 80675 | 40 p | BU312 | 90p | BUW84 | ${ }_{85 p}$ | MJE3055T | $65 p$ $100 p$ | BYT11 | AN315 | 210 p | AN6552 | $45 p$ | BA612 | 120 p | C $\times 136$ | 600p |
| ${ }_{\text {BC }} \mathrm{BC} 183 \mathrm{~L}$ | $7 \mathrm{7p}$ | BD676 BD677 | 48p | ${ }^{\text {BU3 }}$ B 3268 A | 55p | BUW85 | 850p | MJE 13005 | $100 p$ 600 | $\begin{array}{ll}\text { BYT13-1000 } & \text { 30p } \\ \text { BYV96E } & \text { 25p }\end{array}$ | AN316 | ${ }^{3500}$ | AN6554 | $80 p$ | ba614 | 70 p | Cx139A | 750 p |
| BC184L | 7 p | BD678 | 40p | BU406 | 60 p | BUx11 | 200p | MJE13007 | 100p | BYW96E 36p | ${ }_{\text {A }}$ A 360 |  | AN6555 | 50 p | BA618 | 55p | Cx141 | 750p |
| BC212 | 7p | BD679 | 40p | BU406D | $85 p$ | BUX12 | 150p | MJE13009 | 100p | BYX 10 15p | AN362 | 140 p | AN6665 | 359 | Babs | 110 p | Cx | 325p |
| BC212L | 7p | BD680 | 40p | BU407 | 55 p | Bux20 | 350 p | MJE15028 | 200p | BYX55/600 25p | AN363 | 150p | AN6650 | $45 p$ | ${ }_{\text {BA658 }}$ | 350p | C×175 | 325p |
| BC213 | 7 p | BD881 | $45 p$ | BU407D | $75 p$ | BUX21 | 450 p | MJE15029 | 250 p | IN4001 3p | AN366 |  | AN6651 | $45 p$ | BA687a | 350 p | CX187 | 825p |
| BC213L | 7 p | BD682 | 45 | BU408 | 60 | BUx22 | 450 p 900 | MJE15031 | 400p | IN4002 | AN610 | 160p | AN6652 | 45p | BA682A | 300p | Cx804A | 775p |
| BC214 | 7 p | BD705 | 50 | ${ }^{\text {BU4 }} 409$ | 85p | BUX37 | 220 p | MJE18004 | 125p | N4003 | AN3211K | 375 P | AN6671K | 425p | BA683A | 300p | CX867 | 575p |
| ${ }^{\text {BC2 }}$ B637 | $7 \mathrm{7p}$ | BD709 | 50 sop | ${ }^{\text {BU4 }} 12$ | 175p | BUx39 | 450 p | MJF18004 | 175p | IN4005 3p | AN3215K | 350 p | AN6676 | 600p | BA684 | 400p | C8868 | $525 p$ |
| BC238 | 7 p | BD711 | 50 p | BU413 | 175p | BUX40 | $210 p$ | MJFi8204 | 350p | in4006 ${ }^{\text {3p }}$ | AN3236K | 450p | AN6780S | 80 p | BA685 | 400 p | C×877 | 300p |
| BC239 | 7 p | BD736 | 50 p | BU4148 | 250 p | Buxal | 200 p | 0 C 28 | 350p | IN4007 ${ }^{\text {ap }}$ | AN3310K | 325 p | AN68875 | 450p | BA715 | 45 p | CX20015A | 600p |
| BC300 | $20 p$ | BD826 | 50p | BU415A | $170 p$ | BUX42 | 200 p | OC29 | $250 p$ 350 p | IN4148 2p | AN3312 | 350p | AN6878 | $65 p$ | BA728 | 55 | C $\times 201$ |  |
| BC301 | 20 p | BD828 | 50 p | BU426A | 70 p | Buxa | 220 p | - 036 | 350p | IN5400 | AN3313 | 300 p | AN6879 | 225p | Ba806 | 220p | CX20109 | 140p |
| BC302 | 20p | BD839 | $55 p$ | BU433 | 120 p | BUX48A | 150 p $\mathbf{8 0 0}$ | S2000A3 | 255p | IN5401 8p | AN3320K | 450 p | AN6880 | 75p | BA843 | 130 p | CX20187 | 700p |
| BC303 | 25 | BD897 | 50 p | BU500 | 100p | BUX80 | 180 p | S2000AF | 90 p | (N5402 | AN3331K | 450 p | AN6882 | 300p | BA1310 | 160p | CXA1001AP | 1600p |
| BC304 BC 327 | 25p | BD899 BD977 | S0p | BU505 | 2250 | BU×81 | 160 p | S2055A | 175p | (N5403 68 | AN3792 | 300 p | AN6884 | 200p | BA 1320 | 75p | CXA1019P | 150p |
| BC328 | 7 p | BD×33 | 60p | BU505D | 90p | BUX84 | $50 p$ | S2055AF | 175p | iN5405 11p | AN3794 | ${ }_{450}$ | AN6888 | 150p | BA1330 | 120 p | Cxalol9S | 2250 |
| BC337 | 7p | BD×37 | 100p | BU505DF | 90 p | Bux85 | $50 p$ | S2530A | 100 p | IN5406 12p | AN3821K | 6000 | AN6889 | ${ }_{600}$ | BA1350 | $130 p$ | CXA1044BP | 475p |
| BC338 | 7 p | BDX44 | 100p | BU506 | $100 p$ | BUX86 | p | TIP29 | 15p | \|N5407 12p | AN3822K | 600p | AN700 | 650 p | BA1355 | 125 | CXA1081 | 275p |
| BC441 | 28 p | BDX47 | 75 | BU506D | 70 p | BUX87 ${ }^{\text {BUP }}$ | 50 p | TIP29C | 22 p | IN5408 | AN3830K | 800p | AN70 | 250 p | BA1356 | 100p | CXA1081 | 250p |
| BC446 | $8 \mathrm{8p}$ | BDX54C | 750 | BU508A | 60 p | BUZ71 | 359p | TIP29E | 40 p | RGP10RGP15 $\mathbf{2 5 p}$ | AN3990K | 300p | AN7025K | 90 p | BA 1360 | 160p | CXA1081S | 300p |
| BC477 | 18 l | ${ }^{\text {BDX }}$ B3C | 175 p | BU508AF | 60 p | Buz71aF | 100p | TiP30 | 25p | RGP30 | AN3991K | 400 p | AN7060 | 175p | BA1404 | 120p | CXA1082as |  |
| BC516 | 22p | ${ }^{\text {BD }} \times 64 \mathrm{C}$ | $175 p$ | BU508APH | 60 p | BUZ72A | 100p | TIP30C | 25p | SR2M 50p | AN5010 | 250 p | AN7062 | 300p | BA1604 | 125p | CXA1191M | 2500 |
| BC546 | 8 p | BDX65 | 80p | BU508D | 75p | BUZ72AF | 100p | TIP31A | 22 p |  | AN2020 | ${ }_{8}^{250}$ | AN7072 | 250p | BA2266A | 250 p | CSA120 | 4000 |
| BC54 | 8 p | BDx66C | 175 p | BU508DF | p | BUZ73a | 60p | TP32 | 27 p |  | AN5025 | 250p | AN710 | 170 | BA3 | $70 p$ | FT5764M | 250p |
| BC548 | 8 p | BDX67C | 275p | BU508DR | 130p | BUZ73AF | 60p | T1P32A | 24 p | I.C. SOCKETS | AN5033 | 40 | AN7106K | 135p | BA3312 | 60p | HA1124 |  |
| BC549 | 8 p | BDx71 | 70 p | BU508V | 110 | BUZ80 ${ }^{\text {B }}$ | 1135 135 | TIP32C | 28 p | 8 PIN 4 p | AN5034 | 400 p | AN7110 | 75p | BA3402 | $90 p$ | HA1125 | 120p |
| BC550 | 8 | BDx77 | 175 p | BU508VF | ${ }_{75} \mathbf{7 0 0}$ | BUZ80AF | $200 p$ | TIP33 | 50 p | $14 \mathrm{PIN} \quad 5 p$ | AN5070 | 125p | AN7111 | 100p | BA34 | 120p | HA1137W | $150 p$ |
| BC557 | 8 sp | ${ }^{\text {BDX }}$ 88C | 150 p | BU536 | 100p | BUZ83 | 200p | TIP33C | 60 p | 16 PN 6p | AN5071 | 100 p | AN7112 | 45p | BA3416BL | 80p | HA1151 | $175 p$ |
| BC558 | 8p | BDW24 | 55p | BU546 | 125p | BUZ90A | 180p | TIP34 | $65 p$ | ${ }_{20}{ }^{\text {PRN }}$ 10p | ANS5132 | 450 p | AN7114 | 120 p | BA3422 | 350p | HA1197 | 130 p |
| BC559 | 8 p | BDW93 | 50 p | BU603 | 125 | BUZ91A | 260p | TIP34C | 60 p | $22 \mathrm{PIN} \quad 12 \mathrm{p}$ | AN5135NK | 400 p | AN7116 | 1190 | BA | 70 p | HA1201 | $225 p$ |
| BC560 | 8 p | BDW94 | 50 p | BU606D | 225p | BY448 | 20 p | TIP35C | 65 | 24 PIN 13p | AN5138NK | 350p | AN7117 | 65 p | BA3516 | 120p | HA1202 |  |
| BC637 | 20 p | BDY29 | 225 p | BU608D | 120p | BYT11 | 25 | TIP36C | ${ }_{25 p}^{65 p}$ | $28 \mathrm{PIN} \quad 13 \mathrm{p}$ | AN5150 | 400p | AN7120 | 100p | BA3520 | 130 p | HA1319 | $200 p$ |
| B6639 | $20 p$ | BDY56 | 225p | BU626 | 120p | IRF120 |  |  | 220 | 40 PIN 15p | AN5151 |  | AN7130 | 75p | BA3521 | 225p | HA1338 |  |
| 8C640 | 200p | BDY58 | 500p $\mathbf{1 2 5 0}$ | BU706 ${ }^{\text {B }}$ | 135p | ${ }_{\text {IRF140 }}$ | 555p | TiPs2a | 20 p |  | AN5210 | 675 p | AN7131 | 90p | BA3704 | 200p | HA1339A | 350p |
| BCY34 | 200p | BDY92 | 100p | BU706F | 150p | IRF230 | 550p | TIP42C | 22p | IODE | AN5215 | 100p | AN7133N | 325 p | BA3706 | 75p | HA1367 |  |
| 8CY70 | 16p | BF137 | 35p | BU724A | 100p | IRF240 | $425 p$ | TiP47 | 40 p |  | AN5222 | 200p | AN7134 | 300 p | BA3812L | $80 p$ $80 p$ | HA1377 | 120 p |
| ${ }^{\text {BCY7 }} 1$ | 16p | BF167 | 30 p | BU801 | 70p | IRF250 | ${ }_{3}^{375 p}$ | TIP48 | ${ }_{60} \mathbf{4 0 p}$ |  | AN5256 | 150 p | AN7141 | 70 p | BA3824LS | 75 p | HA 1388 | 320 p |
| 8CY72 | ${ }_{30 p}^{16 p}$ | BF 181 BF183 | 18p | BU806 | $70 p$ $\mathbf{6 0 p}$ | \|RF330 | 600p $\mathbf{3 2 5 p}$ | TIP51 | 88 | 1.3 Watts | AN5260 | 300 p | AN7142 | 80 p | BA3920 | 300 p | HA1389 | 210 p |
| BD124P | 50 | BF195 | 7 p | BU807F | 75p | IRF350 | 750 p | TIP52 | 80 p | 2V7 to 39V 9p | AN5262 | ${ }^{175 p}$ | AN7145 | $195 p$ | BA4110 | 75 p | HA1392 | 120 p |
| BD131 | 25p | BF199 | 8 p | BU808DF | 210 p | IRF450 | 650p | TIP54 | 85 p |  | AN5235 |  | AN7146 | $210 p$ | BA4210 | 85 p | HA 1394 |  |
| BD 32 | 25p | BF200 | 16p | BU810 | 110p | IRF510 | 110p | TIP102 | 70 p | voltag | AN5352 | 600 p | AN7148 | $140 p$ | BA4234L | 70 p | HA1397 | 200 p |
| BD133 | 50p | BF225 | 30 p | BU824 | 60p | IRF520 | 110 p | TIP105 | $65 p$ $65 p$ | REGULATORS | AN5411 | 450 p | AN7149 | 160 p | BA4236L | 110 p | HA1398 | 175 p |
| BD135 | 20 p | BF240 | ${ }^{16 p}$ | BU826 | ${ }_{160} \mathbf{1 2 0}$ | lirfs30 | $120 p$ $120 p$ | TIP107 | ${ }_{65 p}$ | 7805 18p | AN5421 | 150p | AN7154 | 180 p | BA4402 |  | HA1406 | 120p |
| BD136 | 20 p | ${ }^{\text {BF245 }}$ | 25 P | ${ }^{\text {BU }}$ B902 ${ }^{\text {a }}$ | 1609 | IRF610 | 120p | TIP110 | 40 p | ${ }_{78060} 180$ | AN5429 | 420p | AN7156 | 240p | BA4403 | 220p | HA11123 | 350p |
| ${ }^{\text {BDD }} 138$ | 20 20p | ${ }_{\text {BF } 255}$ | 12 p | BU903 | 110 | \|RF611 | 120p | TIP111 | 40 p | 7808 25p | AN5431 | 275p | AN7158 | 310p | BA4405 | 80p | HA11211 | 170p |
| BD139 | 20p | BF256 | 18 p | BU910 | 80p | IRF620 | 160p | TiP12 | 35p | 7812 18p | AN5435 | 125 p | AN7160 | 350 p | BA4412 | 50 p | HA11215 | 350p |
| BD140 | 20p | BF257 | 18p | Bu912 | 100 | IRF630 | 10p | ${ }_{\text {TP112 }}$ | 50p | 7815 25p | AN5512 | 100p | AN7161N | 375 1750 | BA5102 | ${ }_{140}$ | HA11221 | 180p |
| 8D144 | 90 p | BF259 | 18p | Bu920 | 100 p | lRF640 | 300p | TIP15 | $3{ }^{30 p}$ | $\begin{array}{ll}7818 \\ 7824 & 25 p \\ 7\end{array}$ | AN5515 | 160p | AN7166 | 350 | BA5115 | 75 p | HA11225 | 130p |
| BD157 | 38p | BF262 | $25 p$ | Bu922 | 110 p | IRF642 | 200p | TIP116 | 30 p 30 p | $\begin{array}{ll}7824 & \mathbf{2 5 p} \\ 7905 & \\ 7\end{array}$ | AN5520 | 550p | AN7168 | 200 p | BA5115L | 75p | HA11235 | 100p |
| BD166 | 30p | BF270 BF273 | 18p | BU932 | 130 1750 | \|RF610 | 150p | TIP120 | $37 p$ | ${ }_{7906}$ | AN5521 | 100p | AN7169 | 225p | BA5204 | 200p | HA11244 | 375p |
| ${ }_{\text {BD }} 177$ | 30p | ${ }_{\text {BF311 }}$ | 21p | BU941 | 250p | IRF720 | 150 p | TIP121 | 35p | 7908 | AN5 | 350p | AN7170 | 260p | BA5208AF | 110 p | HA11247 | 375p |
| BD179 | 32p | BF336 | 20p | BU2508A | 100p | IRF730 | 125p | TIP122 | 30p | 7912 30p | AN5601K | 750 p | AN7171K | 400 P | BA5402 | 180 p | HA11251 | 120p |
| BD181 | $45 p$ | BF337 | 20 p | BU2508AF | 110 p | IRF740 | 125 p | TiP125 | 30p | 7915 30p | AN56612 | 200p | AN7172K | 3250 | BA5400 | 1880 | HA11414 | 300p |
| BD182 | ${ }^{60 p}$ | 8F338 | 20p | BU2508D | 130 120 | 1RF820 IRF830 |  | TIP126 | 40p 35 | 7918 30p <br> 7924  | AN5615 | 300 p | AN7117\% | 375p | BA5413 | $225 p$ | HA11423 | 110 p |
| BD184 | ${ }^{60 p}$ | 8F362 | 30p | BU2508DF | 120 | lirf830 | 110 p | TIP127 | $35 p$ $30 p$ | $\begin{array}{ll}7924 & \text { 30p } \\ 78105 & \mathbf{2 4 p} \\ \\ \\ \end{array}$ | AN5620 | 250p | AN7178 | 180p | BA6104 | 250 p | HA11440 | 250p |
| BD187 BD201 | 30 p | ${ }_{\text {bF }}{ }_{\text {BF371 }}$ | 13 p | BU2520DF | 225p | IRF9140 | 1000p | TIP131 | 30 p | 78L08 | AN5622 | 275p | AN7205 | 35p | BA6109 | 110 p | HA11485B | 400p |
| ${ }^{\text {BD2 }}$ 8202 | 38p | BF421 | $18 p$ | BU2525A | 325 p | IRF9510 | 150p | TIP132 | 30p | 78L12 | AN5625 | 400 p | AN7213 | 40p | BA6110 | 225p | HA11702 | 330 p |
| BD203 | 42 p | BF422 | $21 p$ | BU2525AF | 2200 | IRF9511 | 150 p | TIP136 | 40p | 78L15 24p | AN5630 | 375p <br> $\mathbf{3 5 0 p}$ | AN7216 | ${ }^{1750}$ | ${ }_{\text {BA6125 }}$ | 75p | HA11703 | 280p |
| BD204 | 42 p |  | ${ }_{12} 2$ |  |  | IRF9520 | 150 p $\mathbf{2 0 0}$ | TIP162 | 65p | $78 L 18$ $\mathbf{2 4 p}$ <br> 78124 $\mathbf{2 4 p}$ <br>   <br> 8  | AN5635N | 330 p | AN7220 | $85 p$ | BA6138 | 130 p | HA11710 | 500p |
| BD222 | $31 p$ $31 p$ | ( $\begin{aligned} & \text { BF455 } \\ & \text { BF458 }\end{aligned}$ | $12 p$ $19 p$ | BUF405A | $200 p$ $200 p$ | lif9530 | $200 p$ $200 p$ | TIP141 | 110p | $\begin{array}{ll}\text { 78L24 } & \mathbf{2 4 p} \\ 79005 & \mathbf{3 5 p}\end{array}$ | AN5640 | 500p | AN7222 | 75p | BA6146 | 150p | HA11713 | 250 p |
| BD232 | 31 p | BF462 | 50p | BUH315D | 175p | IRF9540 | 240 p | TIP142 | 75p | 79L08 35p | AN5700 | $90 p$ | AN7223 | 105p | BA6149LS | 700p | HA1715 | 250 p |
| BD233 | 30p | BF471 | 28p | BUH515 | 200p | IRF9541 | 200 p | TIP145 | 50p | $79 \mathrm{~L} 12 \mathrm{35p}$ | AN5701 | 150 p | AN7224 | 75p | BA6154 | ${ }^{60 p}$ | HA17176 | ${ }_{700 \mathrm{p}}$ |
| BD234 | 32p | ${ }^{\text {BF4 } 472}$ | ${ }^{28 p}$ | BUH515D | 250 p | IRF9610 | 120 p | TIP146 | 70p | 79L15 ${ }^{\text {793p }}$ | AN5712 | 1800 | AN7225 | 159p | BA6208 | 85p | HA11724 | 650p |
| 8D235 | 28p | ${ }^{\text {BF } 479}$ | ${ }^{30 p}$ | BUH517 | 275p | ITRF9620 | ${ }_{200} \mathbf{1 1 0}$ | TIP1450 | 80p |  | AN5720 | 70p | AN7256 | 250p | BA6218 | 85p | HA11741N | Op |
| BD236 | 31p | BF494 BF495 | ${ }^{16 p}$ | BUH517D | $175 p$ $425 p$ | iRF9630 | 1800p | TIP151 | 60p | $\begin{array}{ll}\text { LM } 317 \mathrm{~T} & \text { 100p } \\ \text { LM } 23 \mathrm{~K} & \text { 350p }\end{array}$ | AN5722 | 140 p | AN7273 | $75 p$ | BA6220 | 55p | HA11744 | 330p |
| BD238 | $24 p$ | BF595 | 16 p | BUT11A | 35p | IRF9640 | 280p | TIP2955 | 50p | $78 \mathrm{H08KC}$ 800p | AN5730 | 160 p | AN7310 | ${ }^{60 p}$ | BA6222 | 130 p | HA11745 | 330 p |
| BD239 | 30p | BF596 | 16p | BUT11AF | 35p | IRFD9220 | 100 p | TP3055 | 50 p | 79H12KC 700p | AN5732 | ${ }^{120} 7$ | AN7311 | ${ }^{\mathbf{9 0 p}}$ | ${ }_{\text {BA6227 }}$ | ${ }^{50} \mathbf{5 0}$ | HA11749 HA11751 | $\begin{array}{r}\text { 350p } \\ \mathbf{1 5 0 0 p} \\ \hline\end{array}$ |
| BD240 | 40 p | BF615 | 30p | BUT12 | 810p |  |  | TIPL760 | $100 p$ 200 | 79HGKC 800p | AN5753 | 130\% | AN7315 | 40p | ${ }^{\text {BA6 }}$ 8235 | 50p | HA11752 | 325p |
| BD241A | 40p | 8F617 | 30 p | BUT13 | 310 p 80 p | IRFBC40 IRFP140 | 250p | TIPPL762A | ${ }_{200 \mathrm{p}}$ |  | AN5763 | 250p | AN7330 | 110 p | BA6238A | 130 p | HA11839NT | 375p |
| ${ }^{\text {BD243A }}$ | 50 p | BF760 | ${ }^{40 p}$ | BUT18AF | 65 p | IRFP150 | 300 p | TIPL791a | 80 p |  | AN5790 | 240p | AN7362 | 200p | BA6239A | 130p | HA11847 | 700p |
| BD245 | 50 | BF870 | 22 p | BUT30V | 1700 p | IRFP 240 | 300 p | 2N2369 | 15 p | LEDs | AN5791 | $225 p$ | AN7363 | $225 p$ | BA6247 | 150p | HA12002 | 220 p |
| BD246A | 50 p | BF871 | 22p | BUT56A | 65p | IRFP250 | 280 p | 2N2646 | 40 p | 3mm | AN5836 | 450 p | AN7410 | 150p | BA6248 | 140p | HA12003 | 150 p |
| BD265 | 45p | BF960 | 38p | BUT76A | 80p | IRFP350 | 325p | 2N2904 | 20 p | REDIOW 5p | AN5862K | 2250 | AN7411 | ${ }_{275}$ | BA6259 | 300p | HA12010 | 1800 |
| ED267 | 45 p | BF961 | 35p | BUT90 | $1300 p$ $1200 p$ | IRFP460 | 775 | 2N2906 | ${ }_{18 p}$ | GREEN 8p | AN608P | 125p | AN7415 | 70 p | BA6290A | 200p | HA12016 | $120 p$ |
| BD269 | 450 50 | ${ }^{\text {BFO232 }}$ | $38 p$ 75 | BUV18 | 1200p | IRFP9140 | 1450 | 2N2907 | 18 p | 5mm | AN620 | 250p | AN7470 | 100p | BA6294 | 250p | HA12017 | 100p |
| BD311 | 100\% | BFO252A | 60 p | BUV20 | 650p | IRFP9240 | 350p | 2N3019 | 28p | RED $5 p$ | AN6130 | 130p | AN8053 | 200p | Ba6302a | 150p | HA12026 | 125p |
| BD314 | 100p | BFR90 | 85p | BUV21 | 400p | IRFPC50 | 600p | 2N3053 | 18p | YELLOW 8p | AN6135 | 120 p | AN8275 | 250p | BA6304 | 120 p | HA12038N | 140p |
| BD315 | 150p | BFR91 | 99 p | BUV23 | 475 p | IRFRC20 | 250 | 2N3054 | 48 p | GREEN 8p | AN6209 | $350 p$ 500 | AN8370 | 1000p | ${ }^{\text {BA6 }}$ B46325 | 250p | HA12044 HA 12045 | 380p |
| BD317 | 150p | 8R100 | 14p | BUV24 | 350p | IRFZ20 |  | $\stackrel{\text { 2N3055 }}{\substack{\text { N }}}$ | 38 p $\mathbf{5 0}$ |  | AN6247 | 200 p | AN8387 | 350p | BA6328 | 250p | HA12047 | 450p |
| BD231 BD332 | ${ }^{40 p}$ | BR103 | 37 p 885 | BUV25 | 150p | IRFZ44 | 160 | 2N3440 | 45 p |  | AN6270 | 400 p | BA222 | 65p | BA6334 | 75p | HA12058 | 320p |
| BD3361 | ${ }_{60 p}$ | EU305 | 88 p | BUV27 | 125 | M 52501 | 100p | 2N3441 | 175 | RECTANGULAR | AN6300 | 600 p | BA225 | 100 p | BA6410 | 220 p | HA12088 | 375 p |
| BD362 | 60 p | BU108 | 100p | BUV28 | 110p | MJ2955 | 55p | 2N3442 | 85p |  | AN6306 | 380p | BA314 | 40p | BA6411 | 250p | HA12116 | 130 p |
| 70 | 30p | BU109 | 80p | BUV37 | 175p | MJ3000 | 100p | 2N3771 | 85p | $\mathbf{5 m m} \times 2.5 \mathrm{~mm}$ | AN6310 | 200 p | BA301 | 55 p | BA6418N | 100p | HA12411 | 175 |
| 8 C 371 | 30p | BU110 | Op | BUV46A | 75p | M J3001 | 100 p | ${ }^{2 N 3772}$ | 90p | RED ${ }^{\text {Pew }}$ | AN6320 | 180p | BA311 | ${ }_{60}^{80 p}$ | ${ }^{\text {BA64435 }}$ |  | HA12413 | 700 |
| 8D410 | 50p | BU111 | ${ }_{60}^{100 p}$ | BUV47 | $120 p$ $175 p$ | MJ4032 | 175 p 175 p | 2N3819 | 100p | YREEN | ${ }^{\text {AN }}$ A 332 N | 320p | BA333 | 80 p | BA7001 | 150 p | HA12430 | 200p |

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| Make | Models |
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| Hitachi <br> Order Code | VT11, 14, 17, 19, 33, 34, 35, 38, 39, 52, 57, 61, 62, 63, 64, 65, 85 86, 330, 350, 640, 16S, 5030 <br> IDL01 |


| Hitachi <br> Order Code: | VT11, 14, 17, 19, 33, 34, 35, 38, 39, 52, 57, 61, 62, 63, 64, 65, 85 , 86, 330, 350, 640, 16S, 5030 <br> IDL01 | FF Rew Idler 6886792 Price 100p |
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| Goldstar | MZ3666960J2 |
| VXP0521 |  |
| Hitachi | 6861471 |
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| VXP0463 | 1716 | Price: |
| VXP0521 | 1717 | 20p each |
| VXP0581 | 1718 | 16p each pack of 5 |
| 1430662T15620 | 1719 | 13p each pack of 10 |
| NIDL0005GEZZ | 1720 |  |
| NIDL0006GEEZ | 1721 | Packs are for each model |
| NPLY0107GE22 | 1722 | Paks aro for |



# Workshop <br> Equipment <br> for testing, diagnosis and repair 

1998 is the year in which digital TV finally arrived. As this supplement is being prepared, the new DTV services are coming on stream from satellite and terrestrial transmitters.
It's likely that fault-finding amongst the microprocessors, the microcontrollers, the DRAMs and other memories and the processing chips used in DTV receivers will be based on software rather than hardware: we could be using programs rather than prods, probes and meters. Nevertheless as long as there are picture tubes and highvoltage power supplies there will be a need for conventional test instruments and faultfinding techniques. As long as there are line and field timebases that drive copper/ferrite yokes there will be scan failures, sparks and arcs to deal with; and while chopper power supplies and electrolytic capacitors continue to exist they will fail from time to time. In addition lightning, static spikes, surges and heat will continue to take their toll on electronic equipment.
VCRs and camcorders, regardless of format, present other problems. Until - if we get away from moving parts, pollution, dirt and wear will take their toll. And the inevitable breakdowns still have to be dealt with.
The new digital transmissions, rugged though they are, require care in the installation and alignment of the dishes, feeders and any distribution systems used.

Many of these needs require the use of specialised test equipment and service aids. In this feature we will look at what's good and what's new.

## Oscilloscopes

Hameg is perhaps the best-known manufacturer of oscilloscopes for TV and


Ozan's Teletest 2 pattern generator in the workshop - with essential reading!
video servicing. Many Hameg models now have a microprocessor-controlled auto-set and memory function. With auto-set the triggering, sweep and Y-gain are automatically set to provide the best waveform display of any signal presented to the instrument. The memory function stores six different user-defined settings. Two new Hameg models, the HM407 and HM1507, incorporate these features: the HM407 is a $40 \mathrm{MHz}, 100 \mathrm{MS} /$ sec analogue/digital scope at $£ 724$; Model HM1507, at $£ 1,355$, is an analogue/digital type with a 150 MHz bandwidth and a $200 \mathrm{MS} / \mathrm{sec}$ signal sampling speed.
Kenwood has a whole new range of bench-based scopes. The CS5350 is a threetrace 50 MHz analogue model with auto setup and automatic measurement of voltage
and frequency. Model CS5370 has the same features, functions and appearance, but the bandwidth is increased to 100 MHz . The flagship of the Kenwood servicing range, Model DCS8300, is a digital storage scope with 100 MHz capability in normal use and 40 MHz in the digital storage mode. As well as auto set-up this model offers waveform processing functions such as averaging, peak hold and interpolation.
Grundig has a new digital storage oscilloscope, Model SO100, with a digital and analogue bandwidth of 100 MHz . Sampling rates range up to $40 \mathrm{MS} / \mathrm{sec}$, with storage depth to 4 K . There's an optional software pack, in floppy-disk form, for this instrument. It enables waveforms to be displayed, processed and stored by a PC.
The subject of PC-based waveform


Features Relay attenuators Vertical mode triggering Fix synchronisation External trigger Calibration output

Vann Draper is offering readers of TV magazine special discount on the Kenwood range of high quality oscilloscopes. The CS 412520 MHz 2 channel oscilloscope normally sells for $£ 361.33$ but is available for just $\mathbf{£} 319$ including vat \& delivery. The CS 413540 MHz 2 channel oscilloscope normally sells for $£ 528.75$ but is available to TV readers for just $£ 479$ including vat $\&$ delivery.
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Key specifications 3dB bandwidth CRT size CRT voltage Vert sensitivity Input impedance Time base Sweep mag Mode Trigger
Cal signal
$Z$ axis input Weight Size

20 MHz (CS4135 40 MHz )
150 mm rectangular, graticule 8 by 10 divisions
Approx 2 kV (CS4135 approx 12 kV )
$1 \mathrm{mV}-5 \mathrm{~V} / \mathrm{div}$, 12 ranges, $1-2-5$ steps, fine adjust
$1 \mathrm{Mohm}+/-2 \%$, approx 22 pF
$0.5 \mathrm{~s}-200 \mathrm{~ns} / \mathrm{div}, 20$ ranges, $1-2-5$ steps, fine adj $\times 10$
CH1, CH2, Alt, Chop, Add, CH2 invert
Auto, Norm, Fix, TV frame, TV line
1 kHz squarewave, $1 \mathrm{Vpk}-\mathrm{pk}+/-3 \%$
TTL level, dark for positive voltage
7 kg (CS 41357.2 kg )
$300 \times 140 \times 415 \mathrm{~mm}$ excluding protrusions

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display brings us to Pico Technology Ltd., whose 'virtual oscilloscope' designs, based on an AD converter, have been further developed. There are now the ADC-40 (8-bit sampling) and ADC-42 (12-bit sampling) types at $£ 64$ and $£ 90$ respectively; the 12-bit ADC-100 at about $£ 200$; and the ADC-200 series, with bandwidth up to 50 MHz and $100 \mathrm{MS} / \mathrm{sec}$ sampling, at $£ 460$.
Oscilloscopes don't have to have a CRT to provide the display, nor need they be large, heavy or mains-powered. For use in the field - or in the workshop under some circumstances - Fluke has its ScopeMeter range. These models have an LCD display, dual-trace capability and a digital multimeter.

In its TDS200 range Tektronix has compact, light LCD-readout oscilloscopes with bandwidths up to 100 MHz .
The ultimate in convenience and portability is perhaps the Pico OsziFOX handheld (pentype) digital storage oscilloscope at $£ 80$. It has 6 -bit resolution, a sampling rate of $20 \mathrm{MS} / \mathrm{sec}$ and a built-in $16 \times 32$-element backlit LCD readout. Display of 'live' or stored data on a PC screen is possible using the cable supplied and DOS/Windows software.

## Multimeters

There's no doubt that analogue meters of all types are losing ground fast! We still find uses for them in first-line field servicing and, amongst other things, for installing and testing aerials, dishes and their accessories. For these purposes inexpensive yet comprehensive types, such as those in the Altai and Tenma ranges, come into their own. Several of these cost less than $£ 10$ - the best sort if you are going to drop one off the roof accidentally or leave one in the microwave.
Fluke can be recomm-
ended for quality and durability in the DMM field. The newly introduced Fluke 70 Series III range has extra-large characters, analogue bar-graph indication and, for really difficult environments, an auto touch-hold feature. Prices range from $£ 120-£ 150$.
Wavetek has lately made an assault on the DMM market with a wide range of handheld instruments at prices from $£ 35$ to $£ 142$, with features to match.
Wavetek, Fluke and others offer pen-type digital multitesters for use in confined spaces. There must be hundreds of different DMMs on the market at present, many designed for specific applications and environments.
The number of hand-held capacitance testers is increasing. There are new offerings this year from AVO, CIE, Konig, Caltek/Philex and Tenma. Prices range from $£ 40$ to $£ 227$, the latter for the dual-display AVO B131, which measures resistance, capacitance, inductance and $Q$ (at test frequencies of 120 Hz and 1 kHz ) with 1 per cent accuracy.

## Safety Testing

Most of what we've looked at so far provides tests to assist with fault diagnosis. The other, and very important, aspect of equipment testing is for safety and compliance with safety legislation.
Megger and Robin both have new hand-

## 15\% off Pico oscilloscopes

Test Equipment has come a long way over the last few years, traditional 'benchtop' instruments such as oscilloscopes are giving way both to smaller hand held units and more recently to PC based instruments. Pico Technology are at the forefront of these developments and are giving you the chance to save $15 \%$ off the purchase price of some of the highest quality test equipment available today. You can order either the ADC200 or osziFOX oscilloscopes using the order form below. This offer is valid until the 15 Dec 1998.

## Transform your PC.... Into an oscilloscope, spectrum



## analyser and multimeter

The ADC200 range of PC based oscilloscopes offer performance only previously available on the most expensive 'benchtop' scopes. By intergrating several instruments into one unit, the ADC200 is both flexible and cost effective. For video signals the ADC200/50 is an ideal solution, it combines a dual channel 50MS/s digital storage oscilloscope with a 25 MHz spectrum analyser. The screen shots of PAL video signals shown opposite were captured using an ADC200/50.

Connection to a PC gives the ADC200 the edge over traditional oscilloscopes: the ability to print and save waveforms is just one example. Advanced trigger modes, such as save to disk on trigger make tracking down those elusive intermittent faults much easier. The ADC200 is supplied with PicoScope for
 yet simple to use, especially with its comprehensive on line :" help. Installation is easy and no configuration is required; ". simply plug into the parallel port and it is ready to go.
There are three models in the ADC200 range: the ADC200/: $20,200 / 50$ and $200 / 100$ offering a 20,50 and $100 \mathrm{MS} / \mathrm{s}$ scope *: and a 10,25 and 50 MHz spectrum analyser respectively.

[ran + VAT



The DCS8300 digital storage oscilloscope, flagship of the Kenwood servicing range, is available at $£ 2,450$ complete with high-performance probes etc.
held insulation/continuity testers, in analogue and digital form, at prices between $£ 100$ and £300.
The alternative for appliance safety tests is a PAT (portable appliance tester). The new, comprehensive Megger PAT4DVF has an alphanumeric LCD display and a QWERTY keyboard, which is not the first feature that springs to mind when you think about PATs! It can be used with 110 V and 240 V equipment and has an RS232 link for use with a computer running the AVO Powersuite software. Its basic specification is: 500 V insulation test, reading to $50 \mathrm{M} \Omega$; earth-bond current up to 25 A , reading to $1,999 \mathrm{~m} \Omega$; and maximum 3 kV AC flash test, reading to 3.5 mA . Price is $£ 950$. There's a similar product (PAT 2000i) at a similar price in the Seaward range. For those who want to comply with the legislation at a price more in line with repair and servicing costs, the Seaward PAC500 is still available at about £180.
The other important aspect of safety testing is for microwave oven leakage radiation. In this field Celtek's A100 series of leakage monitors stands out. The basic model A100P, which is calibrated to national standards, reads $0-10 \mathrm{~mW} / \mathrm{cm}^{2}$ and costs $£ 140-$ or $£ 160$ as a kit (A100C) with carry-case, waterbeakers, thermometer etc. An alternative


The Fluke TP8O test probe, with 4 mm steel tips, for use with high-density PCBs.
device, available from CPC under order code IN00096, gives visual and audible warnings when the leakage level is above $50 \mathrm{~mW} / \mathrm{cm}^{2}$, has a self-check feature, and comes with a certificate of conformity: price is $£ 94.29$ with accessories.

## Pattern Generators

Amongst TV pattern and test-card generators, the top-end benchmark Promax GV698 remains unchallenged in terms of price and features, though Grundig now has hardware available to generate $16: 9$ widescreen images. At the lower end of the market there's the new Burosch TPG1 hand-held test-pattern generator at $£ 174.48$ : it provides a 'universal test pattern' for overall picture assessment; colour bars; a white raster; RGB bars; a grey scale; a multiburst; and a 1 kHz sinewave test tone.
Burosch also has a new computer-monitor pattern generator in hand-held/pocket form, Model CMT-4 at $£ 203.66$, to stand against the longer-established Black Star Model MTPG at $£ 165$. If a matching PC is available, software-based alternatives like Black Star's 'Testcard' at $£ 29$ provide a cheaper alternative.
The Black Star 1410 video monitor tester from Black Star provides a comprehensive range of line and frame frequencies, including $15.625 \mathrm{kHz} / 50 \mathrm{~Hz}$ for work with projection and conventional TV sets.
Ozan/Teletest continues to produce value-for-money pattern generators for TV and monitor use, an area in which Sencore also specialises.

## Power Supplies

Workshop power supplies find many uses on the bench, especially amongst those who service camcorders, audio or radio products, and those who need to drive VCR decks through their motions while dismantled. A very wide range of units is now available, with analogue and digital V/I readout, voltage ranges up to 60 V (Kenwood PAC series), current ranges to 30A (Altai), and in twinand even triple form, the latter from Tenma at $£ 167$.
New are the Kenwood P-ranges, with LED display, remote sensing and even, in some versions, remote control.
To simulate a car battery, Altai offers fixedoutput (13.7V) regulated mains converters in current ratings from 3A (at about £15) through $5,7,10,15$ and 20A types at up to £64.

## Audio Servicing

Simulation of car batteries is just one aspect of audio servicing - a reasonable profit can still be made from repairing in-car equipment.
The Ozan Teletest Tone is new in the audio servicing field. It generates four pure sinewaves at up to 12 kHz , with four standard levels, plus ITC- and BBC-standard stereoident effects.

Another newcomer is the Tenma LPM6673 laser power meter. Its 633 and $750-820 \mathrm{~nm}$ response, three power ranges and built-in simulator enable more than CD players to be checked. An identical-looking instrument is available in the form of the Konig LPM5673 - but at a different price! So it's worth checking costs and specifications if you are in the market for a laser-power meter.
There's some new audio test gear from Kenwood: the CS1575D stereo oscilloscope has the ability to display simultaneously two conventional traces plus a Lissajous pattern; the SG series of FM/AM signal generators offers stereo and ranges up to 2 GHz ; the AG series of audio generators has a variant (253) that boasts a distortion figure of 0.004 per cent.
Those who like daydreaming at the bench might find a range of digital test instruments


The Fluke 12B digital multimeter. Features include capacitance checking to $10,000 \mu \mathrm{~F}$ and selectable automatic switching to measure AC or DC.
just introduced by the same company of interest. There are, amongst other things, CDROM and DVD encoders and analysers, a DAB OFDM encoder and an IEEE 1394/Firewire bus analyser. I won't quote prices here! They are available from Vann Draper.

## Test Discs and Tapes

Still with audio, a new range of test CDs is available from Burosch and Hama. It includes a general tester with 96 test-signal components, a laser-beam focus checker, and a Surround-sound set-up/test disc that features - would you believe it? - Tyrannosaurus Rex and the sound of a railway station!
Video test tapes have blossomed this year, with a wide range of products from firms such as Burosch and Nedis at prices below $£ 30$ - including a Video-8 stereo version. I

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Temperature Control
Soldering, Revolutionary In its Rapid Response
innovative design provides an $80 \%$ improvement in soldering efficiency over the finest soldering torns currently available in the market place
AD2000 is starc free wivis $230 \mathrm{~V} / 55 \mathrm{~W}$ power supoly and has the facility to be used with either the AD2010 (20W) or the AD2045 ( 50 W ) power chord With a range of quick fil solder cartridges (tup/ele ment as y) up sizes from 0.3 mm to 4.8 mm ( 16 Tivs) and temperature controll from $100 \times 350^{\circ} \mathrm{C}$. This product is a tmust for the professional engineer. ORDER CODE: 23800AS
JT6040 an autonomous desolder station with buili-in hol ail generator and electrontic temperature and ait filow control Vacuum pump for securing the IC's. Power 800W al 230 V . Temperature
selection from $150^{\circ}$ 10 450 C ATr fiow
regulation: from 6 to 34 l mmin .
ORDER CODE: 23800
Trade Prices apply on both products.

ELECTRONOCS BOMOTED
The professional engineess choice
Telephone: 01189876444



The HR flyback-fransformer tester in use.
guess that JVC, even Konig, with their three-figure offerings won't sell many alignment tapes in future!

## TV Test Gear

In the run-up to DTV there hasn't been much new TV test gear on offer. One item I have found to be very effective - in fact better than everything else I've tried - is the HR flyback-transformer tester from CPC at £71.87. It comes with a CD-ROM that illustrates circuits, pin-out details and equivalent types.

Two new remote control testers have been introduced by Burosch. They have LED arrays to indicate the presence and strength of infrared radiation, and are ideal for customer demonstrations in the retail shop or in service reception. The more expensive version ( $£ 30.50$ ) has eight progressive

LEDs, a variable tone generator and an oscilloscope output port! They are available from CPC.

SEME stocks two high-voltage test probes made by Fluke. The $80 \mathrm{~K}-40$, for TV use, measures up to 40 kV DC or 28 kV RMS AC; the $80 \mathrm{~K}-6$, for microwave ovens, measures up to 6 kV DC or peak AC. They can be used with any $10 \mathrm{M} \Omega$ inputimpedance DMM that has 4 mm input sockets with 20 mm spacing.
Now that terrestrial DTV is about to get under way, and with cable systems changing over to digital signals, there have been developments in the TV-signal testmeter field. The Promax 8 is a hand-held, programmable signal analyser with LCD screen: it's basically a swept-spectrum scanner, with coverage from 5 MHz to 862 MHz , that can read relative and absolute amplitude and power, also the carrier-tonoise ratio, of both analogue and digital signals.

## Satellite TV

Many signal-strength sweep-analysers can operate in both the terrestrial and the satellite TV transmission bands. Examples of this are the established Prolink 7 from Promax and the Unaohm flagship Models EP507 and EP318. All three have the capability (optional) of reading the QPSK/QAM bit-error rate (BER). The Unaohm EP507 has the luxury of a colour LCD screen for picture- and spectrumdisplay, while Model EP318 uses a black-and-white CRT: in other respects they are similar.
The Unaohm SBM100 battery-operated satellite BER meter covers the 920 $2,150 \mathrm{MHz}$ range. It has QPSK capability and dual digital/bar-graph readout of the bit-error rate, also LNB power and DiSEqC switching tests.
These instruments can also be used for checking SMATV systems, where problems with data corruption may arise as a result of impedance mismatching and signal reflections.

## Compułers and Monitors

Pattern generators for monitor test and alignment have been covered here already. Sencore has continued the development of its range of test instruments and analysers.
Two new diagnostic systems, at opposite ends of the price spectrum, are available from CPC for those involved in faultfinding within PCs. Dr. Bear at $£ 490$ consists of a card that plugs into a free ISA slot plus leads for connection to the IDE controller and I/O ports. It runs a comprehensive series of tests automatically: the software bypasses DOS to allow systems that won't boot up normally to be tested. A much simpler card for PCI (order code CSO2999) or ISA (code CSO3000) slot-fitting is available at less than $£ 30$. It monitors and displays the POST (Power-On

Self-Test) codes generated by a PC's BIOS as the machine boots up. When an error occurs, the POST code manual supplied enables the code to be interpreted.
Other computer-system tests are provided by the Wavetek RS232 interface tester Models 725, 735 and 775, at prices from $£ 127$ to $£ 252$ (they have multiple-LED indi-


This microwave oven leakage tester is available from CPC under order code IN00096.
cation); and the Cableman PC Cable Check, which tests for open, shorted and cross-connections in a wide range of standard cable/plug configurations.

## Soldering and Rework

The four main manufacturers of PCB rework stations - JBC, Leister, Pace and Weller - continue to compete vigorously. Weller has recently introduced several new products: WT50 desoldering tweezers, the 4024-1LA through-hole desoldering station, the MT1500 microtouch soldering station, and several close-controlled soldering stations in the WS and WSD ranges.
Metcal is now providing competition for


Burosch's new remote control testers.
the 'big four' in rework equipment. The Metcal Smart Heat system is based on a low-mass, quick-heat cartridge tip with built-in heater and regulator. There's a wide range of bits, tips and cartridges for the MXRM3E handpiece and the MX500P power supply unit. The MX-Talon is a tweezertype handpiece with bevelled-edge bits for use with the same power supply unit. Metcal is now part of OK Industries, which has a complete hot-air rework station - Model FCR2100. Its basic price is $£ 1,025$ : there's a huge range of shaped nozzles at $£ 87$ each.
With the emphasis on Health and Safety at Work, there are new fume extractor ranges from Bofa and Airidus. They draw in fumes at the soldering iron and, working from compressed air, filter out the impurities in a closed chamber, returning clean air to the workshop. The cheapest fume extractor I can find - some units are very expensive! is the Cliff bench-standing unit at $£ 40$ : designed for use alongside hand-soldering operations, it uses a replaceable charcoalfilled foam filter to absorb particles down to 5 microns. Complying with health and safety legislation cannot always be cheap, as we saw with PATs.
More 'consumables' are available for surface-mount soldering and rework. Chemtronics' desoldering braid is now available in widths from 0.5 to 5 mm , impregated with several different types of flux. Omega has several new rosin- and lead-free 'clean' solder products, while Electrolube has introduced a range of SM rework flux pens for pinpoint dispensing and an SM adhesive product. Alphametals has a long-life (important in small service departments) solder paste for SM work: the paste is rosin-based and is specially formulated for applications where component termination and PCB surfacefinishes are variable.

## Service Aids

A fluorescent bench lamp with built-in magnifiers is indispensable for work on much of today's equipment. Unfortunately magnifier lamps tend to be expensive. Help is now available from SEME in the form of the AID3053, a big, bright bench light with a 22 W circular tube, a 5 in . 3-dioptre lens and a spring-balanced 45 in . extension arm. Good value at only $£ 55$.
Chemtronics has introduced a rubber keypad repair kit that consists of 3 g of adhesive and 0.3 g of curing agent. When mixed together and painted on they provide a conductive coating that gives a new lease of life to worn remote control and other contact pads. Chemtronics also has a gold guard pen for cleaning and lubricating gold and other precious metal contacts and connectors: it cleans and lubricates in one go.
Most consumer-electronic equipment now contains chips that are ESD-sensitive. This means that precautions against static charge


The Pico OsziFOX hand-held digital storage oscilloscope.
build-up are required when servicing equipment and fitting replacement devices. A new and, at $£ 26$, relatively inexpensive static control field service kit, type 8506, is available from 3 M . It consists of a wristband, earthing cords and a bright red dissipative $380 \times 510 \mathrm{~mm}, 0.01$ in. thick mat: the whole lot folds into a small package for carrying in a pocket or toolcase. Several new ESD-defensive products have been introduced by Vermason: there's a complete workstation kit; a field kit at $£ 29$ and a posher one at $£ 47$; and a couple of rather expensive wall- and bench-mounting wrist strap testers.

## Round-up

The prices quoted here are trade, ex-VAT. They tend to vary as new catalogues etc. are introduced, so check before ordering. If the price of something you require seems to be high, talk to Stewart of Reading or Telnet about used test instruments at bargain prices. Most of what we've looked at in this survey has consisted of stand-alone hardware.
I cannot finish without mentioning the Philips Compair computer-based fault diagnosis, repair and set-up system and its associated technologies Customer Service Mode and Smartman, which with Compair went on sale last month. This has to be the innovation of the decade, and will hopefully be the harbinger of a whole range of software-based service systems from all the manufacturers, ideally in a form that's compatible with the Philips one.
My awards for 1998 go to HR for its very effective LOPT tester; to the various makers of those clever and realistically-priced service and alignment videotapes; and to Burosch for making such a wide range of good test equipment at such down-to-earth prices. The booby prize should perhaps go to a PAT maker who charges nearly $£ 300$ for a wee bit of floppy-disc based software and the same again for a bar-code reader.

## TEST EQUIPMENT MANUFACTURERS AND DISTRIBUTORS

Note that many items are available from several different sources. The ones included in the list below have been selected because they carry a reasonable range of the named brand of equipment.
Items with brand names
mentioned in the text but not listed here are available through distributors such as CPC, Chas Hyde and Son Ltd. (CHS), HRS, SEME and Willow Vale Electronics.

Adroit Technology Ltd. Available from CPC.

Alban Electronics L.td., 6 Caxton Centre, Porters Wood, St Albans, Herts AL3 6XT. 01727832266.

Airidus: Available from CPC.
Altai. Available from SEME.
Avo/Megger. Avo International,
Archcliffe Road, Dover, Kent CT17 9EN. 01304502100.

Black Star, 4 Harding Way, St Ives, Huntingdon, Cambs PE17 4WR. 01480 462440.

Bofa: Available from CPC.
Burosch: Available from CPC.
CHS, Prospect House, Barmby Road, Pocklington, York YO4 2DP. 01759303 068.

Coastal Aerial Supplies, Unit X2, Rudford Industrial Estate, Ford, Arundel BN18 0BD. 01903723726.

CPC plc, Component House, Faraday Drive, Fulwood, Preston, Lancs PR2 4PP. 01772654455

Daiwa. Available from SEME.
Fluke. Available from Willow Vale Electronics.

GoldStar. Available from Maplin.
Grundig: Available from Vann Draper Electronics

Hama, Unit 4, Cherrywood, Chineham Business Park, Basingstoke, Hants RG24 OWF. 01256374700.

Hameg Instruments L.td., 70-78,
Collingdon Street, Luton, Bedfordshire LU1 1RX. 01582413 174. Also available from CPC, SEME and Willow Vale Electronics.

Huntron. Available from SEME.
Instek. Available from Maplin.
JBC: Available from Willow Vale Electronics.

JVC (UK) Ltd., JVC House, JVC Business Park, Priestley Way, Staples Corner, London NW2 7BA. 0181450 3282.

Kenwood. Available from SEME and Vann Draper.

Konig. Available from CHS, Willow Vale Electronics.

Leader. Available from CPC.
Lodestar. Available from Vann Draper Electronics.

Maplin Electronics plc, PO Box 3 , Rayleigh, Essex SS6 2BR. 01702554 161.

Maxcom. Available from Vann Draper Electronics, Willow Vale Electronics.

Metex. Available from CPC, SEME.
Müter. Available from SEME in the UK, from Donberg Electronics, Ranafast, Co. Donegal (075 48 275) in Ireland.

Ozan, Freepost, Wimborne, Dorset BH21 7BR. Freecall 0500009070.

PC Control Systems Ltd., Hamilton House, 66 Palmerstone Road, Northampton NN1 5EX. 01604601677.

Philex plc, 110-124 The Broadway, West Hendon, London NW9 7PP. 0181 2021919.

Pico Technology Ltd., 149-151 St.
Neots Road, Hardwick, Cambridge CB3
7QJ. 01954211716
Precision Gold. Available from Maplin.

Promax. Available from Alban Electronic Ltd

Sadelta. Available from Coastal Aerial Supplies and Willow Vale.

Satellite Solutions (UK) Ltd., 1 Hartburn Close, Crow Lane Industrial Estate, Northampton NN3 9UE. 01604 787888.

Satfinder. Available from Willow Vale Electronics.

Satlook. Available from Satellite Solutions.

Seaward. Available from CPC, SEME, Willow Vale Electronics.

SEME Ltd., Unit 2, Saxby Road Industrial Estate, Melton Mowbray, Leics LE13 1BS. 01664481818.

Sencore. UK agents ITM Ltd., 34 Beaufoys Avenue, Ferndown, Wimborne, Dorset BH229RH. 01202872 771.

Tektronix: Available from CPC.
Tenma. Available from CPC.
Thandar/Thurlby. Available from Willow Vale Electronics.

Unaohm. Available from Satellite Solutions.

Vann Draper Electronics, Unit 5,
Premier Works, Canal Street, South
Wigston, Leics LE18 2PL. 01162771
400 . Stocks a wide range.
Wavetek: Available from CPC
Willow Vale Electronics Ltd., 11
Arkwright Road, Reading, Berks RG2 OLU. 01189876444

## Test gear is also available from:

HRS Electronics Ltd., 100 Great Barr Street, Birmingham B9 4BB. 01217666 668.

Stewart of Reading, 110 Wykeham Road, Reading, Berks RG6 1PL. 01189 268 041. Also supplies used equipment.

Telnet, 8 Cavans Way, Binley Industrial Estate, Coventry CV3 2SF. 01203650 702.

## PINCH ROLLERS



## VIDEO LAMPS



## VIDEO SERVICE KITS



## REPLACEMENT VIDEO CASSETTE HOUSINGS



MODE SWITCH
NV2000, 2010, 7000, 7200, 7800 (VS50048) NV230, 260, 430, 810, 870, 2300, 4300 (VSS0110)

NV830 (VSS0091)
NV $300,333,340,366,688,777,778$
(VSS0060
NVG21, 25, NVH65, NVD80 (VSS0175A)

## AUDIO CONTROL HEADS

AMSTRAD ORIGINAL NO: 15075
Used on: AMSTRAD TVR1, 2, 3, VCR4600, 4600MKII, 4700, FUNAI VS2, VCR4600, 4800, 5200, 5600, 6600, VIP3000, 5000 Also fits: FIDELITY, FUNAI, HINARI, PROLINE, SCHNEIDER TOWADA, UNIVERSUM ORDER CODE: AHO1 PRICE: 1350p

AMSTRAD ORIGINAL NO: 15313
Used on: AMSTRAD DD8900, 8904, VCR2000, 6000, 6100, 8600, 8602 8603, VCR8504, 8700, 8704, 8714, 8800, 9005, 8244
Also fits: ANTECH, BONDSTEC, CASIO, CROWN, FIDELITY, GOLDHAND, GRANADA, HINARI, MARQUANT, OMEGE, PROFEX, SCHNE DER, SEG, SENTRA, SHINTOM, TASHIKO, TATUNG, TOWADA UNIVERSUM ORDER CODE: AHO2 PRICE: 1450

Replacement Audio Control Video Sound Head for National Panasonic

| PART NUMBER | MODELS | PRICE |
| :--- | :--- | :---: |
| VBR 0091 | NVG7 etc | 875p |
| VBR0050 | NV300, NV340 etc | 875 p |
| VBRO061 | NV777 etc | 875 p |
| VBRO103A | NV250, NV450 etc | 625 p |
| VBROL25 |  | 625 p |

## VIDEO TOOLS

## VIDEO CLEANING STICKS

Price 17p each 15p each pack of 10pcs 3p each pack of 25 pcs Order Code: SP14

## VIDEO MAINTENANCE TOOLS

Set of 8 Allen keys packed in a plastic wallet
Order code: TOOL 9, Price 125p Specifically designed for video maintenance UNIVERSAL HEAD EXTRACTOR

Hand tool designed for extracting hard to remove heads without damage to either the head or the mounting assembly. Adjustable so as to suit various heads Order code: TOOL 8, Price 600p

## VCR ALIGNMENT KIT

CONTAINS: SET OF 7 HEAD \& TAPE PATH ALIGNERS
SET OF 8 ALLEN KEYS

- RCA TYPE AUDIO \& CONTROL HEAD POSITIONING TOOL
$0.77 \mathrm{~mm} \quad 0.90 \mathrm{~mm}$
- RCA ADJUSTMENT TOOL FOR TAPE GUIDE POSTS - RCA TYPE BACK TENSION TOOL
- TENSION ADJUSTMENT TOOL FOR VARIOUS USES - VCR ADJUSTMENT TOOL


# 3 REVERSIBLE SCREWDRIVERS SPRING HOOK 

 VCR HEAD EXTRACTOROrder code: TOOL 10, Price 2900p

## TRANSPARENT REPAIR/ADJUSTMENT CASSETTE

This transparent videocassette replaces a normal videotape during measurements, adjustments and inspection. The mechanical parts come into sight and become accessible. Order code: TOOL 23, Price 500p

## BACK UP BATTERIES

PHILIPS
Part Nos: 138-101138, 138-10313 1.2v 90mAH Order Code: BB01
Part Nos: $138-10229,2.4 \mathrm{v} 100 \mathrm{mAH}$ Order Code: BB02

Price: 70p
Price: 135p

FERGUSON
Part No: 00E6-067-0011.2V 100mAH
Order Code: BB03
Part Nos: 00E6-606-8001 2.4V 100mAH
Order Code: BB04

Price: $90 p$
Price: 150p

SATELLITE PSU REPAIR KITS

| MAKE \& MODEL | CODE | PRICE |
| :--- | :---: | :---: |
| PACE PRD800, PRD900 | SATPSU1 | 600 p |
| PACE SS9000, 9200, 9010, 9210, 9220 | SATPSU2 | $550 p$ |
| AMSTRAD SRD510, SRD520 | SATPSU3 | $600 p$ |
| AMSTRAD SRD500 | SATPSU4 | $600 p$ |
| AMSTRAD SRX340, SRX345, SRX350 | SATPSU5 | $600 p$ |
| PACE D100/150 | SATPSU6 | $650 p$ |
| CHURCHILL D2MAC | SATPSU7 | $650 p$ |
| PACE MSS100 | SATPSU8 | $\mathbf{1 1 0 0 p}$ |

## SATELLITE TUNERS

PACE PRD800/MSS200 2Ghz (221-2077062) ORDER CODE: TUNER01 PRICE: 1400p + VAT

PACE PRD900/MSS1000 2Ghz (221-21770112) ORDER CODE: TUNER02 PRICE: 1400p + VAT

## SWITCH MODE TRANSFORMERS <br> PACE 9000

ORDER CODE: PACE9000 PRICE: 800 p
PRD800/PRD900
ORDER CODE: PRD800 PRICE: 550p

| MAKE \& MODEL | CODE | PRICE |
| :--- | :---: | :---: |
| PACE MSS200/300 APPOLL | SATPSU9 | 900 p |
| PACE MSS500/1000 | SATPSU10 | 1230 p |
| FERGUSON SRD4 | SATPSU11 | 650 p |
| ECHOSTAR SR5500 | SATPSU12 | 1600 p |
| ECHOSTAR 6500/7700/8700 | SATPSU13 | 2750 p |
| AMSTRAD SRD600 | SATPSU14 | 2600 p |
| MIMTEC (Surensen) | SATPSU15 | 700 p |
| AMSTRAD <br> SRD700, SR950, SRX100, 301, 501, 502, <br> 1002, 2001, SRD2000 SAT250 | SATPSU16 | 650 p |

SATMETER

| The Satmeter is a professional portable satellite strength meter |
| :--- |
| designed for the installation and maintenance of satellite TV sys- |
| tems. The Satmeter can be used as stand alone with powering |
| the LNB as well as in loop. |
| Through operation with satellite RX powering the LNB. |
| * Acoustical signal: On signal strength *LED indicator: Vert/Hori |
| * Frequency Range: 900 to 2050 Mhz *nput impedence: 70 Ohm |
| * Power amplifier: 18 db *Detection Range: -60 to -10 DBM |
| * Max. input signal: -10 DBM |
| ORDER CODE: TOOL22 |
| PRICE: $8500 p$ |

REPLACEMENT TV SWITCHES
GRUNDIG

## PART No: 29703, 29102

USED ON:
C7500, C8500. C8502, C8712 . . .ETC
Order Code: SW1

Price: 100p

## PHILIPS

## USED ON:

K30, K35, K40, KT3, KT4
Order Code: SW13
Price: $95 p$
SONY

## USED ON:

KV1612, KB1612, KV1614, KV2052, V2056
KV2062, KV2067, KV2212 . . .ETC
Order Code: SW5
Price: 130p

## USED ON:

KV1400, KV1440, KV2040, KV2060
(POWER SWITCH 26mm)
Order Code: SW12
Price: 110 p

## USED ON

KV2020
(POWER SWITCH 21mm +Remote)
Order Code: SW6
Price: 130p

## SONY 2 PIN FUNCTION SWITCH

Order Code: SW9
Price: 35 p

| GTSE |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | TIME LAG |  | BLOW |  |
| CURRENT RATING | ORDER CODE | PRICE | ORDER CODE | PRICE |
| 100 mA | FUSE36 | 75p | FUSE37 | 60p |
| 160 mA | FUSE01 | 75p | FUSE17 | 60 p |
| 250 mA | FUSE02 | 75p | FUSE18 | 60 p |
| 315 mA | FUSE03 | 75p | FUSE19 | 60 p |
| 400 mA | FUSE04 | 75 p | FUSE20 | 60 p |
| 500 mA | FUSE05 | 75 p | FUSE2I | 60 p |
| 630 mA | FUSE06 | 75p | FUSE22 | 60p |
| 800 mA | FUSE07 | 60 p | FUSE23 | 60p |
| 1 A | FUSE08 | 60 p . | FUSE24 | 60 p |
| 1.25A | FUSE09 | 60 p | FUSE25 | 60 p |
| 1.6 A | FUSE10 | 60 p | FUSE26 | 60 p |
| 2A | FUSE11 | 50p | FUSE27 | 60p |
| 2.5 A | FUSE12 | 50p | FUSE28 | 60p |
| 3.15A | FUSE13 | 55p | FUSE29 | 50 p |
| 4A | FUSE14 | 55p | FUSE30 | 50 p |
| 5A | FUSE15 | 60p | FUSE31 | 50p |
| 6.3 A | FUSE16 | 60p | FUSE32 | 50p |


| CTPAMMS |  |  |
| :---: | :---: | :---: |
| CURRENT RATING | ORDER CODE | PRICE |
| 3A | FUSE33 | 100p |
| 5A | FUSE34 | 100p |
| 13A | FUSE35 | 100 p |
|  |  |  |
| CURRENT RATING | ORDER CODE | PRICE |
| 8A | FUSE44 | 185p |
| 10 A | FUSEA5 | 185p |
| 15A | FUSE46 | 185p |
| 20A | FUSE47 | 210p |

NB. All fuses are made in the UK and fully meet BS4265 \& BSi362 safety standards and should not be compared with cheap imported types

## VOLTAGE TESTER

A terminal screwdriver incorporating continuity \& voltage with Euroslot ORDER CODE: TOOL11

## 20mm CERAMIC TIME LAG

CURRENT RATING
ORDER CODE PRICE

| ORDNT RATING | FUSE38 | PRICE |
| :---: | :---: | :---: |
| 6.3 A | FUSE39 | 100 p |
| 8 A | FUSE40 | 100 p |
| 10 A | FUSE41 | 100 p |
| 315 A | FUSE42 | 85 p |
| 4 A | FUSE43 | 85 p |
| 5 A |  | 85 p |

# 38 mm CERAMIC TIME LAG <br> CURRENT RATING <br> ORDER CODE 

** ALL THE ABOVE PRICES ARE FOR PACKS OF 10 FUSES **

## SPRING HOOK

Spring Hook, to unlock springs in audio tape recorders \& VCRs
ORDER CODE: TOOL20
PRICE: 265p

## FAULT FINDING / COMPARISON BOOKS

Satellite Fault Finding Guide Issue 1. Listing about 1,000 faults for over a range of 24 different brands. Order Code: BOOK05. Price $£ 8.50$ - No VAT.

Video Recorders Edition 51997
Over 300 pages packed with more than 5500 faults for different brands
Price $£ 15.00$ - No VAT. Order Code: BOOK01

| SERVICEAIDS |  |  |  |
| :---: | :---: | :---: | :---: |
| DESCRIPTION | VOLUME | CODE | PRICE |
| VIDEO HEAD CLEANER | 75 ML | SPOI | 145p |
| SWITCH CLEANER | 176ML | SP02 | 155p |
| SILICONE GREASE | 200ML | SP03 | 180p |
| FREEZE IT | 170 ML | SP04 | 295 |
| FREEZE IT | 400ML | SP16 | 580 |
| FOAM CLEANER | 400ML | SP05 | 180 |
| ANTI-STATIC | 200ML | SP06 | 180 p |
| atrokleane | 200 ML | SP07 | 200p |
| AERODUSTER | 200 ML | SPOB | 340p |
| AERO DUSTER | 400ML | SP17 | 580p |
| PLASTIC SEAL | 200 ML | SP09 | 250p |
| GLASS CLEANER | 250 ML | SP10 | 170p |
| COLOKLENE | 250 ML | SP | 235p |
| EXCEL POLISH 80 | 250ML | SP18 | 180p |
| AOHESIVE 120 | 400ML | SP19 | 225p |
| LABEL REMOVER 130 | 200ML | SP20 | 260p |
| REFURB 140 | 400 ML | SP21 | 260p |
| TUBE SILICON GREASE | 50 GRAMMES | SP11 | 225p |
| TUBE SILICON SEALANT WHITE | 75ML | SP2 | 250p |
| TUBE SILICON SEALANT CLEAR | 75 ML | SP | 250p |
| TUBE HEAT SINK COMPOUNO | 25 GRAMMES | SPl2 | 150p |
| DRIVE CLEANER | 200ML | SP24 | 150p |
| SCREEN CLEANER | 200 ML | SP25 | 145p |
| COMPUTER CARE KIT | - | SP26 | 2100p |
| All the above items are manufactured by Servisol If you purchase more than one Servisol Product, postag <br> \& package will be charged as follows: <br> 300 p for 2.5 cans <br> 500p |  |  |  |
|  |  |  |  |

## TELEVISION

 Edition 6Lists more than 8,450 faults with 460
pages covering 58 different brands
Price: 1600p only - no VAT. Order Code: BOOK02

## Satellite Repair Manual Edition 4

A comprehensive guide to receiver reviewing, featuring stock faults and installation tips.
Price $£ 15.00$ Only No VAT Postage 100p Order Code: BOOK03

## SOLDERING ACCESSORIES

## DESCRIPTION

ANTEX SOLDERING IRONS 25 WAT 240 VAC (XS25W 240V) 15 WATT 240 VAC (XS 15 W 240 V ) 25 WATT SPARE ELEMENT 15 WAT SPARE ELEMENT SOLDERING STAND \& SPONGES SOLLDRING STAND (MADE BY ANTEX)
SPARE SPONGE SPARE SPONGE SOLDER
18 SWG 500 GRAMMES 20 SWG 500 GRAMMES 22 SWG 500 GRAMM $\qquad$
DESOLERING AIDS
SOLDR MOP STANDARD GAUGE $1.2 \mathrm{MM} \times 1.5 \mathrm{M}$ SOLLER MOP $1.2 \mathrm{MMX} \times 10 \mathrm{M}$ SPARE NOZZLE

CODE PRICE

## S101 900p

$\$ 102900 \mathrm{p}$ \$103 450p S108 350 S109 55p $\$ 110$ 500p $\$ 111650 \mathrm{p}$ $\$ 107 \quad 100 \mathrm{p}$ $\begin{array}{ll}\mathrm{S} 113 & 420 \mathrm{p} \\ \mathrm{S} 105 & 320 \mathrm{p}\end{array}$ $\begin{array}{ll}\text { S105 } & 320 \mathrm{p} \\ \mathrm{S} 106 & 60 \mathrm{p}\end{array}$

SEMICONDUCTOR COMPARISONS 1997/8 Listing more than 31,600 Semiconductors with suitable alternative complete with descriptions and base information.
Price: $£ 15.50$ - No VAT. Order Code: B00K04
SEMICONDUCTOR COMPARISONS 1997 The new 1997 Jaeger Semiconductor with 952 pages packed with information on over 80,000 semiconductors in much greater detail plus mar keting data on SMD devices and a separate generic table of all type designations. Price: $£ 40.00$ only - No VAT (+ $£ 5$ Postage) Order Code: BOOK06

## I.C. PROTECTORS

ICPF10, ICPF15, ICPF20, ICPF25, ICPF38, ICPF50, ICPF75
ICPN5, ICPN10, ICPN15, ICPN20, ICPN25, ICPN 38, ICPN50, ICPN75

CAN'T FIND WHAT YOU'RE
LOOKING FOR?
RING US...AS THIS IS ONLY
A SELECTION OF THE
ITEMS THAT WE STOCK

## CASSETTE DC MOTORS

| 6V MOTOR | 170 p |
| :--- | :--- |
| 9 V MOTOR | 170 p |
| 12V CW MOTOR | 170 p |
| 12 V CCW MOTOR | 170 p |
| 13.2 V MOTOR | 290 p |

CASSETTE TAPE HEADS
MONO HEAD ..... 90 p
MINI HEAD ..... 110 p
AUTO REVERSE HEAD ..... 200p

J.V.C. 1990 . 992 , LATE 1987-1988-XLE300BK, XLE31BK, XLE51BK, XLE900BK, XLME91BK, XLV101BK,


XL-M5048K, XL-M505TN, XL-M508, XL-M509, XL-M705TN, XL-V131BK, XL-V151TN, XL-V22 1 BK,
XL-V241TN, XL-242BK, XL-V251TN, XL-V252BK, XL ,Z1050TN, XL-Z551TN, XL-25528K
XL-V241TN, XL-242BK, XL-V251TN, XL-V252BK, XL-Z1050TN, XL-Z551TN, XL-Z552BK
MXS20, MXS 30 , MXS60, PCX105, PCX130, PCX95, RCX230, RCX320, RCX520, RCX620,
RCX720, UXA4, UXA5, UXA55, UXC7, UXT1, UXT3, XLF 115, XLF116, XLF215, XLF216,
XLMC100M, $\times$ LMXG7, XLMXG9, XLV163TN, XLV164BK, XLV174, XLV263TN, XLV264BK,

XLV274BK, XL2
,
DP5040, DP520, DP7030, DP7040, DP7050, DP730, DP920, DP930, DP950, DPM650, DPM6630,
DPM 7730 , DPM850, DPM 991, DX6620, M225, M25, M450, M850, PD3030, PDM991, $\mathrm{RDX25}$,


SLP 1777 , SLP202A, SLP212A, SLP222A, SLP277A, SLP377A, SLP477AK, SLP477A
SLPG100A, SLPG200A, SLPG400A, SLPG500AK, SLPG500AS SLP J244, SLP $126 A$
SLPJ27A, SLP J28A, SLPJ325A, SLPJ325A, SLPJ37A, SLPJ38A, SLP J46A
5LPJ27A, SLP J28A, SLP J325A, SLP J325A, SLP J37A, SLPJ38A, SLPJ46A $691-30209 \quad 5500 \mathrm{P}$


## SANYO



## SHARP

SHARP
CD $111, \mathrm{CD}-301, \mathrm{CD}-302, \mathrm{CD}-304, \mathrm{CD}-310, \mathrm{CD}-\mathrm{CD}, \mathrm{CD}-\mathrm{L} 700, \mathrm{CD}-\mathrm{L800}, \mathrm{CD}-\mathrm{U1}, \mathrm{CD}-\mathrm{U10}, \mathrm{CD}-\mathrm{X10}$,

DX-R77, DX-R770, DX-R820, DX-R840, DX-Z100, DX-Z1000, DX-Z1500, GFCD55, OT-30CD, OT-33CD
aT-350CD, OT-37CD, OT-38CD, OTTCD20, OT-CD33, RS95, SC.77CD, SC-99CD, SC-RS95, SG-A1,

$\qquad$


TECHNICS
SLP200, SLP230, SLP250, SLP333, SLP555, SLP777, SLP999,SLPA10, SLPC20, SLPJ25,
SLPJ45, SLPS700, SLPS900

| Description | Code | Price | Description |
| :---: | :---: | :---: | :---: |
| AKAI |  |  | A512120/230 |
| RC-V10A | RC876 | 650p | A514790 |
| RCV 37 B | RC891 | 650p | A5088470 |
| V25A | RC896 | 650p | A518612 |
| decca |  |  | SCL002 |
| RC70 | RC894 | 650p | ${ }^{\text {C2096 }}$ |
| FISHER |  |  | ${ }^{\text {A } 511940}$ |
| RC905B | RC879 | 650p | 655602H |
| granada |  |  |  |
| UNIVERSAL TEXT | RC309 | 650p | FS4 ${ }^{\text {a }}$ |
| MK4 TEXT, 70155G, 70115G, 70133 G | RC880 | 650p | RG305 |
| 95288 E | RC882 | 650p | RG306 |
| 94490 D | RC884 | 650p | FS9/1-10/1 |
| GRUNDIG |  |  | VS5 RUK |
| TP160E | RC107 | 650p | VS4-1 |
| TP200, TP300 | RC380 | 650p | MULTICONTROL (17C20) |
| TP400 | RC401 | 600p | LOEWE |
| TP590-600 | RC600 | 650p | DC11 |
| TP390. TP610 | RC610 | 650p |  |
| TP621 | RC612 | 650 p | MATSUI |
| TP630, TP650 | RC650 | 650p | 010270601 |
| TP666 | RC660 | 650p | VX770 |
| TP661 | RC661 | 650p | NOKIA |
| HITACHI |  |  | SATELLITE |
| CLEB00-CLE830 | RC140 | 650p | ORION |
| A617402/655602 | RC1920 | 650p | RC53 |


| Description | Code | Price | Description |
| :---: | :---: | :---: | :---: |
| PANASONIC |  |  | SONY |
| EUR51200 | RC200 | 650p | RM604, RM605, RM606 |
| TC2200 | RC204 | 650p | 32 CHANNEL |
| VS00357/NV730 | RC202 | 650 p | RM613 |
| TNQ1621 | RC203 | 650p | RM632, RM636 |
| PHILIPS |  |  | TATUNG |
| RC5002,5154 | RC134 | 650p | FXA |
| KT3 NON TEXT | RC135 | 650p | RC70 |
| 69117032 | RC178 | 650p | FX70 FASTTEXT |
| 69117194 | RC180 | ${ }^{650}$ p | FX70 FASTIEXT |
| RC5991-UNIV | RC300 | 550p | TELEFUNKEN |
| RC38 | RC301 | 650p | FB632 |
| KT3 TEXT | RC5301 | 650p | FB639 |
| RC5352 | RC5352 | 650p | THORN/FERGUSON |
| RC5375 | RC5375 | 650p | 3V35-42 |
| RC5 STANDARD | RC300 | 550p | 3V31-32 |
| RC5903 | RC5903 | 650p | 3V57-58 |
| SALORA |  |  | TX10 TEXT |
| SERIES L | RC190 | 650p | TX10 SIEREO TEXT |
| 86173 | RC882 | 650p | TC9-90-100 |
| SANYO 2 |  |  | 3V55, FV11 |
| RC218, JXGE | RC140 <br> RC878 | 650 p 650 p | TX100 FASTTEXT |
| JXGE | RC878 RC884 | $650 p$ $650 p$ | TX100 ST, FASTTEXT |
| VHR2300 | RC890 | 650 p | PROFESSIONAL |
| RC628 | RC865 | 650p | TOSHIBA |
| SHARP |  |  | CT937 |
| G0121CESA, 123CESA, 204, 251 | RC140 | 650p | CT9117 |

SOAD70A

## REMOTE CONTROLS

| Code | Price |
| :--- | :--- |
| RC990 | 650 p |
| RC901 | 650 p |
| RC902 | 650 p |
| RC903 | 650 p |
| RC994 | 650 p |
| RC905 | 6550 |
| RC906 | 650 p |
| RC1920 | 650 p |
|  |  |
| RC143 | 650 p |
| RC148 | 650 p |
| RC305 | 650 p |
| RC306 | 60 p |
| RC307 | 650 p |
| RC308 | 650 p |
| RC308 | 650 p |
| RC311 | 650 p |
|  |  |
| RC146 | 650 p |
|  |  |
| RC889 | 650 p |
| RC892 | 650 p |
|  |  |
| RC550 | 650 p |
|  |  |
| RC892 | 650 p |

## WE STOCK REMOTE CONTROLS FOR OVER 5,000 DIFFERENT MODELS RING FOR MODELS NOT LISTED ABOVE ON 01819002329

[^2][^3]| Part No. | Code | Price | HITACHI |  |  | 45150119 | LOT169 | 1500p | TLF 14520 F | Lotio | 1500p | 094-01020/0.7 | LOT59 | 1400p | 39-303-31 | T9 | 300p |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AKAI |  |  | 2424593 | LOT44 | 1050p | 45150124 | LOT137 | 1600p | TLF 14521 F | LOT39 | 1850p | 094-01021/0.6 | LOT59 | 1400p | 1-439-303-32 | LOT94 | 1300p |
| 45150344 | LOT56 | 1650p | 2432101 | LOT79 | 1600p | 45150146 | LOT136 | 1600p | TLF 14567 F | L0T39 | 1850p | 094-01027/0.0 | LOT186 | 1825p | 1-439-311-00 | LOT95 | 1550p |
| 101-214017.03 | LOT278 | 1300p | 2432461 | LOT169 | 1500p | 45150301 | LOT169 | 1500p | TLF 14568 F | LOT40 | 1500p | 094-01038/0.7 | LOT245 | 1900p | 1-439-311-11 | LOT95 | 1550p |
| 101-220005-03A | LOT72 | 1600p | 2432611 | LOT80 | 1800p | 45150302 | LOT180 | 1550p | TLF 14584 F | LOT41 | 2000p | 094-01052/0.8 | LOT186 | 1825p | 1-439-311-13 | LOT95 | 1550p |
| D 050/3 | LOT27 | 1450p | 2432651 | Lotro | 1800p | 45150304 | LOT159 | 1500p | TLF 14586 F | LOT42 | 1800p | 094-01057/1.1 | LOT285 | 1450p | 1-439-311-31 | LOT95 | 1550p |
| D 053/37 | LOT207 | 1550p | 2432761 | LOT169 | 1500p | 45150305 | LOT180 | 1550p | TLF 15606 F | LOT256 | 2000p | 610.018.6620 | LOT189 | 1650p | 1-439-311-32 | LOT9 | 1550p |
| D 056/37 | LOT56 | 1650p | 2432981 | LOT37 | 1200p | 45150306 | LOT168 | 1550p | TLF 70012 | LOT78 | 1500p | 610.018.6637 | LOT215 | 1800p | 1.439-331-22 | LOT96 | 1550p |
| D 059/37 | LOT200 | 1400p | 2432981 | LOT37 | 1200p | 45150308 | LOT22 | 1250p | TLF 70012 F | LOT78 | 1500p | SHARP |  |  | 1-439-331-41 | LOT | 1550p |
| D 069/37 | LOT56 | 1650p | 2432982 | LOT37 | 1200p | 45150309 | $10 T 178$ | 1500p | TLF 70012A | 10778 | 1500p | RTRNF 1220 CEZZ | LOT3 | 185 | 1-439-332-00 |  |  |
| FCM 2015 AL | 10778 | 1500p | 2433011 | LOT171 | 1650p | 45150310 | LOT168 | 1550p | TLF 70018 | LOT274 | 1550p | RTRNF 1783 BMZZ | LOT202 | 1800p | 1-439-332-11 | LOT9 | 1600p |
| FERGUSON |  |  | 2433012 | LOT171 | 1650p | 45150313 | LOT30 | 1250p | TLF 70018 F | LOT274 | 1550p | RTRNF 1783 CEZZ | LOT202 | 1800p | 1-439-332-21 | LOT99 | 1600 p |
| 00 D-3-508-001 | Lотзв | 1250p | 2433014 | LOT171 | 1650p | 45150314 | LOT174 | 1400p | TLF 70161 | LOT278 | 1300 p 1600 p | RTRNF 1786 BMZZ | LOT211 | 1850p | 1-439-332-41 | LOT 100 | 1500p |
| $00 \mathrm{D}-3 \cdot 508-002$ | 10738 | 1250p | 2433212 | LOT168 | 1500p | 45150315 45150318 | LOT22 | 1250p | TLF 70162 A | L0772 | 1600p | RTRNF 2000 BMZZ | LOT214 | 1600p | 1-439-332-42 | LOT101 | 1450p |
| 00 D-3-508-003 | LOT276 | 1400p | 2433291 | LOT246 | 1350p | 45150319 | Lот30 | 1250p | TLF 70162B | LOT72 | 1600p | RTRNF 2002 BMZZ | Lот307 | 1450p | 1-439-333-00 | LOT270 | 1550p |
| 00 D-3.515-001 PL1 | LOT276 | 1400p | 2433441 | LOT188 | 1900p | 45150320 | Lotigo | 1650p | TLF 70162G | LOT72 | 1600p | RTRNF 2002 CEZZ | LOT307 | 1450p | 1.1-439-333-11 | L0T270 | 1550p |
| 00 D-4-208-001 | $L 0779$ | 1600p | 2433442 | LOT191 | 1600p | 45150322 | LOT196 | 1550p | TLF 77001 B | LOT274 | 1550p | RTRNF 2003 BMZZ | LOT308 | 1350p | 1-439-333-12 | LOT270 | 1550p |
| 00 D-4-208-002 | 10779 | 1600p | 2433451 | LOT81 | 1350p | 45150324 | LOT194 | 1550p | PHILIPS |  |  | RTRNF 2004 BMZZ | LOT307 | 1450p | 1-439-363-11 | LOT268 | 1400p |
| 00 D-4-235-002 | LOT240 | 1250p | 2433452 | LOT82 | 1250p | 45150325 | Lot22 | 1250p | 482214010142 | LOT142 | 1800p | RTRNF 2005 BMZZ | LOT308 | 1350p | 1-439-363-21 | LOT268 | 1400p |
| $00 \mathrm{D}-4-235-002 \mathrm{HTI}$ | LOT81 | $1350 p$ 1350 p | 2433453 | LOT82 | 1250p | 45150326 | LOT198 | 1550p | 4822140101145 | LOT134 | 1450p | RTRNF 2006 BMZZ | LOT308 | 1350p | 1-439-387.11 | LOT311 | 1450p |
| $00 \mathrm{D-4-235-00201G}$ | LOT81 | 1350p | 2433455 | LOT234 | 1600p | 45150328 | LOT27 | 1450p | 482214010146 | LOT112 | 1700p | RTRNF 2007 BMZZ | LOT307 | 1450 | 1-439-387-21 | LOT311 | 1450p |
| $00 \mathrm{D}-4 \cdot 260-704 \mathrm{HTI}$ | LOT38 | 1250p | 2433521 | L0T85 | 1600p | 45150329 | LOT193 | 1550p | 482214010151 | LOT 102 | 1700p | RTRNF 2023 BMZZ | LOT310 | 1500p | 1-439-416-11 | LOT255 | 1600p |
| $00 \mathrm{H}-0.701-2400$ | LOT182 | 1450p | 2433581 | LOT22 | 1250p | 45150330 | LOT179 | 1550p | 482214010167 | LOT103 | 1250p | SONY |  |  | 1-439-416-12 | LOT255 | 1600p |
| ${ }_{06} 06$ D-3-3083-001-002 | $\begin{aligned} & \text { LOT82 } \\ & \text { LOT82 } \end{aligned}$ | 1250p | 21 | LOT83 | 1400p | 45150331 | LOT207 | 1550p | 482214010171 | LOT104 | 1500p | 3753100 | LOT275 | 150 | 1-439-416-21 | LOT255 | 1600p |
| ${ }^{0} 06$ D-3-3083-002 | LOT82 LOT23 | 1250p | 51 | LOTO1 | 1300p | 45150334 | LOT56 | 1650p | 482214010176 | LOT114 | 1150p | 1.439-243-00 | LOT91 | 1600p | 1-439-416-23 | LOT25 | 1600p |
| 06 D-3-084-001 | LOT23 | 1400p | 2433752 | LOTO1 | 1300p | 45150335 | LOT193 | 1550p | 482214010194 | LOT105 | 1500p | 1-439-243-11 | Lot91 | 1600p | 1-439-416-41 | LOT255 | 1600p |
| 06 D-3-087-001 |  | 1400p | 2433752 | LOT250 | 1350p | 45150338 | LOT27 | 1450p | 482214010198 | LOT116 | 1600p | 1-439-243-12 | Lot91 | 1600p | 1-439-416-51 | LOT255 | 1600p |
| 06 D-3-088-001 | LOT204 | 1450p 1600p | 2433891 | LOT23 | 1400p | 45150340 | LOT200 | 1400p | 482214010201 | LOT104 | 1500p | 1.439-243-31 | Lor229 | 1700p | 1-439-430-21 | LOT271 | 1550p |
| 06 D-3-095-002 | LOT87 | 1000p | 243 | LOT33 | 14000p | 45150344 | LOT56 | 1650p | 482214010247 | LOT105 | 1500p | 1-439-244-00 | LOT48 | 1600p | SHIBA | LOT131 |  |
| 06 D-333-512-001 | LOT204 | 1600p | 2434002 | LOT200 | 1400p | 45150346 | LOT201 | 1550p | 482214010254 | LOT107 | 1450p | 1-439-244-11 | LOT48 | 1600 p | 37011 | LOT131 | 1450p |
| FETX 10090 DEG | LOTO4 | 1500p | 2434141 | Lотз3 | 1000p | 45150350 | LOT27 | 1450p | 482214010263 | LOT117 | 1550p | 1.439-244-21 | LOT48 | 1600p | 37012 | LOT131 | 1450p |
| FETX 90 WHITE | LOTO6 | 1650p | 243 | Lотз3 | 1000p | 45150351 | LOT27 | 1450p | 482214010269 | LOT210 | 1350p | 1.439-244-31 | LOT48 | 1600p | 37013 | LOT131 | 1450p |
| FETX 100100 DEG | LOT34 | 1500p | 2434274 | LOT44 | 1050p | 45150375 | LOT56 | 1650p | 488214010271 | LOT208 | 1650p | 1.439-256-00 | LOT45 | 1650p | 37014 | LOT131 | 1450p |
| GRUNDIG |  |  | 2434274 | LOT44 | 1050p | 45161601 | LOT22 | 1250p | 482214010274 | LOT123 | 1450p | 1-439-256-11 | LOT45 | 1650p | 5 | LOT131 | 1450p |
| 29201.008 .01 | LOT153 | 1750p | 2434453 | 10786 | 1600p | MITSUBISHI |  |  | 482214010282 | LOT122 | 1300p | 1-439--256-21 | LOT45 |  | 37016 | LOT131 | 1450p |
| 29201.014.01 | LOT140 | 1500p | 2434455 | LOT234 | 1600p | 731003 | LOT51 | 1550p | 482214010283 482214010294 | LOT104 | 1500p | 1-439-256-22 | LOT45 |  | 37017 | LOT131 | 1450p |
| 29201.015.01 | LOT149 LOT60 | 1400p | 2434593 | LOT44 | 1050p | 276-16399 | LOT49 | 1500p | 482214010294 482214010306 | LOT125 | 2150p | $1.439-276-21$ $1-439-280-00$ | LOT230 | 1700p 1600p | 37018 | LOT131 | 1450p |
| 29201.017.01 | LOTG0 LOT163 | 1250p | 2435062 2435121 | LOT296 | 1400p 1000p | 334807803 334 C 078030 | LOT50 | 1450p 1450p | 482214010306 482214010325 | LOT110 | 1200p | $1-439-280-00$ $1-439-280-13$ | Lot92 | 1600p | 37019 | LOT131 | 1450p |
| 29201.018.02 | LOT61 | 1700p | 2435121 | L0T87 | 1450p | 334 B 08104 | LOT74 | 1600p | 482214010326 | LOT122 | 1300p | 1-439-286-00 | LOT46 | 1300p | 1810951 | LOT55 | 1400p |
| 29201.019.01 | LOT62 | 1250p | 2435141 | LOT282 | 1300p | 334808108 | LOT295 | 1600p | 482214010328 | LOT124 | 1450p | 1-439-286-11 | LOT46 | 1300p | 2433751 | Loror | 1300p |
| 29201.019.02 | LOT62 | 1250p | 2435301 | L0T88 | 1450p | 334 P 18506 | LOT51 | 1550p | 482214010349 | LOT106 | 1250p | 1-439-286-12 | LOT46 | 1300p | 2433752 | Lor28 | 1350p |
| 29201.022.01 | LOT63 | 1700p | 2435671 | L0т99 | 1600p | 334 P 18507 | LOT75 | 1500p | 482214010353 | LOT284 | 1450p | 1-439-286-13 | LOT46 | 1300p | ${ }^{23236023}$ | LOT131 | 1300p |
| 29201.022.02 | LOT166 | 1600p | 2436201 | LOT109 | 1200p | 5908-05008A-AA | 10770 | 1500p | 482214010356 | LOT284 | 1400p | 1-439-286-21 | LOT46 | 1300p | 23236052 23236098 | LOT288 |  |
| 29201.022.03 | LOT 165 | 1350p | 2436202 | LOT109 | 1200p | D 108/37 | LOT49 | 1500p | 482214010367 | LOT286 | 1400p | 1-439-288-00 | LOT228 | 1750p | 23236098 23236198 | LOT288 | 1400p |
| 29201.022.04 | LOT165 | 1350p | 2432101-2 | LOT79 | 1600p | DCF 1577 | LOT273 | 1700p | 482214010369 | LOT109 | ${ }^{\text {1300p }}$ | 1-439-288-12 | LOT228 | 17500p | 23236255 | LOT289 | 1400p |
| 29201.022.04A | LOT165 | 1350p | 2433451H | LOT81 | ${ }^{1350 p}$ | DCF2077A | LOT272 | 1300p | 482214010381 | LOT128 LOT127 | 1300p | $1-439-289 \cdot 00$ $1-439-289-21$ | LOT47 | 1400p 1400p | 232368424 | LOT129 | 1400p |
| 29201.024.01 | L0T65 | 1500p | 2433453 H | LOT82 | 1250p | KFS 60226B | LOT279 | 1550p | 482214010384 482214010395 | LOT127 |  | 1-439-289-21 |  |  | 23236425 | LOT288 | 1400 p |
| 29201.024.04 | LOT164 | 1400p | 2433891 H | LOT23 LOT84 | ${ }_{\text {1450p }}$ | MSH-1FBW08 NIKKAI | LOT78 | 1500p | 482214010395 482214010406 | LOT116 | 1600p | 1-439-289-22 | LOT47 | 1400p 1400p | 23236428 | LOT289 | 1500p |
| HINARI |  |  | 2433892G | LOT84 | 1450p | NIKKAI BABY10 |  |  | 482214010406 482214010421 | LOT109 | 1150p 1200p | 1-439-294-00 | LOT93 | 1450p | 3122113837011 | LOT131 | 1450p |
| 154138 K 51139141 | LOT24 | 1500p $1500 p$ | 1.T.T. 45150108 |  | 1400p | BABY10 ORION | LOT67 | 1450p | 482214017078 | LOT103 | 1250p | 1-439-294-11 | LOT93 | 1450p | 150F6D | LOT131 | 1450p |
| 51141841 | Lot24 | 1500p | 45950115 | LOT136 | 1600p | 3714002 | LOT02 | 1500p | SANYO |  |  | 1-439-294-21 | LOT269 | 1550p | TFB 4039 AD | LOT29 | 1550p |
| CF 44 A | LOT24 | 1500p | 45150116 | LOT139 | 1675p | PANASONIC |  |  | 094-00020/0.9 | LOT113 | 1400p | 1.439-303-00 | LOT94 | 1300p | TFB 4048 AD | LOT28 | 1300p |
| HM51-1411834-1 | LOT24 | 1500p | 4515011 | LOT139 | 1675p | TLF 14512 F | LOT39 | 1850p | 094-00035/0.2 | LOT16 | 1350p | 1-439-303-11 | LOT94 | 1300p | TFB 4048 BD | LOT | Op |





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| Sony | RCUNI02 | Samsung | RCUN107 |
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| Hitachi | RCUNI04 | Ferguson | RCUN109 |
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## continued from page 34

## Philips 14GR1227 (GRI-AX Chassis)

The set was dead. Its line output transformer had failed, which is quite common with this chassis. After fitting a replacement transformer there was a normal picture but the sound was severely distorted. A new TDA7052 audio output chip was required to complete the repair.

## Ferguson TX100 Chassis

Gurgling and spluttering noises came from the LOPT area. The tell-tale sign that R143 was charred then indicated that the BC372 Darlington line driver transistor TR8 was in trouble. In fact it was very leaky collector-to-emitter. After replacing TR8 and Rl43 I was surprised to find that the symptom was still present.
When I checked the BU508A line output transistor I found that it had developed base-emitter leakage. But a replacement still didn't get the set going. Instead it produced the familiar "click, click, reach for the transformer" noise. With a new LOPT installed the set at last behaved itself.

## Hitachi VT14

The AC fuse on the small vertically-mounted rectifier board on the right-hand side of this VCR was shattered. This section supplies HT to the large multi-regulation board at the rear of the machine. I measured a direct short-circuit to chassis at its output connector. When the dew sensor plug was disconnected there was no short, and on applying power the machine worked correctly. I managed to scrounge a working sensor from a scrap machine.

## Ferguson 51J8 (TX99 Chassis)

An old boy summoned me to his car and pointed to the set resting on the back seat. "Lift it out for me mate, me back's gone again. Happened when I put it in."
I did as asked, and soon had the set on the bench waiting for its owner to catch us up. When he arrived he took a couple of deep breaths and started to speak.
"Every time I go to switch on the telly the mains under the stairs trips out. So I called out an electrician bloke. Real clever fella he was. Polite too - you don't get a lot of that nowadays. Anyway he says it's the telly that's tripping the mains, only he don't fix tellys. Charged me thirty quid call out, but I suppose you have to pay for expertise."
I thought if that's clever then I'm a genius, and was about to speak when he continued.
"I don't want an expensive repair bill, as I've already forked out thirty quid on it."
I did my best to hide it, but felt irritation and annoyance taking hold of me. So it's all right for someone to point to a TV, say there's something wrong with it then charge $£ 30$ for his "expertise", but I'm supposed to penny-pinch fixing it! I walked him to the door and suggested that he should phone later.
The on/off switch was jammed and was coated with black, burnt carbon. The contacts had shorted every which way. This explained the mains tripping. When I'd fitted a new switch and discarded the old, cracked mains plug, which contained five turns of wire wrapped around the fuseholder pretending to be a fuse, the set came to life. But the picture was awful!
There was no degaussing action and the picture was was all greens and blues. I looked to see if the degaussing plug was disconnected. It wasn't. Then I checked under the PCB for dry-joints at the degaussing posistor, but the connections seemed to be OK. I resoldered all the joints anyway, including the degaussing coil socket pins. Still no difference. Then I found a second-hand

PTH45IC posistor that didn't rattle and soon had it fitted. But the symptom was still there. It wasn't until I cut off the degaussing plug and soldered the two leads directly to the socket pins that a normal picture appeared. Phew!
Later in the day the old boy was on the phone for a progress report.
"It's all done" I said, "forty quid to you."
"What!" he exclaimed, "that means I've spent seventy pounds on the set. Is it worth it?"
"Yes" I replied, "it's definitely worth $£ 40$ to have the set working again, but if you don't want it done pay me $£ 30$ instead. As you said, you have to pay for expertise."

## Sanyo CBP2145 (E2-B21 Chassis)

Intermittent field collapse was the problem with one of these sets. Resoldering obvious dry-joints at the pins of the TDA3651 field output chip IC431 cured the trouble, but on test I noticed that the three primary colours would drop out at random and return. Gently tapping the small, vertically-mounted RGB output subpanel on the tube base PCB made no difference, and the soldering on it appeared to be OK. But resoldering the panel did the trick.

## Sony KVM1620 (BE2A Chassis)

Apart from the familiar Sony switch-on buzz and a slight flicker from the standby indicator this set seemed to be dead. In fact its power supply was producing the correct 120 V HT output, but this didn't reach the line output transformer because the CPN 15 circuit protector PS801 had gone open-circuit.
A replacement protector brought the set back to life, and a long soak test proved that all was well.

## Amstrad CTV250

There was a normal picture but no sound, just a faint buzz at high volume settings. When I removed the back I noticed that the vertically-mounted PCB which contains the sound IF and audio circuitry had become detached from its chassis-mounted guide. As a result it was leaning over to the left, with its track side resting against the body of the tuner unit - exactly where the soldered joints of the TDA3857 sound IF chip are situated. I returned the PCB to its correct position, but there was still no sound.
A check showed that the 5 V supply was present at pin 19 of the chip. So I presumed that it had been damaged, and was about to order a replacement when I spotted a charred stand-off resistor some distance away. It was designated R215, and had 12 V at one side and nothing at the other - in fact it was open-circuit. I didn't have the circuit diagram, but assumed that it provides a supply to maybe the Nicam section. Normal sound returned when a replacement had been fitted. During a long soak test the resistor remained cool, with 12 V at one side and 11.2 V at the other.

## JVC HRD830

In the E-E mode the sound was low and distorted - it could just be heard amongst the white noise - and the picture was blanked out. When testing the machine I found that the sound might improve after a while, to almost normal, but the screen remained blank. The 2SD1863 5V regulator transistor Q02 in the tuner/IF block was very hot to touch and the surrounding area was scorched and damaged. Once the board had been repaired and a new transistor had been fitted everything was OK.

# Digital TV Processing 

## Cedric Applewright provides a brief guide to the processing applied to the digital signals that arrive at your dish, aerial or cable termination



Digital TV has now arrived in the UK: regular Sky Digital broadcasts via Astra at $28.2^{\circ} \mathrm{E}$ started on October 1st. Until about ten years ago the idea of transmitting a TV signal in digital form would have been out of the question, because of the bandwidth that would have been required.
To convert a video signal from analogue (the camera's output) to digital form the signal has to be sampled at a rate of at least twice the highest frequency present. For reasonable definition, equivalent to the analogue original, each sample consists of eight bits (this gives 256 signal levels). With a luminance signal that extends to 5.5 MHz (system I), the sampling rate is set at 13.5 MHz . So the bit rate is $13.5 \times 8=108 \mathrm{Mbits} / \mathrm{sec}$. To this must be added two chroma signals that are sampled at 6.75 MHz . Thus the total becomes $216 \mathrm{Mbits} / \mathrm{sec}$. This implies a bandwidth of some 135 MHz ! And that's before adding extra data for error detection and correction.

## Compression

To make digital TV a feasible proposition, signal compression is required. This is possible because a video signal contains a vast amount of redundant information. If, for example, a picture contains a large area of blue sky, there will be a large number of identical blue pixels. To compress this, we can simply transmit a signal
that tells the receiver how many blue pixels are present and where. This type of redundancy is called spatial redundancy. There is also temporal redundancy, since much of the content of successive TV frames is identical. So we don't need to transmit each complete frame. In practice one in twelve frames is transmitted with just the spatial redundancy removed. These are called Intraframes (I frames). The data for the other eleven frames ( P and B types) tells us about the changes taking place from one frame to the next.
The signal compression standard used is called MPEG-2. Implementation has been made possible by the tremendous advances in digital signal processor chip technology in recent years, and huge reductions in the price of processor and memory chips. The amount of compression possible with MPEG-2, from about $216 \mathrm{Mbits} / \mathrm{sec}$ of video information to $4-16 \mathrm{Mbits} / \mathrm{sec}$ depending on the amount of action in the scene, means that several digital TV programmes can be transmitted simultaneously within the bandwidth of a single conventional analogue signal channel.

## Block Diagram

Fig. 1 shows in simplified block diagram form what digital TV involves at the transmission end. The analogue signal is first converted to digital form, by sampling then quantisation, i.e. conversion to 8 -bit bytes.


Fig. 1: Block diagram showing the basic processing carried out at the transmission end of the signal path.


Fig. 2: Much simplified block diagram to illustrate the action of an MPEG-2 video encoder.

The next step is MPEG encoding, where the compression takes place: we will return to this. The output from the encoder is next chopped into 187-byte packets. A one-byte sync signal and an identification signal are added to each packet.
These packets are fed to a multiplexer, which produces an output stream of packets for transmission. The audio and any data packets (e.g. teletext) are added at the multiplexing stage and, as several different programmes can be transmitted in a single channel, other signals can be added here. The audio signal has also undergone AD conversion and MPEG coding of course - the latter is quite different from video MPEG coding. Scrambling for conditional access (pay TV or pay-perview) is also undertaken at this point.
From the multiplexer we get what's known as the transport data stream. It consists of video/audio/data packets for one or several programmes interspersed in a single data stream. Forward error correction (FEC) is then applied. This means the addition to each packet of extra data that can be used by the receiver to check for errors introduced by the transmission path and, if the errors are not excessive, to carry out correction - packets with too many errors are simply rejected. In practice there's more to the FEC process than this, as we shall see later. Once FEC has been applied the signal is fed to a DAC for conversion to I and Q form. It then goes to the modulator, after which it's applied to the transmitter - or sent down the cable.

## MPEG Video Encoding

We have referred to spatial and temporal redundancy in the video signal. This is a handy way of appreciating how redundancy arises. Removal of spatial and temporal redundancy is not undertaken separately however. It's all part of one highly complex process. Fig. 2 gives an impression of what's involved.
The initial step is to divide the picture into blocks of $8 \times 8$ pixels - actually $8 \times 8$ luminance pixels plus $2 \times$ 4 each red and blue chroma pixels. These are passed to a movement estimator, which checks for changes between successive frames. Each twelfth frame is passed straight through to the DCT section. These are the I frames: the term intraframe indicates that it's coded without reference to any other frames, i.e. the frame is subjected to spatial redundancy compression only.
DCT stands for discrete cosine transform. This means that the amplitude differences between the discrete
pixel sample bytes in the block are converted to cosine equivalents which are then represented by their coefficients (multiplication factors). The signal is thus converted from one that represents amplitudes to one that represents frequencies. In itself this doesn't contribute to compression: it enables the compression techniques that follow to be applied.
Once the DCT has been carried out, quantisation can be undertaken as part of the compression. Coefficients below a certain level are reduced to zero (this is known as thresholding), and the coefficients are rounded up and down. These steps take into account the inability of the human eye to detect very small changes in a picture.
We now have $8 \times 8$ blocks of quantised coefficients. These have to be scanned to convert them to serial data form. A zigzag scan is carried out, starting at the top left coefficient, which represents the DC signal level. As the zigzag scan proceeds, higher and higher frequencies are scanned. The advantage of this form of scan is that the resultant serial data stream is optimised for the next compression applied, run-length and vari-able-length coding.
Run-length coding converts long series of zeros to a code that indicates the number of zeros in each series. Variable-length coding uses the same principle as the Morse code: short code lengths are used to encode the values that occur most often.
The result of all this is a data stream whose rate varies continuously. The following packetisation and multiplexer require a fixed data rate input. This problem is solved by feeding the variable-rate data into a FIFO (first in, first out) buffer memory then reading it out at a constant rate. If the buffer should overload, feedback is used to block the input temporarily (data rate control).
So much for an intraframe, which is subjected to a relatively low level of compression. The other eleven frames in each group of twelve are of the $P$ (predicted) and B (bidirectional) type. A P frame occurs every third frame after an I or P frame, from which it is predicted using motion-compensated prediction. This is why the movement estimator is required. Its action is based on the comparison of macroblocks ( $16 \times 16$ pixels) in successive frames. This is a highly complex procedure that has a significant effect on the performance of an MPEG encoder. B frames are coded by bidirectional interpolation between the nearest I and P frames. All this is referred to as interframe coding.
This interframe coding makes use of the lower section


Fig. 3: Block diagram to show the basic signal processing carried out in a digital TV set-top box/receiver.
of the block diagram shown in Fig. 2. What the MPEG encoder is doing here is to remove temporal redundancy by means of a movement-compensated feedback system. The output from the zigzag scanner is taken to an inverse DCT and is then fed back to the subtract box. This P and B frame coding is a complex procedure that greatly increases the signal compression.
The above is only a very approximate account of MPEG-2 video encoding. It mentions the main processes and their role in the overall system. The highly complex processing is hidden away in silicon chips. It's possible that different chip set designers employ different arrangements. We don't need to know the finer detail.

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## Packetisation, Multiplexing and FEC

Packetisation and multiplexing are self-explanatory and have been referred to already in connection with Fig. 1. The multiplexer's output, the transport stream, consists of a series of data packets, all with identification so that they can be found and extracted at the receiver. Audio, video and data packets for one or maybe several programmes are interspersed.
FEC adds codes to enable errors generated in the transmission path to be detected and corrected - provided the data corruption is not excessive. Standard techniques such as Reed-Solomon coding are employed. The Reed-Solomon coding adds 16 parity bytes to each packet, which thus becomes 204 bytes long. But there is rather more to this part of the signal processing.
Signal randomising is carried out to provide energy dispersal; interleaving to spread errors; and convolutional coding to aid correction of random errors caused by noise. Convolutional coding complements the ReedSolomon coding and interleaving: it is not used with cable distribution, which is a relatively benign environment for the signals.
The convolutional coding provides powerful protection but reduces the channel's information bit rate by a factor that's specified, for example, as $1 / 2,2 / 3,3 / 4$. These code-rate figures represent the ratio between the information and the total transmitted bit rate.

## Transmission

Different modulation techniques are used for satellite, terrestrial and cable transmission - QPSK, COFDM and 64-QAM respectively. Each offers advantages for the particular transmission medium. QPSK is less sensitive to the effects of phase shifts, CODFM is less sensitive to fading and multi-path effects, while 64-QAM provides very efficient spectrum use.
Because of these different modulation techniques, receivers for satellite, terrestrial and cable use need different digital demodulators. FEC differences (see above) also affect receiver front-end design.

## Receivers

An article elsewhere in this issue describes the basic sections of a digital TV receiver, with specific reference to servicing. Fig. 3 provides an overall outline. The channel tuned in is demodulated and, after error correction, is applied to the transport demultiplexer which sorts out the packets required for the selected programme. The video MPEG decoder carries out the reverse processing to the encoder described earlier, but is considerably simplified since movement estimation is not required.


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## Reports from

Philip Blundell, AMIIEelec
Eugene Trundle
Michael Dranfield
Michael Maurice
Richard Flowerday
Gerald Smith and
Pete Gurney, LCGI

## Samsung V1375

The power supply had previously failed, no doubt after its outputs had risen, and a new one had been bought and fitted. Now the machine was dead again. When the main PCB was removed R638 and R664, both $100 \Omega$ surface-mounted resistors, were found to be open-circuit while the case of the KA8301 loading motor drive chip had split.

Once these three items had been replaced the machine was found to be none the worse for its ordeal.
Note that in later production a 27 V , IW zener diode is connected across R116 in the power supply to provide improved overvoltage protection. P.B.

## Philips VR522

If the power supply is 'chirping' and its output voltages are low and pulsing, suspect that C2112 ( $100 \mu \mathrm{~F}$, 385 V ) has lost capacitance. The voltage across C2112 may still be correct even though the capacitor is faulty. Its part no. is 4822124 41556. P.B.

## Samsung SI3240 Series

The cassette lift drive gears sometimes go out of alignment. A modified cassette lift right-hand side is now supplied. The part no. is 62203-0025-01 (Willow Vale code 79030 CR ). Also check the gear eject drive for wear - part no. 61473-0051-01 (Willow Vale code 79326J).

## VCR Clinic

The above applies to Models SI3240, SI3260, SI3560, PI30R and VI30R. P.B.

Daewoo 5172 and 7372
These machines are now about five years old and the F mechanism they use is beginning to wear. One effect of this is bad sound wow and/or flutter because of a problem in the reel-drive clutch that's incorporated in the reel-drive gear assembly (part no. 97SA46900). It is possible to dismantle the assembly and doctor the clutch, but it's better to replace the whole thing. E.T.

## Panasonic NVHD610

This newish machine had a fullylaced tape in it. When it was switched on the drum ran at a million miles an hour and the front display showed the error code F09. This means that there's no serial clock signal transmission between IC6001 and IC7501. In fact the cause of the problem turned out to be IC6001's 6 MHz crystal X6001. If you touched it with a finger, the machine came to life and continued to work all day. But next day, when the machine had been standing overnight, the fault would be back. A new 6 MHz crystal put an end to the trouble. M.Dr.

## Aiwa HVGX750

This new machine wouldn't come out of standby. Checks around the main microcontroller chip showed that the power-on line (pin 60) remained low. There was a 10 MHz clock signal at pins $72 / 73$, and the real-time clock crystal at pins 69/70 was also active. But the serial clock/data lines, at pins 90-91, remained inactive. The reset pin 16 was low at 2 V : to reset the microcontroller chip correctly, this pin must be above 3.3 V .

Multimeter checks failed to reveal the cause of the problem, but when we disconnected all the com-
ponents connected to pin 16 we came to a small decoupling capacitor, C565 ( $0.1 \mu \mathrm{~F}$ ), which was holding the reset pin low. A check on C565 produced a reading of $200 \mathrm{k} \Omega$. Replacing it cured the fault. M.Dr.

## JVC HRJ425

Failure to eject was the complaint with this machine. The carriage is driven by the capstan motor in this deck. In the eject and tape loading mode, the 'gear-change' drives the carriage via the 'belt-change'. The gear-change is engaged/disengaged by the arm-change assembly, item 74 in the diagram in the manual. A spring, item 76, holds the arm in position in this mode.

The plastic lug on the armchange assembly had broken, the result being that the gear-change didn't engage with the pulley. A new arm-change assembly cured the fault. Its replacement required a fair amount of dismantling. M.M.

## Aiwa VXT1410

This TV/VCR combination's fault was in the video section. When the unit was cold, the servos would hunt and there were gross tracking errors. After a while the servos would stabilise and a picture would appear - with severe patterning. The cause of the trouble was C523 $(100 \mu \mathrm{~F}, 16 \mathrm{~V})$. Although my tester produced a reading of $88 \mu \mathrm{~F}$, the capacitor responded to heating and freezing when in circuit. A new capacitor cured the fault. M.M.

## Toshiba V204

There was a tape stuck in this machine. The customer said that cassette insertion had been difficult before. It was easy to remove the tape: the cause of the problem was simply that the cassette-flap opener on the right-hand side of the carriage had become unclipped.
Refitting it and reassembly should have been the end of the matter, but
the customer had been of the opinion that a liberal spraying of WD40 through the cassette flap would cure the problem. So a further half hour had to be spent cleaning it up. Fortunately it hadn't ruined the heads. M.M.

## Ferguson FV7ILV

This machine was dead apart from the power supply which was ticking. The cause of the problem was eventually traced to a $10 \mu \mathrm{~F}, 63 \mathrm{~V}$ capacitor that's mounted on the print side of the power supply PCB. Note that the power supply ticks when unloaded, i.e. not connected to the main PCB. M.M.

## Matsui VP9501

This machine failed to wind the tape into the cassette on eject. The capstan motor didn't even turn. There were no problems once the mode switch had been replaced. M.M.

## Sharp VCA49

This machine had been brought in about six months previously because the upper drum had failed. It was now back, the complaints this time being low sound and noise bars through the picture. When I tested the machine I found that there was also poor rewind.

The cause of the trouble was excessive friction between the tape and the AC head, because of excessive wear. Once a new AC head had been fitted and aligned the symptoms had cleared. M.M.

## Toshiba V226B

No playback or E-E sound was the customer's complaint with this almost new machine, which was still under warranty. It recorded sound however, proved by playing a test recording on another machine. The cause of the fault was easily traced to the BA7795LS audio record/playback chip IS001, from which there was no audio output. It's not the first time we've had this problem with these
Toshiba machines and their
Ferguson-badged equivalents. R.F.

## Akai VSG855

When a tape was inserted the clock display went out and the machine 'died'. Some checks in the power supply revealed that the 14 V output wasn't smoothed. Replacing C222 cured the fault. G.S.

## Toshiba V726

When this machine was switched on there were no functions and auto
tune showed in the display. After many fruitless checks I found that a replacement tuner unit cured the fault. G.S.

## Daewoo V215

There were intermittent symptoms with this machine: no mode functions and the clock becoming blank. I had to wait patiently for the fault to appear, then found that crystal X70l wasn't running. A new crystal cured the fault. G.S.

## Tatung TVR933

This machine produced very snowy E-E pictures with low luminance. Checks revealed that the AGC output at pin 2 of IC4001 was low and cramped. A replacement chip restored good E-E pictures. G.S.

## Aiwa HVFX2500

This machine had a picture fault in both the E-E and playback modes. In the E-E mode the left-hand side of the picture was too dark while the rest of the picture was too bright. In the playback mode the picture had dark streaks. The problem was cured by resoldering the pins of the Y/C processor chip IC301. G.S.

## Philips VR6490

This machine had failed when it was unplugged: when the mains supply was restored it remained dead. The power supply is not the easiest section of the machine to reach, being burried under the main PCB. But you can remove it then reconnect it outside the machine, the harness being just long enough to permit this.

I found that the power supply worked and that its outputs were correct, except for the 5 V line which was low at 3 V . Quick scope checks at the relevant reservoir and smoothing capacitors C119 and C120 (both $1,000 \mu \mathrm{~F}, 16 \mathrm{~V}, 105^{\circ}$ types) revealed that they were virtually open-circuit. As the ventilation in these machines is poor, I decided to replace all the electrolytic capacitors on the secondary side of the power supply, using the correct low-ESR types. P.G.

## Mitsubishi HSB82

This S-VHS machine's video output was very poor: there was rolling, and the video was extremely crushed. In fact the output was poor from the scart and phono sockets and the RF modulator, which helped to narrow the field of search a bit.

A look at the myriad signal
paths and switching ICs showed that the common source of the video signal is at the buffer transistors Q208/7/6. Q208 feeds the scart connector and the RF modulator. The Y output from the YC S-VHS socket J204 was similarly crushed and distorted. Its source is prior to Q208, at the emitter of Q206. The cause of the problem was C 232 , a $10 \mu \mathrm{~F}, 16 \mathrm{~V}$ surface-mounted capacitor that couples the video signal to the base of Q206. On closer inspection, visible leakage could be seen on the PCB. A clean-up and new capacitor cured the fault. P.G.

## Goodmans TX 1200

There was severe patterning in the E-E mode, but the severity of the symptom decreased the longer the VCR was left on. A check on the tuning revealed that the channels didn't correspond with the selected channel numbers. This suggested that there was a tuning voltage fault.

The 30 V supply was found to be low, and a scope check showed that a large AC component was present. The cause of the trouble was traced to $\mathrm{C} 803(100 \mu \mathrm{~F}, 50 \mathrm{~V})$ which was open-circuit. When a replacement had been fitted the channels had to be retuned back to their correct channel numbers - the customer had altered them over a period of several months to compensate as the capacitor dried up. P.G.

## Samsung SII260

Tape chewing was the complaint with this machine. Everything seemed to be OK when a dummy tape was loaded, but after a few minutes the capstan motor refused to work in the play mode and wouldn't spool the tape back when unthreading. Fast forward and rewind were not affected initially, but eventually failed.

A quick check at the supply plug ( CN 201 ) to the motor on the main PCB showed that the voltages were mostly correct. The exception was the permanent 15 V motor feed voltage, which varied erratically depending on which function was selected. The feed comes from the always 15 V rail via two series-connected 1N4001 diodes, D212/3. What was happening was that D213 went open-circuit under load. A replacement diode cured the problem.

In the past I've had D212 cause similar problems, but in addition intermittent/poor loading - the junction of D212/3 feeds the loading motor drive chip IC206. P.G.

# Portable Appliance Testing 

# Regular testing of portable electrically-powered appliances is a requirement under the Electricity at Work Regulations 1989. It can form a useful source of additional income for the service department. Russ Phillips describes what PAT testing involves 

The Seaward PAC500 portable appliance tester. This simple unit provides insulation and earth-bond tests with separate pass/fail indication for each. Available from CPC under order code
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af $\mathbf{x 1 7 5 . 1 6 .}$ The price includes a carrying case and operating instructions.

Anyone who reads this magazine should be aware of the Electricity at Work Regulations 1989. The Health and Safety Executive (HSE) periodically visits companies to ensure that these regulations, and any other relevant safety requirements, are being observed. Many people however are probably not aware of what portable appliance testing (commonly known as PAT testing) involves - or that offering the service to local businesses can provide a useful source of extra income.
Unfortunately the law is unclear about PAT testing requirements and how often it should be carried out. In my area the HSE maintains that all appliances connected to the mains supply via a flexible lead and plug should be tested at least once a year by a competent person. What is meant by a "competent person" is not clear either, but it seems reasonable to assume that anyone qualified to repair TV sets has the required competence. Appliances that have been tested should be identifiable, often by some sort of serial number or bar code, and the results of a test should be kept for future reference.

## PAT Testers

A PAT tester is required to carry out this work. It's used to check the resistance of the earth cable while this is passing a high current (up to 25 A ), and to test the appli-

ance's insulation when a high voltage (normally 500 V DC) is applied.

Cheaper units often have a fixed earth test current and use LEDs to indicate whether or not the appliance being tested has passed. More expensive units supply selectable earth test currents. They provide an analogue or LCD indication of the earth cable's resistance and the appliance's insulation.
There are also units that can store all the test results for subsequent transfer to a PC, and can recognise bar codes used to identify appliances. Many of these more expensive units can also carry out load tests, leakage current tests and 'flash tests' (where the insulation resistance is measured at around $1-1.5 \mathrm{kV}$ ). Such tests are not really necessary however. So I wouldn't recommend buying a tester of this type unless you have a real need for these extra facilities.
The problem with cheaper units is that they are less flexible. My recommendation therefore is to select a mid-price unit that has a selectable earth-test current and an analogue or LCD display to show the result of the tests.

## Visual Inspection

The first and arguably most important thing in a portable appliance test is the visual inspection. Most faults will be discovered during this part of the test.
Check the mains plug first. It should be intact, with no cracks or other damage, be of a BS-approved type, and should have shrouded live and neutral pins. If the plug is not moulded on to the cable, open it up and check that it's correctly wired. Also that the correct value fuse is fitted. The cable should have the modern colour coding - brown for live, blue for neutral and green/yellow for earth.
There should be two layers of insulation throughout the length of the cable, which should be free from damage and be securely gripped where it enters the appliance - so that it can't be pulled out, pushed in or twisted. If the cable is damaged it should, ideally, be replaced rather then repaired.
If a connector is used it should grip the cable's outer sheath securely at both points of entry. With connection via a plug and socket, the plug should be connected to the appliance and the socket to the mains supply. It should not be possible to touch the socket's live or neu-
tral connectors when the plug is disconnected. Note that connectors of either type can increase the earth connection resistance.
The appliance itself should be undamaged, with the outer casing securely connected.
Where an extension lead is in use, open the socket to make sure that it is correctly wired and that the cable grip holds the cable securely by its outer sheath. If the socket has a fuse, make sure that its value is correct.
If the appliance has a detachable lead, make sure that the connector on the appliance is male, of a BSapproved type, and that there are no obvious signs of damage. The connector should be secured in such a way that it cannot be opened or removed without the use of tools. The cable should be secured to the female connector tightly, so that it cannot be pulled away.
If there are accessible fuse holders, they should be undamaged and should not permit the user to touch a part live at more than 50 V when the carrier is removed.
Any output connectors should be undamaged. If an output voltage is greater than 50 V , the short-circuit current should be less than 5 mA .
Finally the mains on/off switch should work correctly, with no visible signs of damage.

## Earth-bond Test

An earth-bond test is the next step with an earthed appliance. If the appliance is not earthed, it should be marked as double-insulated - the symbol for this is two squares, one inside the other.
The earth-bond test is carried out by plugging the appliance into the tester and connecting the test lead to the appliance's conductive case. A high current, at least twice the appliance's fuse rating (up to a maximum of 25 A ), is then fed via the earth lead for five seconds while the resistance is measured. The reading obtained should normally be no greater than $0.1 \Omega$, or $0.5 \Omega$ if the fuse rating is 3A or less. This figure does not include the resistance of the mains cable. The two resistances should be added. As a general rule, a combined resistance of $0.5 \Omega$ or less ( $0.75 \Omega$ where the fuse rating is 3 A or less) is usually OK.

## Insulation Test

The final step is the insulation test, which is carried out at a voltage of at least 500 V DC. With an earthed appliance, the live and neutral pins are shorted together and the resistance between them and the earth pin is measured - no other connection to the appliance is necessary. When a double-insulated appliance is being tested, connect the test lead to any exposed metalwork. A voltage of at least 500 V DC is applied for five seconds while the insulation resistance is measured. To pass the test, the reading should be at least $2 \mathrm{M} \Omega$ with an earthed appliance and at least $7 \mathrm{M} \Omega$ with a double-insulated appliance.

## Keeping Records

It is a good idea to mark each appliance with a serial number and the dates when it was last tested and when the next test is due. It's probably easiest to use a selfadhesive sticker. Suitable stickers can be bought from component supppliers or they can be specially printed for the job. If you have a tester that can read bar codes (some of the more expensive ones can), a bar-code system could be used.
As a practical point, note that appliances which get hot, kettles for example, tend to melt the adhesive on a sticker. With such appliances it is often a good idea to use a fine-point permanent marker to write the serial

number on the appliance directly.
The record of a test visit normally shows each appliance number, the appliance's make and model designation, the manufacturer's serial number where appropriate, and the results of the earth-bond and insulation tests. It might also be worthwhile making a note of any work that had to be carried out on each appliance for it to pass the test, for example plug or fuse replacement.

## In Conclusion

Finally, I hope that this article will help some of you to earn extra income. It probably wouldn't be possible to run a business that relied on PAT testing alone, but it can provide additional work that generates useful income.
The testers illustrated are available from CPC Plc., Component House, Faraday Drive, Fulwood, Preston, Lancs PR2 9PP. Phone 01772654 455, fax 01772654 466. Other PAT testers are available from CPC.


The Seaward PAT10005 portable appliance tester. This model will test in a manual or automatic sequence a series of eight conditions and stores up to 1,000 test results in a battery-backed memory. Use is simple via menu and screen prompts on the high-contrast LCD screen. Available from CPC under order code INPAT1000s-240 at 8619.65 . The price includes an aftached accessory pouch that contains the earth test lead, flash test probe, mains lead with plug and a comprehensive instruction manual. A printer lead is available as an optional extra at $£ 25.75$.



#### Abstract

Terrestrial DX and satellite TV reception reports and news. A new satellite band for uplinking. The proposed digital LAN system, a potential source of interference. Roger Bunney reports


Test paftern received via Telecom 2A and 28 af 8 and $5^{\circ} \mathrm{W}$ respectively.

There was, as usual, reduced terrestrial DX-TV signal propagation during August. Fortunately Sporadic E signals arrived on a few days. The settled hot weather from August 8-11th produced a slight tropospheric enhancement, with Band III and UHF signals from the Benelux countries, France,
Denmark and the closer German stations received across the South Eastern and Eastern coastal areas of the UK. You couldn't call it a "wide-open" period, but at least it gave a lift to an otherwise quiet time. It's some years since we had a really widespread tropospheric opening - put it down to global warming!

The $\mathrm{SpE} \log$ for the period is as follows:

5/8/98
6/8/98

RAI (Italy) ch. IA.
YT (Ukraine) ch. R2;

10/8/98

12/8/98
13/8/98
14/8/98
15/8/98

16/8/98

18/8/98

23/8/98
29/8/98 30/8/98

## 31/8/98 <br> 1/9/98 <br> 2/9/98

RTS (Serbia) ch. E3. Several unidentified signals on chs. E3, E4 and R2.
RAI IA, B; Video (Italy) E2.
RTP (Portugal) E2, 3; TVE (Spain) E4. SR (Sweden) E2; YLE (Finland) E3.
RTP E2, 3;TVE E2, 3, 4; RAI IA; RTL+ (Hungary) R2.
TDF (France Canal + F2, 4; LTV (Lithuania) R2; TVE E3, 4; NRK (Norway) E2, 3; Video E2.

checking with 3C51 for confirmation of frequency and programme content. If the reception is confirmed as being from Equatorial Guinea this is good news and an exciting end to the ' 98 season. Our thanks to Skywaves bulletin for some of this information.

Typical of the use of Band I these days is the report that RSL FM station Wings FM ( 87.7 MHz ) used a 52.875 MHz studio-transmitter link (STL) during the Royal International Air Tattoo at RAF Fairford.

Congratulations to Alan Smith (Chonburi, Thailand) who married recently and has moved "down the road". His dish is to follow shortly The local UBC DTH digital TV service to which he subscribes offers 28 channels, five film, at $£ 15$ a month: the receiver and 60 cm dish come at $£ 150$. BBC World has problems there with "freezing pictures". This could possibly be because of a low data rate from the BBC on the several hops to the regional satellite downlink to Thailand. Alan welcomes the return of BBC World, which was dropped by Star TV two years ago for political reasons. In mid-June Star TV advertised that it would go digital on July 1st. The analogue TV plugs were all pulled on July 7th, leaving most of Star's SE Asian viewers without pictures and with no IRDs available!

## Satellite Sightings

I've been exceptionally busy during the past few weeks, with varying degrees of success. After a lot of
thought I eventually bought an RSD ODM300 digital receiver. The results have been frustrating. Several evenings were spent setting frequencies, symbol rates etc., but only frozen pictures have been seen. When I checked the news feeds via Intelsat K ( 11.566 GHz ) I found that the system was partially working. Reuters' Moscow and Washington identifications appeared, but when actual news material came along all I got were freeze frames with occasional jumps - and no audio. More recently the unit has refused to lock even with previously receivable services. I'm awaiting advice from the manufacturer.

More luck with band C however. Lots of signals have been resolved using my trusty Echosphere SR1000 and a Manhattan LT6300 Plus Mk 2 receiver. The latter is a basic IR-controlled model, i.e. it's cheap. But it has full potential for DXing - fast tuning, no OSDs, full frequency readout, ease of use and threshold extension down to 3 dB . It operates in both the C and Ku bands. I hope to review it shortly in these pages - basically it provides, with modern technology, the service you get from a manual, rotarytuned receiver.

For C-band work I'm using my old 1.5 m dish. The results, from many satellites, have been encouraging. Even weak news feeds via Arabsat 2 B at $30 \cdot 5^{\circ} \mathrm{E}$ can be seen easily with threshold extension. It proves that you don't need a 3 m or larger dish for effective C-band work.

One recent problem was picture degradation, noise etc. with $\mathrm{Ku}-$ band reception whenever the C band system was connected with its power supply on. The manual A/B switch I had been using to connect either the Ku -band ( A ) or C -band (B) LNB to the receiver was the cause - there was poor isolation between the inputs. I solved the problem by using a high-isolation, F-socket A/B switch from Maplins (order ref. number MY30, price about $£ 7$ ). The defective and more expensive switch had been obtained from a London satellite firm.

There have been lots of reports of sports feeds. The European Athletics Championships at the Nep Stadium, Budapest were given wide coverage by the BBC, with feeds via the French Telecom 2B and 2C satellites at $5^{\circ} \mathrm{W}$ and $3^{\circ} \mathrm{E}$ respectively. The transponder mostly used was the 12.645 GHz vertical one aboard 2C. Good to find that SIS
(sound in syncs) plus audio was used rather than digital!

The month saw a mega corporate event in the merger between oil companies Amoco and BP. On the evening of August 11 th a London facility house was seen preparing for a two-way staff conference the following morning. The up tests, via Intelsat K , were in analogue form at 11.682 GHz vertical. They continued to well past 2300 hours.

The Omagh bomb blast received extensive coverage, with the BBC using Telecom 2C for contributions to local TV programming as well as interviews and reports to London for network news. Telecom 2B was used at 1830 for a report to London on the Mo Mowlem visit.

During the same period the transatlantic satellite circuits were busy with coverage of the President Clinton/Monica Lewinsky affair. Intelsat K and PAS-3 ( $43^{\circ} \mathrm{W}$ ) carried most of the analogue material fed to London for Sky and other broadcasters.

There was a live report on Hurricane Bonnie on the 27th at 1800BST, with a reporter at a US east coast beach attempting to stand and shout his piece to the camera despite the high wind, driving rain and mega waves behind. Having completed the shot, the cameraman called over "the studio wants a take 2 ". This elicited a profound comment from the reporter! All via our favourite, Intelsat K - at

### 11.498 GHz horizontal.

While exploring the esoteric world of $C$ band on the 26 th I came across weak colour bars, with the identification "Kourou CTS", via Telecom 2 A at $8^{\circ} \mathrm{W}$. The signal was at 3.772 GHz with RHC polarisation and I suspect was related to the launch of Astra 2A, though nothing else was seen while I was monitoring the signal.

Arabsat 2B at $30 \cdot 5^{\circ} \mathrm{E}$ is a good source of news from the Middle East and SE Asia. During a morning Reuters news package (at 3.967 GHz RHC) 1 noticed an odd form of scrambling: the central three-quarters of each frame was upside down and reversed, the top and bottom eighths being normal. Subsequent monitoring indicates that this is a common practice simple but effective.

In all a busy and varied month.

## Terrestrial News

Sweden: As only eight channels are available in the first DTT multiplex, the following allocations have been agreed. TV3 and Kanal 5 will

share one channel, TV8 and Cell Internet another. National Broadcaster SVT will transmit SVT-1 and a planned sports/news service SVT-24, shelving plans to include the SVT-2 network. TV4 has a nationwide single channel, allowing for regional opt-outs.
Canal + has a channel to itself.

Iraqi TV via Nilesat at $7^{\circ} \mathbf{W}$. There's a familiar face in the shield at the centre of the logo!

## Aerial Techniques



M bit memory, two sets of S-VHS inputs \& outputs, NTSC to PAL and PAL to NTSC, 500 lines dynamic \& static resolution, full line \& frame conversion time base correction.................. $\mathbf{£ 6 4 9 . 0 0}$


4 M bit memory, two inputs \& outputs, NTSC to PAL and PAL to NTSC also SECAM, 500 lines static resolution, dynamic 300 lines, full line \& frame conversion, time base correction, AC operation............................. $£ 449.00$

CDM 600
2 M bit memory, single input \& output, NTSC to PAL and PAL to NTSC also SECAM, 420 lines static resolution, dynamic 250 lines, full line \& frame conversion, time base correction, AC operation.


## THOMSON MULTI-SYSTEM NICAM VCR



Test for a two-way staff conference on the BP/Amoco merger. Via Intelsat K.

Below left: Roger Bunney's C-band LNB with Chaparral feedhorn mounted on his 1.5 m dish.

Below right: A hitech C-band LNB cover-the bottom of a twolitre white spirit polythene container, sprayed green. Plenty of ventilation, but keeps the system dry.

SVT will regionalise services in five areas and share with Kunskaps TV.
The Netherlands: A number of new Dutch regional/local stations are due on-air by the end of 1998, using existing transmitter sites. They offer considerable DX potential. For details see Table 1. Belgium: The PM5544 test pattern used by RTBF-2 now has "La Deux" in the bottom square and the transmitter identification at the top, e.g. "Tournai Canal 63", Philippines: The world's highestpower, solid-state VHF transmitter has just been installed for GMATV at Tandang Sora, Manila. Details will be included in the 1999 Guiness Book of Records. The transmitter has "nearly 1,200 paralleled transistors, 96 fully redundant amplifier modules, 40 cooling units and a dual 50 kW switchless combiner system with a circularly polarised antenna". The 750ft high mast also carries the aerials for a 40kW UHF transmitter.

Some 48 VHF/UHF transmitters are being installed for the GMA network to provide optimum

Table 1: New Dutch regional/local stations.

| Station | Channel | Power | Site |
| :--- | :--- | :--- | :--- |
| TV Noord | E36 | 100 kW | Hoogezand |
| Omrop Fryslan | E28 | 150 kW | Irnsum |
| TV Drenthe | E25 | 250 kW | Smilde |
| TV Oost | E22 | 200 kW | Zwollerkerspel |
| TV Oost | E36 | 50 kW | Hengelo |
| TV Oost | E36 | 200 kW | Markelo |
| TV Gelderland | E32 | 100 kW | Apeldoorn |
| TV Gelderland | E58 | 32 kW | Arnhem |
| TV Gelderland | E40 | 50 kW | Ruurlo |
| TV Gelderland | E24 | 50 kW | Tiel |
| Omroep Flevoland | E26 | 50 kW | Lelystad |
| Omroep Zeeland | E54 | 50 kW | Goes |
|  |  |  |  |

nationwide coverage.
50MHz Amateur band: The following beacons are now active: Czech Republic OKOEY
50.011 MHz ; Croatia 9A1CAL. The RSGB's 50.050 MHz beacon GB3NHQ has closed permanently after a serious PA fault. A replacement using the same call sign may be established elsewhere. The
RSGB has applied to the RA for a 1 kW experimental permit to operate at 50 MHz .
RSL-TV: Still no date for the start of transmissions from TV-12 on the Isle of Wight. The French have now agreed to a channel allocation and equipment problems are being blamed for the delay.

## K band

Programme uplinking for Ku band satellites is usually at around 1314 GHz . But conditions in the Clarke belt are becoming tight, with vast quantities of transmissions from satellites only $3^{\circ}$ apart. Agreement has therefore been reached to use band K (17.318.4 GHz ) for uplinking. It offers better transmission protection with
increased bandwidths. So it will be K up and Ku down.

The Andrews Corporation, which is well-known for high-quality communications dishes, is well into K -band aerial design. With a 60 per cent efficiency dish the corporation is achieving typical beamwidths of $0.1^{\circ}$ at the -3 dB points. That's really sharp. Isolation between feeds has improved to 35 dB . This avoids interference between adjacent and opposedpolarity uplink signals.

## Interference Sources

Each month seems to bring more radio/TV interference problems. For example a neighbour's computer now produces a mass of white dots on any ch. E4 pictures received here. It hit the air waves about six weeks ago!

Dave Lauder, in his EMC column in the August issue of the RSGB's journal Radcom, mentions a potentially alarming threat to radio/TV reception. It's called DPL (digital power line) and is being tested by NOR.WEB. We've already had local communications,

e.g. baby alarms, via house mains wiring. The DPL technique uses the mains distribution cables as a LAN (local area network) system. The digital LAN system currently being tested is reckoned to be able to provide over $1 \mathrm{Mbits} / \mathrm{sec}$ downloading between the source and a subscriber. But it means that RF is being sent along the mains supply lines.

Worries have arisen in amateur radio circles because the tests used a carrier at close to 4 MHz , with sidebands/harmonics extending into the $3 \cdot 5-3 \cdot 8 \mathrm{MHz}$ amateur band. What if higher frequencies are used as mains carriers? Would HF interference be radiated from the mains distribution system to houses etc.? With mains power distribution often via poles, widespread interference could occur.

Filtering might be included at domestic users' inputs to prevent interference to equipment - and perhaps to prevent hacking - but the costs would be high. It's possible that the system will simply be brought into use with any subsequent interference complaints dealt
with on a one-off basis.
The immunity levels quoted by Dave in his column are such that amateurs, medium-/short-wave DXers, other weak-signal operators and even MW cordless phones could be adversely affected

NOR.WEB DPL has been formed as a company to market the system, so we can expect it to be developed commercially. It's unlikely that the company will be concerned about the interests of minority hobbyists. Fortunately the RSGB is taking up the issue of DPL with the DTI, RA, OFTEL and OFFER. We'll have to keep an eye on the outcome.

## Satellite News

The long-awaited Canal+ news channel is expected to open in the autumn of 1999. A new partner is being sought as the newspaper Le Parisien has decided to leave the project. A 24-hour Spanish-language news service called CNN Plus is expected to start this December via Canal Satellite Digital, run by Canal Digital, Canal+ Espana and CNN.

NRK (Norway) has signed with Canal Digital to provide a joint satellite TV service with both analogue and digital channels. Canal Digital is already transmitting the NRK-1 and -2 channels - the new smart card includes NRK, TV2 and TV Norge. The latter is to change from clear analogue at $1^{\circ} \mathrm{W}$ to D2MAC. There will eventually be a common Scandinavian conditionalaccess standard.

The Arianspace launch base at Kourou, French Guyana has had a quiet time recently because of a shortage of satellites. The PAS-7 satellite is receiving further checkouts, and ST-1 is being factory modified. Eutelsat's new W1 satellite suffered fire damage at the Aerospatiale factory. Arianspace still hopes to achieve its annual quota of twelve launches this year, including a firing of the new Ariane 5 launch rocket.

Eutelsat has ordered a spare W series satellite from Matra Marconi for delivery in December 1999. It will provide Hot Bird type coverage and act as a back-up for the 7 , 10,16 and $36^{\circ} \mathrm{E}$ slots.



Monitors

Other common sites for dryjoints are R804, R805, D813, D815 and connector PL802. C.H.

## Microspot M1595LR

This monitor produced a distinctly yellow display. The cause was a duff 2SC1370 video output transistor (Q903) on the CRT base PCB. A BF472 restored colour to its cheeks - and its customers'. C.H.

## Ideal PVI776A

This monitor was dead because the IRF640 chopper FET Q621 had overheated and gone short-circuit As a result, the power supply had shut down. Strangely, the line output transistor was OK. When a replacement FET had been fitted and power was reapplied the picture wobbled badly and Q621 soon burnt out again. The cause of the trouble turned out to be C629 ( $22 \mu \mathrm{~F}, 250 \mathrm{~V}$ ). It's a smoothing capacitor in the HT supply. G.M.

## Olivetti DSM50-148

This monitor suffered from intermittent EW bowing. When the fault was present there was no EW correction parabola at the diode modulator in the line output stage. Tracing back to its source, I found that it went missing at coupling capacitor C302 (1nF, 100V) which was going open-circuit intermittently. G.M.

## Hyundai HCM428B

This monitor was dead because of a power supply blow-up. The 2SC3457 chopper transistor Q101 was short-circuit and its 2SC2316 driver transistor Q102 had shattered, blowing the $1 \cdot 2 \Omega, 1 \mathrm{~W}$ fusible feed resistor R109. G.M.

## Samtron SC428PSL (TLQ Chassis)

The problem with this monitor was uncontrollable EW bowing and excessive width. One of the pincushion distortion correction diodes, D406 (RU4D), had gone short-circuit, killing the driver transistor Q406 (KSE800). Use a

UF5408 diode in position D406 and a BD679 transistor with insulating kit in position Q406. G.M.

## ICL 15505

If the display is over bright - you may hear the CRT base spark gap arcing - check R446 ( $2 \cdot 2 \mathrm{M} \Omega$ ) which is probably open-circuit. It's at the chassis side of the CRT's first anode control. P.B.

## Viglen 145

If the picture is lost after a few seconds because the CRT's heater voltage disappears, replace D841, D842 and R878. R.P.

## Dell D1528LS

This monitor was dead with the 2SC5048 line output transistor short-circuit. Note that the correct type, 2SC5048, must be used: a BUW13A, BU508A etc. won't cope. I tried a BUW13A initially to prove that the line output transistor was the cause of the fault, but it immediately went short-circuit. R.P.

## Viglen CA1428LE

This monitor was dead with its BU2508DF line output transistor Q312 short-circuit. In addition the following items in the power supply had to be replaced: the UC3842 chopper control chip IC1; the 2SA966 transistor Q2; the BUW12AF chopper transistor Q1; and the $0.47 \Omega, 1 \mathrm{~W}$ resistor R 2 . R.P.

## ACI VG340

There was lack of height because R206 (1 $\Omega, 1 \mathrm{~W}$ ), which is in series with the frame scan coils on the chassis side, had increased in value to $2 \cdot 2 \Omega$. When this happens, the reduced frame scan current upsets the operation of the EW correction circuit. You will find that this second sympton also goes when R206 has been replaced. I.F.

## AST LR14

If one of these monitors rustles up briskly then quietly dies, suspect


Fig. 1: The basic chopper power supply arrangement used in the Acorn A4000 monitor. The values of vulnerable components will be found in the accompanying text.

Q208 (2SB1149). It's one of the HT supply selector transistors for the line output stage. The fault could cause confusion by giving the impression that the line output transformer has failed. I've had it only once to date. I.F.

## Acorn 44000

This monitor was dead with a power supply blow-up - you get this when the 2SK1117 chopper MOSFET Q1 fails. As a precaution, I decided to check the mother board by hooking it up to a PC chopper power supply. Incidentally the mother board power connector is identical to a disc drive plug, but the connections are not the same. Once the mother board was found to be OK, repairs to the power supply began.

As you can see from the circuit - Fig. 1 shows the basic chopper arrangement - the power supply is neat and simple. Though a lot of it is destroyed when Q1 fails, repair isn't too difficult. Before starting, note that the markings on the PCB for R3, R10 and R11 are close together, so these items may not correspond to the official circuit diagram.

Q1 had gone short-circuit, destroying R10 (1 $\Omega, 1 \mathrm{~W})$ and R11 ( $1 \cdot 2 \Omega, 1 \mathrm{~W}$ ). C20 provides a DC block in the excess-current sensing circuit: although it doesn't look as if it is adequately rated, it prevented damage to Q4 (2SC1923). When R10 and R11 had gone
open-circuit, the current flowing via Q1's gate had destroyed Q3 (2SA1015), which had gone shortcircuit after venting soot on the side of C11. Q2 (2SC945-a 2 SC 1815 will do as a replacement) had also gone short-circuit, taking with it the 12 V zener diode ZD6 and U1 (TC4069UBP). Note that this chip's UBP suffix is important. It must be unbuffered CMOS with a drain voltage supply rating of up to 18 V : an HC or HCT type must not be used!

In addition, the following components must be checked: R36 (10 ) , PC1 (PC111), R1 and R2 (both $33 \mathrm{k} \Omega, 3 \mathrm{~W}$ ), R3 (47 ), D12 (1N4148), and the snubber network components C6 (33nF), R9 and R20 (both $100 \mathrm{k} \Omega, 1 \mathrm{~W}$ ) and diode D5 (1N5397) - to ensure that snubber network failure was not the basic cause of the trouble.

When rebuilding, leave Q1 out until last so that the oscillator can be checked with power applied. For this purpose use a pair of inverse-parallel connected LEDs with a $3.3 \mathrm{k} \Omega$ resistor in series, as shown in Fig. 1 (top left). First connect this network between pins 8 and 13 of U1: both LEDs should light. Then move the lead connected to pin 8 to the junction of Q2 and Q3's emitters and R36: the result should be the same. If both these tests fail, check R1 and R2 which, though start-up resistors, also provide the running supply for the chopper drive circuit. It's also
important to check the voltage stabilised by ZD6: if this falls below $12 \mathrm{~V}, \mathrm{Q} 1$ will be under-driven and will overheat.

If you have any difficulty obtaining a 2SK1117 MOSFET, the specification for the 2SK1118 is the same except that the latter is fully insulated and has a power rating of 45 W instead of 100 W . It seems to me that a TO220 device plus mounting kit and a fully insulated TO220 device with a lower power rating amount to the same thing! Alternatively the MTP6N60 is the same as the 2 SK 1117 while the MTP6N60AFL is the same as the 2SK1118. They are all 6A, 600 V devices. I.F.

## NCR 0261

When switched on this monitor produced a dim picture that gradually brightened until the power supply was overloaded. The cause of the trouble was a crack in the CRT base panel - the only track affected was the one to the control grid pin.

When I reassembled the monitor I noticed that the foam rubber pad glued to the CRT base shielding was oversize and had been permanently deformed by the pressure. Trimming it down seemed to be a good idea.

This chassis is identical to the AST LR14, with four controls that point down under the side edge and an odd-shaped sub-panel inside.
I.F.

## What a Life!

## Bores and other problems, mainly with tellys. Donald Bullock's monthly round up

reeneyes never forgets a face. I do. I can talk to someone for half an hour in the shop and, unless they have green hair or two heads or something, I'm unlikely to know them next day. Some of them find this disconcerting. They can't understand why the chap who showed such interest in a set brought in yesterday doesn't seem to know who they are when they call for it the following day

## Bores

While I'm in the confessional box, here's something else. I find it very difficult to keep up an appearance of friendlv interest with a bore. As I'm told for the third or fourth time how a set tailed and what was on at the time, then the service history of their previous set is unfurled, my eyes glaze over and I find myself reliving the time I caught that 22pound pike at Waltham Pits.

Take the fellow who staggered in the other day with a monster Philips set, Model 24CE3588/05B (CP110 chassis)
"Ha, ha" he started, "the set was all right until we pulled the plug and went on holiday. To Blackpool actually. We watched the Ester Poltergeist programme just before we went. Do you know Blackpool? Yep, right as rain it was till we went there. And her's was the last programme we watched. Funny, ennit? I remember the missus saying, as I switched 'im off, 'pull out the plug Charlie'. And of course I did. I likes Blackpool, do you?"

I picked up a pen. "Name?" I asked.

He looked at the set. "Philips" he said.
"And your name?" I asked, trying desperately in smile.
"Phillips" he replied.

## And Another

As he walked out a similar sort of chap came in and deposited a

Ferguson set on the counter.
"Pinged three times and died, he did. Just as that Bruce Foresight chap comes in. I was having me dinner at the time. The missus gets sausages and mash twice a week. Do you like sausage and mash? Yeah, pinged three times 'e did. Or was it four? No three times, that's right. I remember saying to the missus 'reckon these sausages are fresh?' Not as 'er'd give me bad uns, mind. Yea, Bruce Foresight was on at the time . . ."
"Name?" I asked, dishing my smile.
"Ferguson" he replied.
"No, your name?"
"Yes, Ferguson. Do you like Bruce Foresight?"

## Marconi

As Steven settled down to the sets a foreign looking chap came in with an old Marconi radio. I drew up a card.
"Mr Marconi?" I asked.
He raised an eye and looked at me. "I haf never called my wireless 'Mr'" he said, "vie do you call wirelesses ' $\mathrm{Mr}^{\prime}$ ' in this country?'"
"Oh, er, ha, ha . . . My mistake" I said.

## Work

Meanwhile Steven had pulled the Philips set on to the bench. "The capacitor 'battery' has gone" he said. For better access he pulled out both the speaker and the degaussing plug, then fitted the new capacitor. After doing that he was called to the phone.

I sauntered over and replaced the plugs. The yellow one in the yellow socket, the reddish-brown one in the red socket. When I switched the set on it went bang and emitted a puff of smoke. But it came on - without any sound.
"Ah" said Steven, "the yellow plug came from the red socket, and the reddish-brown one from the yel-

low socket."<br>"Of course" I said, "should have known."

We fitted a new TDA8190 sound channel chip but there was still no audio output. Its safety-type feed resistors R3102 and R3672 were both open-circuit. Once we'd replaced them all was well.

The Ferguson set was a Model 66 M 3 , which is based on the ICC5 chassis. Steven disconnected pins 8 and 10 of the line output transformer, connected a 100 W bulb from pin 8 to chassis and switched on. The bulb pulsed three times then went out.
"Power supply's OK" he said. After removing the line output transformer he tried again. This time the HT came up and remained, with no pulsing. The line output transistor proved to be OK, so we fitted a new transformer and tried again. The HT pulsed three times and shut down.

An hour later Steven had made no progress, despite checking a dozen or so associated components. He took the new transformer out and tried again. As before, the HT came up and remained. Steven sat down and pondered. I was at a loss too. Could the new transformer be faulty? We checked it for shorts and didn't find any, but this didn't prove much.

As a long shot Steven moved over to the power supply and checked the BU508A chopper transistor. It tested perfectly of course. But he fitted another and tried again. This time the set sprang to life.

## An Akai VCR

Meanwhile Paul was working on an Akai VSF30 VCR. After replacing the usual carriage gear he tried it out. The monitor's screen flickered blue a few times then the machine died.
"Now I'm in trouble" he com-
mented. After a further hour's investigation he found that FR221, a $120 \Omega$ safety resistor, was opencircuit. It's in the 30 V line to the tuner/display and control circuitry. No reason for its failure could be found, and a replacement brought the machine back to life.

## Mr Zwymer

Then Mr Zwymer brought in a Ferguson T14R portable. "Is new" he said, "unt is dead. Bot fot can I do about it? Ze vife von it in a raffle. Silly voman! Vie did I marry such a voman?"

The set's fitted with the TX805 chassis, and there was no HT across C 17 ( $100 \mu \mathrm{~F}, 160 \mathrm{~V}$ ). So the Wessel combined chopper/line output circuit wasn't working. Most times it's not necessary to do anything other than check the three $68 \mathrm{k} \Omega$ resistors in the start-up circuit. Sure enough RP41 had failed.

When Mr Zwymer called for it we presented him with a bill for $£ 12.50$. He broke into an hysterical laugh.
"Vie, that is chicken feed" he declared, "now I lof my vife again!"

## A Tatung

Squadron-leader Pettigrew has a moustache that's wider than his face. "You'll have to get the old telly out of the car for me" he said. "You and you" he ordered, pointing at Paul and me. "I'm giving it one last chance. Seems to want to mess me about - and nobody does that!"

We brought it in and he took his leave. It was a Tatung TV9704 (170 series chassis). We plugged it in and switched on. As it warmed up the picture started to flicker and shake. Then it slipped sideways across the screen, went to black and white, next to a blue screen, then faded to nothing. We reached for the freezer, but it didn't help.

At the back of the chassis there's a 4in. PCB that stands upright. Between this and the metal chassis surround there's an LM317T regulator (I802) that provides a 12 V output. At some time in the past it had been unscrewed from the metal, which acts as its heatsink. As a result it had overheated and was now leaky.

A replacement cured the fault. When we'd boxed the set up and tried it again I let it know the score. "No more playing up" I said, "or it'll be curtains for you."

## Some Onwas

Doris Blugg called in with a Bush 2059NTX. "No picture, Mr

Bugbear" she grinned, "he's like my husband, no good for nuffin."

The set was dead and wouldn't go into the standby mode. When we advanced the setting of the first anode control we got a milky raster with flyback lines. This proved that the 12 V supply was missing. So we checked R422, the $3 \cdot 3 \Omega, 2 \mathrm{~W}$ safety resistor that feeds the $12 \mathrm{~V}, 1 \mathrm{~W}$ zener diode D402. As it was opencircuit we fitted a replacement. Then we checked the zener diode, which was short-circuit. This was replaced as well.

Before switching on again we checked C909 ( $47 \mu \mathrm{~F}, 25 \mathrm{~V}$ ) and $\mathrm{C} 910(10 \mu \mathrm{~F}, 50 \mathrm{~V})$ in the power supply. C909, which couples the drive to the base of the chopper transistor, produced an odd reading. We fitted a replacement rated at $50 \mathrm{~V}, 105^{\circ} \mathrm{C}$. Although C910 tested OK, we decided to replace it with a $105^{\circ}$ type.

When we switched on again we had a picture. But when standby was selected the set remained on though the screen darkened. We've also had this fault before: Q907 (2SC2335) goes short-circuit and R920 rises in value. We fitted a new BUT560A transistor in the Q907 position and a new resistor. This time all was well.

When Doris Blugg returned she was still on about her husband. "He wants to take some of that Niagra stuff" she said, "if there's one thing worse . ."
"Thank you Mrs Blugg" I cut in. "Now we'll just get this set to your car."

As you'll have gathered, the set uses an Onwa chassis - though it's a rather more complex one than usual.

With the next set, an Osume OS 1464 14in. portable, we were again faced with an Onwa chassis. It tripped three times at switch on.
"We should be able to polish this one off quickly" said Steven. "We'll check the usual suspects." The 12 V zener diode ZD401 was short-circuit and its feed resistor R414 was open-circuit. After replacing them we checked the BU508D line output transistor Q402 which was also short-circuit.

Once we'd fitted replacements we moved to the power supply and renewed the troublesome electrolytics C909 and C910, using $105^{\circ}$ types.
"That'll probably be it" Steven said, "these stock faults can be moneymakers."

When he switched the set on there was terrible arcing from the


A foreign looking chap came in with an old Marconi radio.
scan coil area and from the tube's anode cap to its Aquadag coating. Looking shaken, he switched off quickly, then disconnected the feed to the line output transformer and checked the voltage across the HT reservoir capacitor. It was very high at 193 V .
"It's still unregulated despite what we've done" he said, then started to examine the chopper circuit in greater detail. The two zener diodes ZD901 (8.2V) and ZD902 ( 9.1 V ) and the $0.1 \mu \mathrm{~F}$ capacitor in the drive pulse shaping network were all short-circuit. He replaced them and, for good measure, the 2SA1815 error detector transistor Q901, though it read OK.

When he switched on again the HT voltage reading was correct at 109 V and was properly adjustable. But when he reconnected the feed to the line output stage the set tripped three times and shut down.

Further checks showed that the line output transformer had been damaged by the over-voltage condition - it had shorted internally.

The customer had accepted our quote for regulator repairs, but refused the increased quote to include the transformer. So the work we'd done was a waste of time.

HELP WANTED
The help wanted column is intended to assist readers who require a part, circuit etc. that's not generally available. Requests are published at the discretion of the editor. Send them to the editorial department - do not write to or phone the advertisement department about this feature.

Wanted: LOPT type 3220012 for the Orion 20JT/20JR. Wes Campbell, 7 Silverstream Park, Bangor, Co. Down, N. Ireland BT20 3LU. 01247455 675.

Wanted: EW coil (circuit ref. no. LG11) for the Ferguson 59P7 (ICC5 chassis). D. Goodfellow, 5 Green Lane, Clifton, Ashbourne, Derbyshire DE6 2BL. 01335344805.
For disposal: Twelve VHS VCRs, a couple of TV sets and various handsets, free. Phone 01932565248 (Chertsey) after 7p.m. and ask for Terry.
Wanted: Spares for the Samsung CI212R Voyager 10 in . TV set plus service information with voltages marked. Philip Gay, 80A Milton
Brow, Weston-super-Mare, Somerset BS22 8DE.
Wanted: LOPT type MHF 023-21 7X18 (?) for the Hantarex Model MTC9000 video monitor. Also a replacement display for the Akai VS765EK VCR. Ian Johnson, 24 Seymour Road, St. Albans, Herts AL3 5HW.
Wanted: Circuit diagram, the power supply circuit or the number of the chopper output stage in the IBM 6542-103 monitor. S. Falzon, 142 Fleur-de-Lys Road, B'Kara, Malta. Phone. 443802 , fax 448257.
Wanted: LOPT for the Sunkyong SCT1045 radio/TV, also a circuit diagram for the Goodmans Compact 110 TV. A. Mc Ghie, 1 Boyach Crescent, Isle of Whithorn, Wigtownshire DG8 8LD. 01988500443.
Wanted: Wells Gardner
monitors/chassis, dead or alive, Models 13K7893, 25K7124, 27K7329 or similar, also tubes A63ADG and G-A68ACT00X, and Zenith chassis CD27MAMF1, CD25MVRF07 and anything similar, LOPTs etc. Call Phillip Hardacre on 01482329 957, fax 01482585414 or mobile 0860 671056.

Wanted: Circuit diagram for the Pye Model 42K7228/15W, photocopy OK. John Dove, 9 Bernard Street, Ely, Cambs CB6 1AU. 01353662 298.

For disposal: Complete PCB and power supply for the Goodmans GHC40, with Dolby Pro Logic including SSM2126A decoder and all other chips and service manual. Full switch bank as well if required. All or part for small money offer. D.
Williams, 382 Kings Road, Stretford, Manchester M32 8GW. 0161862 9432.

Wanted: Timer/clock panel PCB module for the Sharp VC381H VCR. Pete Shepherd, 25 Tomkins Close,
Stamford Le Hope, Essex SS17 8QU. 01375640618.

Wanted: HV unit (H Stat) part no. 1 22848231 for the Sony Model KV2060UB and HV unit part no. 1 22673311 for the Sony Model KV2212UB. Ray Smith, 51 Compton Road, Pedmore, Stourbridge, W. Midlands DY9 0TG. 01562886493. For disposal: Television magazines dated May 1994 to December 1997 inclusive. C. Godleman, Flat 4, 35 Station Road, Harlesden, London NW10 4UP. 01818383340.
Wanted: Two SN76023N audio ICs. Ian G. Jeffery, 275 Monks Road, Lincoln LN2 5JY. 01522540521. Wanted: Copy of the power supply circuit for the Osaki/Philips Model P140. R. Brown, 44A Middle Road (side door), Shoreham, Sussex BN43 6GA. 01273464339.
Wanted: Capstan motor, capstan flywheel and capstan flywheel bearing for the Sharp VC9300 VCR. H. Wright, 90 Harvelin Park, Lee Bottom, Todmorden, W. Yorkshire. 01706814505.

Wanted: IF can/coil (WE121.19. 0231) for the Philips B4X12A/19A valve radio. A. Mansfield, Lederbach 32, Herisau 9100, Switzerland. Wanted: Circuit diagram/service manual for the Uniden UST8008 analoge satellite receiver. Photocopy OK. Also need original remote control unit. Richard Warwick, Scarborough, N. Yorkshire. 01944728267. Wanted: User's manual or circuit diagram for the Fisher FVHP906 VCR, photocopies OK. C.T. Hawker, 89 Brooklyn Gardens, Cheltenham,

Glos GL51 8LP. 01242582971.
Wanted: Mains transformer for the Samsung TV Model CI338X-14. D. Jennings, 4 York Drove, Bitterne Village, Southampton SO18 5SA. 01703490174.

Wanted: Instruction manual/circuit diagram (photocopy OK) for the Telequipment Serviscope (valve model). I need to know resistor values. Also circuit diagram for the Cobra 19GTL FM citizen's band radio (photocopy OK). John McClean, 66 Castle Park, Limavady, Co. Londonderry, N. Ireland BT49 0SB. 01504763045.

Wanted: Service manuals/circuit diagrams for the following: Pioneer SX600L; Technics SUC03; Sansui AUD22. Rerturn guaranteed if required. J. Hall, Cortons Electrical, 29 Red Lion Street, Aylsham, Norfolk NR11 6ER. 01263733391. Wanted: Telefusion panels to fit side windows of Escort Mk II estate. Other companies' panels considered. Philip Barry, 6 Cowling Road, Burrill, Bedale, N. Yorkshire DL8 1RN. Wanted: Circuit diagram for the Cathay CTV3501B colour portable (or is there an equivalent model in another range?). Also an STR451 IC. Donald Bills, 69 Greenfields Road, Kingswinford DY6 8EG.
Wanted: Camcorder battery ref. VMB1 for the Amstrad Videomatic Model VMC100. Also a remote control for the Mitsubishi B11 VCR. Stuart Stark, 43 Brunswick Road, Edinburgh EH7 5PD. 01314781020. Wanted: Panasonic G deck adjustment information or copies of the May/June 1991 issues of Television that cover the alignment in depth. Gary Williams, I Dunblane Close, Garswood, Wigan WN4 0SH. 01942 728161 or e-mail garywillliams1@compuserve.com For disposal: Television issues from December 1976 to December 1997 (some missing), also B\&K 15 MHz precision scope. Offers please. S.P. Webb, 38 High Street (back), Dolby Cottage, Ely, Cambs CB7 4LQ. 01353668407.

## Answer to Test Case 431 <br> - see page 19 -

There's no auto grey-scale tracking in the Tatung D series chassis to confuse the diagnosis when an incorrect colour balance fault is present. And there's no need for RGB drive controls, such is the stability of modern picture tubes and the components used in the drive circuitry. The standing voltages at the tube's cathodes are governed by those at the outputs from the decoder chip. But the trouble wasn't being caused by this IC - as Cathode Ray discovered when he fitted a replacement!
In fact the problem remained unsolved until Television Ted returned from his holiday. He was quite horrified by Cathode Ray's action, and made him refit the original jungle chip and return the new one to stores. The cause of the fault was a very minor problem on the CRT base panel: R922 ( $100 \mathrm{k} \Omega$ ) had changed value.
This resistor provides DC feedback to stabilise the working point of the two-tranistor blue output amplifier. The corresponding resistors in the red and green output stages are R912 and R932 respectively. They had also started to increase in value. By way of preventive medicine, all three resistors were replaced. After that a correct grey scale was achieved with the three set-up potentiometers at very close to their centre settings. And there was no more colour drift.

## NEXT MONTH IN TELEVISION

## Servicing the Panasonic Alpha 2 chassis

The Alpha 2 chassis remained in production for about six years and was used in a number of models. So there are a lot of these sets around. John Coombes provides a detailed faultfinding guide.

## Chips for DTT

LSI Logic has developed a sophisticated set of chips for digital TV decoders-receivers. The latest addition is a DTT COFDM demodulator chip that was developed in conjunction with the BBC. A look at the demodulator, its performance and the complete chip set.

## Power at remote locations

Bill Wright on a simple way of obtaining low-current mains voltage at remote locations - via coaxial cable as low-voltage AC. Applications include TV distribution and surveillance equipment.

## The Velleman hand-held oscilloscope

The Velleman K7105 is a hand-held scope with LCD screen and a multi-function digital voltmeter in kit form. There's also a ready-built version (HHS5). It is ideal for field servicing and won't hurt your pocket. Pete Roberts has built two of them and describes the procedure. With some interesting features it's a worthwhile investment.

## Toshiba service briefs

More know-how from Toshiba Technical.

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Published on the third Wednesday of each month by Reed Business Information Ltd., Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Filmsetting by JJ Typographics Limited, Unit 4, Baron Court, Chandlers Way, Temple Farm Industrial Estate, Southend-on-Sea, Essex SS2 5SE. Printed in England by BPC Magazines (Carlisle) Ltd., Newtown Trading Estate, Carlisle, Cumbria CA2 7NR. Distributed by MarketForce (UK) Ltd., 247 Tottenham Court Road, London W1P 0AU (0171 261 7704). Sole Agents for Australia and New Zealand, Gordon and Gotch (Asia) Ltd.; South Africa, Central News Agency Ltd. Television is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to currency exchange fluctuations and VAT, and that it shall not be lent, resold, hired or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

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| Tuner Cans | ENV57887GS ENV 57888FI | $\begin{aligned} & £ 30 \text { each } \\ & £ 30 \text { each } \end{aligned}$ |
| Panasonic Remotes | $\left.\begin{array}{l}\text { TNQ 8EO (443) } \\ \text { TNQ 8EO (415) } \\ \text { TNQ 8EO (414) } \\ \text { TNQ 8EO (447) } \\ \text { TNQ 8EO (412) }\end{array}\right\}$ | £3.25 each |
| Discount for bulk orders $+p \& p$ <br> Tel: 01633430040 ask for Bob |  |  |

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## TV SERVICE FIELD ENGINEERS TELEVISION MARKET RESEARCH

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You will need to have knowledge and experience of TV and VCR technology, although you will also receive additional training by our specialists in our London Headquarters. Applicants must be qualified to at least City \& Guilds 224 or equivalent, have a service background and good communication skills. A clean driving licence is essential.
These positions are initially on a sub-contract basis but could lead to full time positions in the longer term.
If you have the background and experience for this role, and want to be part of a growing team, then please send your CV and a covering letter (with current salary details) to Tammy Law, Personnel Executive, Taylor Nelson Sofres, Westgate, London W5 IUA.
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## ADVERTISERS' INDEX

| Alberice.............................. 27 | ICHE................................. 27 |
| :---: | :---: |
| Aerial Techniques................ 57 |  |
|  | J.J. Components................... 33 |
| Besco............................... 70 |  |
| Broughframe...................... 72 | Marapet............................... 2 |
| Bull Electrical..................... 23 | MCES................................ 51 |
|  | Müter, Ulrich....................... 76 |
| Campion Wholesale TV...... 72 |  |
| Central TV Wholesale ......... 67 | PCB Computers................... 51 |
| Coastal Aerial Supplies.......... 72 | Philex................................IFC |
| Colour Trade....................... 70 | PV Tubes............................ 26 |
| Cricklewood Electronics........ 26 |  |
| Dartel............................... 71 | Rocdan Ltd......................... 72 |
| East London Components...... 29 | Sendz Components $\qquad$ IBC |
| Economic Devices...............4-5 | Silicon Galaxy..................... 71 |
| Electronic Sound Systems ...... 2 | Smart B............................... 66 |
| Euras................................ 66 | Stewarts of Reading.................. 59 |
| Express TV. $\qquad$ 71 | Swift TV Publications................. 51 |
| Gogglebox.......................... 66 | Tree. W................................. 70 |
| Grandata Ltd.............................35-46 |  |
|  | Wallis Universal.................... 22 West Midlands TV ........... 67 |
| HCTV.......................................... 68 | Willow Vale Ltd..................BC |
| HST Distributors London....... 67 | Wiltsgrove Ltd..................... 69 |



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