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Fault reports TVs, VCRs, PC Monitors and Satellite

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September issue on sale August 18th.

Next issue, dated October, on sale September 15th.

Monopoly dangers

There's a danger that we are heading towards a full circle with respect to competition in the broadcasting industry. Back in the early Fifties there was the BBC and that was it. When increased frequency spectra became available, there was a very considerable clamour to allow commercial broadcasters to use it. In the TV field the ITA, forerunner of the ITC, was set up and given the job of assessing prospective broadcasters (they had to provide programme plans and details of how money would be raised etc.), allocating franchises to them, and keeping an eye on what happened. Thus commercial broadcasting came to the UK, under careful supervision. But it was a bit coy about using that term: 'independent TV' was thought to provide a better image. Rather as, today, you seldom hear about pay-TV, instead subscription, multichannel or whatever. Never mind, it was undoubtedly beneficial that the monopoly was broken and that services could be provided by a multiplicity of broadcasters.

The ITA proved to be no stooge, making considerable use of the powers given to it. The initial ITV broadcasters were astonished when, at the first review, a couple of major companies lost their franchises.

One of the main concerns of governments then and since has been to ensure that independent broadcasters don't simply work towards a commercial monopoly – a duopoly with the BBC. Hence the emphasis on regional broadcasters, franchise allocations that were time and area restricted, not allowing takeovers (something that was subsequently permitted), and in general trying to ensure that the commercial services were indeed independent and competitive. The most obvious example of the importance given to this was the decision that the franchise for the London area should be on a time-split basis – weekdays and weekends.

Over the years there has been a considerable erosion of these principles. Broadcasters have been allowed to own franchises in more than one area and, on occasion, merge. There is now nothing like the original multiplicity of ITV companies. To take just one example, United News owns the Anglian, Meridian and the HTV franchises, which were all originally independent. In fact there are now just the big three (Granada, Carlton and United) plus Scottish Media Group and two small regional companies, Ulster and Border.

In recent years the ITV companies have faced increased competition – from Channels 4 and 5, the satellite broadcasters and the cable companies. Other media compete for the available advertising revenue, and technology is forever coming up with new prospects such as the internet. The revenues of the ITV companies have been on the decline, though they still account for 60 per cent of TV advertising.

There continue to be strict regulations: a 15 per cent ceiling on ITV companies' share of TV viewers, and a 25 per cent restriction on the share of advertising a company can obtain. Recently the Office of Fair Trading has decided to review this latter limitation, which has been in operation since 1994. There are suggestions that an "ideal structure" would consist of just two ITV franchises, one (Granada) covering the northern parts of the UK and the other (Carlton) the southern parts. The result, media analyst Paul Richards of WestLB Panmure suggests, would be "two very nicely balanced groups". How convenient. And how totally different from the original idea of 'independent TV'.

This might not have been too much of a worry had it not been for monopolistic tendencies elsewhere. No one else is going to get much of a look-in when it comes to satellite broadcasting, dominated as it is by BSkyB. Cable TV might have presented something of a counterbalance. It, too, has been regulated on the principle of a number of companies serving different geographical areas. One recalls the idealism of the days of Greenwich Cablevision. Six years ago there were still 24 cable companies in the UK, each running completely independent operations. In 1996 there was a four-way merger that created the largest current cable TV company, CWC. This is now to be taken over by one of its two major competitors, NTL, and there is talk of a further stage of consolidation that would bring Telewest into a virtual cable monopoly.

Thus the prospect, if the present trends pan out, is for BSkyB up above, CWC/NTL + down below (so to speak), and a couple of companies running ITV. How long would it be before further consolidation took place?

This is not at all what was envisaged when the franchising system was originally set up, or when the regulations were subsequently modified. The situation needs to be carefully watched. In particular the government and its regulatory authorities need to be mindful of the public as well as the broadcasters' interests.

Cover price increase

We regret the need to increase the cover price of *Television* from the next issue, dated October, to £2.80. Our costs have risen, and we have to be able to cover them. We trust that readers will understand, and for our part will continue to make every effort to provide value for money. Subscription rates remain unaltered for the present.

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But the subject doesn't stand still. New models, new faults - there is always something to add. So here we have the fifth edition, which has been completely updated and now has 300 pages and a more attractive cover. In addition to receiver fault notes and general information you'll find many useful button sequences for resetting parental lock codes, resetting installation choices to factory defaults and other less well known operations, practical information on LNB's with typical current drains, a list of manufacturers and suppliers addresses, other useful information and a beginners section. Digital receivers are now available so the manual includes a chapter to deal with these too."

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What a Life!

The life and death of Dylan. Various TV and VCR repairs. Treatment for a conductive PCB. Donald Bullock's servicing commentary

I was thinking the other day about an old friend, Dylan. When I first noticed him he was poring over a propped-up magazine at the other end of my then local, the Royal Oak. He was thick-set and pale, with neglected hair. Rather rough and tough looking in fact.

He was there when I next called, and before long seemed to be a fixture. He would always sit in the same place, his face lost in the magazine.

Then, one night, someone touched my elbow. I turned and saw this very man. He smiled slightly and said "I hear you're a TV engineer. Could you advise me about a problem set I have?"

He spoke quietly, with a captivating Welsh accent, and I noticed that the magazine in his hand was the current issue of *Television*.

The Life and Death of Dylan

I came to know him well. He'd been brought up in a remote Welsh valley, where he had taught himself to 'pull voices from the air' by making crystal sets and one-valvers. He'd then been conscripted and, after leaving the forces, had come to live in local lodgings. He lacked formal education, was slightly eccentric and was sparing with words. But he was reliable and straight – and came to call me 'son'.

His job was as a motor fitter. One day he offered to help with a fault in my car, and subsequently started doing odd jobs in our workshop. He would sometimes bring with him an old television set to tinker with. I still recall my astonishment at his method of testing paper capacitors – he would squeeze them with a pair of pliers while watching the screen. He 'checked' transistors by warming them with the iron. We introduced him to an Avo, and he soon took to conventional fault-finding methods. Being quietly dogged, he became an expert at dealing with some of our more tricky faults.

The bane of his life was Doug Trickey, a small bundle of fast-moving energy who would leap into gear and think afterwards.

"What d'you think he did today" Dylan once said, "washed some spiders out of the works' fusebox with a water hose. Shut us down for half a day!"

Dylan and I would have the occasional drink together. One night he was restless and glum. I asked if he had a problem.

"I did something despicable today, son. I stole Doug Trickey's insulated side-cutters."

"How come?" I asked, "had he stolen something from you, done you a bad turn or something? Was it to pay him back for washing out the fusebox?"

"Nothing like that" he said. "I just wanted them."

His conscience wouldn't let him rest. Next day he returned Doug's side-cutters.

He was also inventive. His old Morris van was the only one I ever knew that had a built-in driver's urinal. A sort of funnel arrangement with a copper pipe that passed through the floor of the van.

"I live a long way from the pub" he explained when I expressed my astonishment.

Dylan's landlady liked him well enough. This rankled her husband, who was so thick he couldn't tell the time. With her permission, Dylan carried out the odd wireless repair job on the kitchen table. Until her husband objected.

This pettiness upset Dylan. "I worked neatly on a thick cloth and always cleared up afterwards" he said. "Her husband starts work at seven each morning, and prides himself on his punctuality. But he'll be late tomorrow!"

Next evening he was gleeful. "It worked, son" he said.

"How come?" I asked.

"Before turning in I took a valve out of his wireless" he replied. "He didn't know the time."

Eventually Dylan opened a little TV repair shop in a busy backstreet. His bond was his word, and the business thrived. We would help each other out with the odd transistor or capacitor, parting with them when we met in the Royal Oak.

One night he wasn't to be seen. His shop was closed the next day, and I couldn't get him on the phone. I figured that he'd popped back to Wales for a day or two, as he often did. But it wasn't that.

Alerted by neighbours, the local policeman got a ladder to his bedroom window, above the shop, and found him dead on the floor. He'd suffered a massive heart attack. At just forty four.

A Strange Daewoo TV

"This set's driving me mad" said the dusky, deranged-looking chap who strode in with a 20in. Daewoo colour set. "The sound keeps cutting out." I reached for a job card.

"And that's not all. I'm watching ITV, right?" He tapped my chest with a finger. "ITV, got it? ITV."

"ITV, yes" I said.

"Next thing the picture's changed to BBC1. BBC1!"

"BBC1!" I echoed.

"So I grabs the remote control thing to get me picture right, only 'e don't do nuthin. Not nuthin."

"Nuthin" I said, looking him straight in the eye.

"Then the set tunes himself to one programme after another."

"Does it do anything else?" I asked, reaching for my pen.

"Ain't that e-bloody-nough?" he yelled.

The set, a Model T202 (CP330 chassis), gave us as much trouble as it gave him. The cause of the trouble was the 24C08P EPROM memory chip IV02. Anyone who gets this fault will save himself a lot of time and bother by being sure to replace it with the correct Daewoo type.

Stuck

Mrs Moss is a big woman. She brought in a JVC C14A1EK and plonked it on the counter. "Stuck!" she bellowed.

"Right" I said, wondering what she was on about.

When she had gone Paul put the set on the bench and found that it certainly was stuck – in standby.

"Where d'you reckon the fault will be?" I asked.

He pondered. "In the standby circuit" he eventually suggested.

I nodded. "You could well be right" I said.

The chassis has a power supply based on the STR50115A chopper chip, with a three-transistor HT switching circuit on the secondary side of the chopper transformer. Paul set about checking the transistors here and found that Q903 (2SA1370) was open-circuit all ways. A replacement restored normal operation.

Save Me!

The Reverend Goode's ancient saloon car came to a halt outside. He waved a video recorder at me from the running board.

"Save me, Donald!" he boomed. "We're due to record a Christening this afternoon, but this chap doesn't give us any sound."

"Doesn't give us any sound" confirmed his curate, the Reverend Blande.

They left the machine, a JVC HRD500EK, with us. When we tested it we found that it produced sound from a prerecorded tape but wouldn't record sound.

Steven made for IC1, the thirty-pin LA7295 chip, and found that pins 15, 21 and 23 were dry-jointed. Resoldering them cured the fault, and we later phoned the reverend to let him know that all was now well. He expressed his delight and called shortly afterwards.

"God smiles upon the blessed, Donald" he proclaimed. "You're so good to us. Er . . . my curate will carry it to the car.

"Carry it to the car" said the curate, doing just that.

It Blew Up

Our next caller was as delightful a young lady as you could wish to lay eyes on. "Who'll bring in my telly from my little car" she asked as she wriggled in.

Paul disappeared outside and was next seen yanking a heavy-looking TV set from the boot of her car.

"It was all right till one of my silly boyfriends wanted the sound louder" she purred. "Alec, it was. Plugged his 150W hi-fi speakers into the two little sockets at the back. Went very loud, then blew up in a cloud of smoke."

"Alec did?" I asked, hopefully.

"No, the set" she laughed.

It was a 21in. Panasonic set, Model TX21V1, with stereo sound and Fastext. There are external speaker sockets at the back, with a switch that disconnects the internal speakers when external ones are being used. Alec's experiment had led to the disintegration of the LA4270 sound output chip, which is capable of an output of 6W. A replacement restored the sound.

Alec later called to collect the set. He looked anything but Smart. More like a dyspeptic question mark I thought.

Sony VCR Problem

Paul had meanwhile pulled a Sony video recorder on to his bench, an SLV815B which has a very high-specification. The complaint had been about interference on the picture and was confirmed when we played back a known-good tape. Further tests showed that the fault was also present with E-E operation.

"It'll be the Elnas" Paul said.

I eyed him suspiciously. "Some family of goblins?" I asked.

"No. Elna capacitors. The chopper power supply is full of them. I suspect the ones on the secondary side of the transformer. There are thirteen of them. When they leak the voltage supplies become unstable. Sometimes one or two of them dry out completely. If they go short-circuit the machine fails or gives the dead symptom. I'll replace them with some off the shelf, but there's a modification kit

Dylan carried out the odd wireless repair job on the kitchen table . . .

that consists of the complete set. CPC supplies it as Kit 777, their part part number being SYA 675 957 4A."

When he got into the power supply he found that the problem was more serious. C207, an 820µF, 10V electrolytic, had leaked heavily. The electrolyte had soaked well into the PCB material, with the result that a small patch of the panel had become conductive. A resistance check produced a reading of 500kΩ over half an inch of the board. The effect of this was to inhibit the action of the 3PJ4 thyristor THY201, with loss of the 12V supply.

Superficial cleaning, though carried out thoroughly, didn't help. Paul eventually decided to give the board a number of applications of isopropyl alcohol. When the board had dried out he found that, though it was still conductive, the resistance reading was now higher. So he repeated the process, which produced a further improvement. He continued the treatment frequently over several days until his meter failed to show a reading when in its 20MΩ range.

He then replaced all the capacitors and switched on. The result: perfect operation.

TELETOPICS

Cable Merger

In a major consolidation of the UK's cable TV industry NTL is to acquire CWC's domestic cable operations for £8·2bn in cash, shares and debt. NTL has signed an agreement with CWC's parent company Cable and Wireless excluding any other offers. Barclay Knapp, chief executive of NTL, has gone on record as saying that a merger with the other remaining major cable TV operator in the UK, Telewest, would be possible once the NTL-CWC takeover has been completed.

The background to this is quite complex. Both NTL and Telewest were interested in buying the cable TV business of CWC, at present the UK's largest cable TV company, which was itself formed from a four-way merger in 1996. But financing the project was a problem. NTL's deal was made possible through the help of France Telecom, which already has a £700m investment in NTL and is to provide a £3·48bn contribution to the cost of taking over CWC's domestic telephone and TV side. In return, France Telecom will have a 25 per cent stake in the enlarged cable operation.

The deal will make NTL by far the largest cable telephone and TV company in the UK, with over 2·8 million customers. Its networks will pass some twelve million franchise homes, over half of all UK households. The NTL-CWC deal is no give away: in effect, NTL will pay about £1,300 per home in the CWC franchise areas. But, with the prospect of increased use of internet and interactive services via cable, NTL foresees a profitable future.

Digital TV

Between its launch last November and late June ONdigital has signed up some 250,000 subscribers. About a third have taken the service since the 'free' STB offer at the end of May. Over 70 per cent of UK homes can now receive digital terrestrial TV: the coverage is expected to increase to 90 per cent by early next year.

Comet is now selling the complete range of integrated digital TV models available in the UK, four in all. The LG DI28Z12 at £699.99 is a 28in. widescreen receiver for digital satellite and analogue terrestrial reception. The Philips 28DW673, also a 28in. widescreen model, provides ONdigital plus analogue terrestrial reception at £1,199.99. Both these models incorporate a modem. The Hitachi C32W40DTN at £1,299.99 and the Sony KV32DS60 at £1,999.99 are both 32in. widescreen models that provide analogue plus free-to-air digital terrestrial TV reception. The Hitachi model offers Dolby Pro-Logic surround sound while the Sony model has a Super Trinitron CRT and 200Hz flicker-free scanning.

Farnell Electronic Components now has available a complete range of lightning and transient overvoltage protection devices from Furse. The range includes data and signal line protectors and ethernet protectors for use with any network cables that enter or leave a building. There is also protection for telephone lines and CCTV systems. The products are all tested to BS 6651 and come with a five-year warranty.

The Furse protection range is available with a wide range of mounting options, and contributes only limited signal attenuation.

For further details apply to Farnell Electronic Components Ltd., Canal Road, Leeds LS12 2TU, phone 0113 263 6311, fax 0113 263 3411.

Digital TV Courses

The College of North West London has received accreditation to offer the City & Guilds digital TV Level 3 Electronics Servicing course 2254. The college will be setting the exams and students who pass will receive a City & Guilds certificate. It's the first college-devised course of this type in the UK. Other colleges will be able to run the same course with CNWL permission, subject to the College's quality checks. Curriculum manager Fawzi Ibrahim said colleges will have to apply to the CNWL. "We control the whole thing" he added, "which shows the confidence that C&G has in the quality of our courses."

Fawzi Ibrahim is the author of the standard textbook *Television Receivers* and has contributed several articles to *Television*.

For further information on the courses phone Kay Shelley at the College of North West London on 0181 208 5196

Satellite TV

SES has ordered two more digital satellites, to be known at Astra 2C and Astra 2D, which will be positioned at 28·2°E.

Astra 2D will have fifteen transponders (sixteen at the beginning of its life) and will provide coverage of the UK and Ireland, operating in the band 10·7-10·95GHz. It's to be launched via an Ariane booster in late 2000.

Astra 2C will be launched via a Russian Proton booster in the first half of 2001. It will have 28 transponders (32 for the first five years) operating in the bands 10·7-11·2GHz and 11·7-12·2GHz, and will provide coverage across Europe.

Europe Online Networks SA has taken additional transponder capacity aboard Astra craft at 19·2°E and 28·2°E to develop its Internet via the Sky service, which was introduced in May with a mass-consumer market launch scheduled for August 27th. The service aims to deliver varied broadband internet content to TV sets and PCs, using an internet-ready digital STB or a plug-in PC card. Compliance with the open Digital Video Broadcasting/Internet Protocol standard should ensure the availability of reception equipment at reasonable prices.

Eutelsat has taken over the France Telecom satellite Telecom 2 at 8°W, which has 11 Ku-band transponders. At the end of its nominal lifetime, in the course of 2004, a new satellite will be deployed at this location.

The French utilities and communications group Vivendi has increased its stake in BSkyB to almost 25 per cent by purchasing the shares held by BSB Holdings, which is owned by Granada and Pearson. Vivendi has also increased its stake in the French pay-TV company Canal+, to 49 per cent, though it intends to reduce this to 40 per cent. The move has re-ignited speculation that there could be a merger between the two pay-TV companies.

Dolby Laboratories demonstrated a high-definition TV system that features 5.1 Dolby Digital audio at the recent SBCA national satellite Convention and Exposition in the USA. Broadcaster HBO began HDTV transmissions last March.

Eurosat is to continue as exclusive distributor of Echostar products in the UK and Ireland. The range includes analogue and digital STBs. A recent addition, Model D2500IP, is a digital receiver with built-in positioner and two common-interface CAM slots. Further additions to the range will be announced shortly. For further details apply to Eurosat Distribution Ltd., 1 Oxgate Centre, Oxgate Lane, London NW2 7JA. Phone 0181 452 6699, fax 0181 452 6777.

Infineon Technologies has introduced the SQC6100 COFDM digital receiver chip for use in DTT receivers and set-top boxes. It carries out input signal filtering, AD conversion, digital demodulation and FEC. When used with Infineon's TDA6190 mixer IC, no feedback to the RF front end is required. The 100-pin chip can handle both the 2k and 8k COFDM standards, with channel bandwidths of 6, 7 and 8MHz. Infineon Technologies can be reached on 01344 396 313 or www.infineon.com/

Low-temperature Soldering

A range of specialised alloys for soldering and jointing at temperatures between 58-220°C has been developed by Mining and Chemical Products. The six alloys have been formulated for soldering the same range of metals as conventional lead-tin solders, using similar manual and automatic techniques.

The five lower-temperature (58-145°C) alloys are intended for making joints close to materials or components that might be distorted or damaged by the application of lead-tin solder, which melts at 180°C. They can be applied near existing joints without melting or softening them.

The six alloys wet readily and have low viscosity and surface tension. When molten they flow freely, producing joints with good adhesive and mechanical properties.

For applications that require nil toxicity in the solder, the range provides lead-free formulations that meet the conditions of IS09543:1990 and BSEN 29453:1994.

For further details apply to Mining and Chemical Products Ltd., The Mill House, Laverstoke, Whitchurch, Hants RG28 7NS. Phone 01256 897 200.

Dolby News

The Dolby Digital multi-channel audio format has been accepted as a transmission standard by the Digital Video Broadcasting (DVB) project. This means that broadcasters can transmit Dolby Digital audio exclusively. Australia and Singapore, which have adopted the DVB standard, plan to transmit Dolby Digital rather than MPEG-2 audio. German broadcaster ProSieben will be the first European broadcaster to transmit Dolby Digital, which is the standard format for digital broadcasting in many parts of the world including the USA, Korea, Taiwan and Argentina.

Sony plans to introduce headphones that use Virtual Dolby Digital technology, offering multi-channel sound via an infra-red link.

According to Dolby eleven million pieces of equipment that incorporate Dolby Digital sound had been sold worldwide by the end of the first quarter, 1999. They include 5·7 million TV sets and 2·6 million DVD-Video players. Over 500 LaserDiscs and 2,600 DVD titles have Dolby Digital soundtracks.

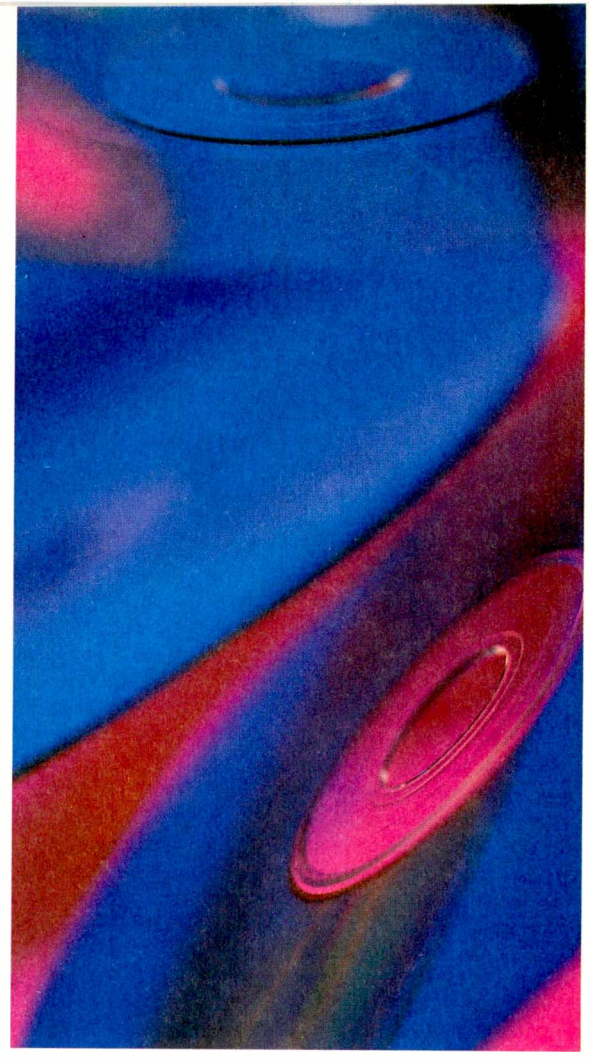
Price Comparisons

Are the prices charged for domestic electrical and electronic products in the UK higher than elsewhere? Dixons, the largest UK electrical retailer, has commissioned and published a detailed study, by the professional services firm Arthur Anderson, into the prices of electrical goods in Europe and the USA. It covers more than a hundred products in twelve categories – audio systems, camcorders, cameras, TV sets, VCRs, dish washers, fridges, washing machines, irons, toasters, vacuum cleaners and PCs.

The study concludes that "within Europe there is no systematic tendency for the prices of electrical goods and PCs to be higher in the UK than elsewhere: prices are relatively high for some goods, notably vacuum cleaners, but relatively low for others such as VCRs". It found that price differentials are often accounted for by different specifications for different markets, national tastes and preferences, and manufacturers' marketing strategies. As an example, the washing machines sold in Northern Europe tend to be more expensive because they have higher spin speeds, a consequence of the cooler climate. An indicative basket of products was found to cost five per cent less in the UK than elsewhere in Europe.

Average prices in the USA were found to be substantially lower than in Europe. This was attributed to economies of scale in a larger market, commoditisation of some products, and lower taxes and duties.

The Super Audio CD Format



The first of a new generation of audio players that use this new format was launched last May. George Cole fills in the technical details

Last May saw the launch of the first of a new generation of audio players that use the Super Audio CD (SACD) format, which was developed by Sony and Philips. The format is designed to move home digital audio to a higher plane while maintaining compatibility with the basic CD audio format.

CD Basics

We'll start with a brief recap on the Compact Disc-Digital Audio (CD-DA) format, which was originally launched in Japan in October 1982. The audio CD format was developed by Philips and Sony: Philips contributed much of the technology as a development from its LaserVision optical disc format, while Sony provided much of the error-correction technology. In the late Seventies the music industry and electronics companies were keen to replace the vinyl LP with a new consumer audio format based on digital technology.

A number of rival digital audio systems (collectively known as Digital Audio Discs – DADs) had been developed. Several used a 30cm disc, the same size as an LP. But the Philips/Sony system, which uses a 12cm disc, was adopted as the standard for home digital audio. The audio CD is based on optical disc technology, i.e. a laser-scanned disc, with pulse-code modulation (PCM) for the signal. To convert it to digital form, the analogue signal from the recording microphone is first sampled at a series of regular intervals after which the samples are converted (quantised) into digital numbers that represent the signal levels. The digital signal thus obtained is then coded, i.e. error-correction coding is added.

The CD Specification

Audio CD was originally designed as a 14-bit system, i.e. 14 bits per sample. It was upgraded to 16 bits, which enable 65,536 signal levels to be represented. In the audio CD format the analogue signal is sampled 44,100 times per second per channel, each sample being given a digital value. During playback digital-to-analogue converters translate the digital numbers into analogue voltage waveforms, which are filtered to remove traces of digitisation. Analogue signals are thus restored for feeding to the loudspeakers.

The digital audio signal is recorded on a 12cm polycarbonate disc as a spiral track of pits (or, more accurately, bumps). A reflective aluminium coating is then added and topped with a protective lacquer. The playback laser scans the disc from the polycarbonate side. An infra-red laser is used, the light wavelength being 780nm.

In addition to music an audio CD contains sub-code data that provides time and track information. The audio CD standard, known as the Red Book, also has provision for CD+ Graphics – teletext-like text and graphics – though this feature is rarely used. There have been a few extensions to the Red Book specification, such as CD-Video which combines PCM audio with analogue video, and CD Text for storing text information such as song titles or lyrics.

The audio CD specification includes a disc playback time of 74 minutes, though discs that provide a running time of almost 80 minutes are not unknown; two- or four-channel audio (the latter has not, as far as I am aware, been used for a commercially-released CD title); a frequency response of 20Hz-20kHz; a dynamic range of over 90dB; a signal-to-noise ratio of over 90dB; and harmonic distortion at less than 0·01 per cent. In comparison the vinyl LP provides a running time of about 30 minutes per side; a frequency response of 30Hz-20kHz; a dynamic range of 70dB; a signal-to-noise ratio of 60dB; and harmonic distortion at about 1-2 per cent.

Despite this superior specification, the main reasons

for the success of the CD as a consumer format were its smaller disc size, longer running time and convenience features such as track programming, repeat play and A-B playback. Over 700 million CD mechanisms are in use worldwide, and there are billions of prerecorded discs.

Improvements

When the CD system was launched in the UK in 1983 Philips used the advertising slogan "Perfect Sound Forever". Perfect sound for now would have been more accurate. At the time of its development the audio CD format made use of the best technology available, especially in terms of filters and DACs (digital-to-analogue converters). But the technology has continued to evolve.

Techniques such as Sony's Super Bit Mapping (SBM) have been used to improve audio CD sound quality, in this case by using intelligent digital filters designed to take advantage of the non-linear response of the human ear. The ear is less sensitive to higher and lower frequencies: SBM uses a system known as noise shaping to push quantisation noise into frequency regions where the ear is less sensitive. Techniques such as SBM and Technics' MASH work well – Sony claims that SBM provides performance equivalent to 20 bits per sample – but at the end of the day these enhanced CD systems are still limited by the basic 16-bit audio CD technology.

In the mid-Nineties the audio industry started to look for a new audio format that would one day supersede the audio CD. The International Steering Committee (ISC), which represents the music industry, in 1996 issued a list of features it would like to see with a "Super CD" format. The list included improved sound quality; two-channel stereo and six-channel sound; a 12cm disc with a single side; no caddy; anti-piracy and copyright management systems; and the option to add video, text and data to the music. Another feature was backwards-compatibility with the audio CD, though this has been interpreted in different ways: some think it means that any new audio players must also be able to play audio CD discs, others that new audio discs should be playable using today's CD players.

DVD-Audio

Like the CD, the DVD (Digital Versatile Disc) was always seen as a multi-purpose carrier of music, data and video. The DVD-Video specification includes Linear PCM (LPCM) audio with 20- or 24-bit coding and 96kHz sampling. A number of 24-bit/96kHz audio discs have been released, mostly on specialist audio labels. In January 1996 a new DVD Working Group (WG4) was convened to set the standard for a DVD-Audio format. At the time of writing (early summer 1999) this standard is still being finalised. It will be for a new type of DVD-Audio disc that cannot be played using current DVD-Video players.

DVD-Audio is, like audio CD, an LPCM format. But a DVD-Audio disc can store up to 4·7Gbytes of data, seven times more than a CD. The extra data capacity is used to improve sound quality rather than provide extended playing time – a DVD-Audio disc stores about 74 minutes of audio. The bit rate is 9·6Mbits/sec compared with some 1·5Mbits/sec with a CD. The DVD-Audio standard caters for a number of sampling rates and quantisation values. These are arranged in two groups.

The group known as Scalable Linear PCM Multichannel Audio has sampling rates of 44·1kHz (the same as CD), 48kHz (same as DAT), 88·2kHz and 96kHz. These can be combined with 16-, 20- or 24-bit coding. It can provide up to six audio channels. The group known as Super High Quality Linear PCM uses sampling rates of 176kHz and 192kHz, which can be combined with 16-, 20 or 24-bit coding, but the number of channels is limited to two.

In addition to up to six sound channels, DVD-Audio discs can carry multimedia material such as text, pictures (one still picture per track), web-site addresses and video. The latter is based on the DVD-Video file format. Audio discs that contain multimedia material are known as DVD-Audio (V) – for video.

Super Audio CD

But a split occurred in the DVD-Audio camp. Sony and Philips decided to develop their own rival format – though the companies continue to support DVD-Audio officially. In February 1998 the two companies announced that they would be licensing their new format, which is known as Super Audio CD (SACD). The royalty was set at the same rate as for the audio CD: three cents per disc.

Why did Sony and Philips develop this separate format? It's down to a difference of opinion on improving digital-audio sound quality. Sony and Philips argue that while PCM audio can be improved by increasing the sampling frequency, this creates additional problems; and that improvements in the technology provide smaller and smaller benefits. The reason for this lies in the filtering used with PCM audio.

The 'conventional' multi-bit PCM recording system samples the analogue signal at a very high rate, say 64 times the audio CD sampling frequency, but with a low resolution (usually one bit). A digital decimation filter then 'down-samples' the rapid data stream to give a sampling rate of 44·1kHz with 16-bit encoding. 'Brickwall' filters are used to block signals at or above the half-sampling frequency, removing unwanted harmonics that would degrade the audio signal. While these filters must reject say 22·05kHz, they should allow a 20kHz signal to pass. A series of filters are used in the digital recording and playback process. For playback, interpolation filters 'oversample' the signal during digital-to-analogue conversion. Sony and Philips argue that these filters add quantization noise that degrades the audio signal. The solution seems to be simple: omit the filters and record the original 1-bit resolution data stream directly on to the tape or disc.

Direct Stream Digital

Sony and Philips call this technique Direct Stream Digital (DSD). The analogue signal undergoes 64X oversampling, after which the bit stream is recorded directly on the disc without decimation. The 2·8224MHz sampling frequency produces a vast amount of data (2·8224Mbits/sec), but this is only four times more than with the audio CD system (16 x 44,100Hz = 705·6kbits/sec) and can be handled by existing tape and disc formats.

DSD uses negative feedback in analogue-to-digital conversion, see Fig. 1. The analogue input is compared with the output from the quantiser. If its value is higher, the output is a one, if lower a zero. As a result a positive half-cycle consists of a series of ones while a negative half-cycle consists of a series of zeros, a process called Pulse Density Modulation (PDM). Sony and Philips say

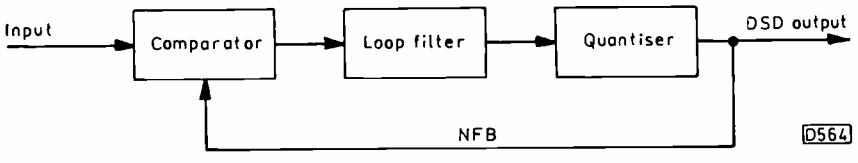


Fig. 1: Block diagram of the DSD analogue-to-digital converter. The loop filter provides noise shaping and integration.

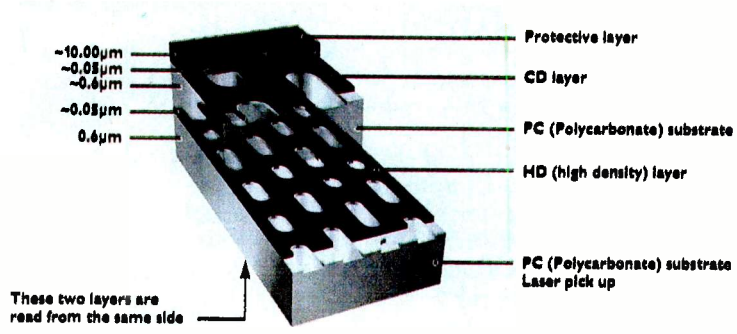


Fig. 2: The hybrid SADC format disc.

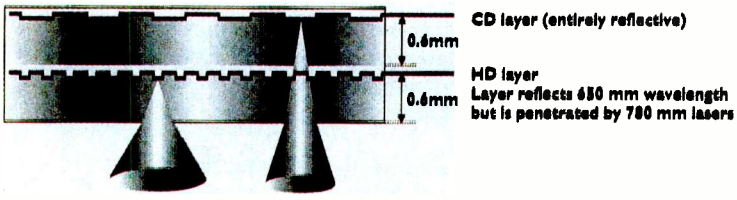


Fig. 3: How a hybrid SACD disc is read.

Table 1: CD and SACD layer characteristics.

Characteristic	*CD*	*SACD*
Reflectivity	Reflective	Semi-transmissive
Capacity	780Mbytes	4·7Gbytes
Min. pit/land length	0·83µm	0·4µm
Track pitch	1·6µm	0·74µm
Laser wavelength	780nm	650nm
Pickup lens NA*	0·45	0·6

*Numerical aperture.

that the digital signal produced in this way 'looks' almost analogue, and in theory all you need to do is to pass it through a low-pass filter to restore the analogue signal. In practice however things are not quite so simple. The PDM pulse train is quite noisy, so noise-shaping filters are required to achieve a very high signal-to-noise ratio.

DSD provides a very wide frequency response, DC-100kHz, and a dynamic range of 120dB, far surpassing previous analogue and digital recording systems.

The decision to use a 2·8224MHz sampling rate was made because it converts easily to the standard digital formats (32, 41·1 and 48kHz). This makes it relatively simple to down-convert the DSD signal for archiving and mastering.

The Hybrid Disc

Three types of discs can be used with the SADC format: a single-layer disc that holds a high-density recording, a double-layer high-density disc, or a double-layer disc that holds a high-density recording in one layer and Red Book CD audio in the other layer. The latter are called hybrid discs, and enable SADC discs to be played by existing CD players.

A hybrid disc consists of two 0·6mm discs bonded together to create a disc of standard CD thickness (1·2mm), see Fig. 2. The same process is used for DVDs. Fig. 3 illustrates disc scanning. The top layer carries CD audio (16bit/44·1kHz), is fully reflective and can be read by an infra-red laser (wavelength 780nm). The high-density layer beneath can be read by a red (650nm) laser. They are separated by a semi-transmissive layer that transmits the infra-red light but reflects the red light. In practice only 25 per cent of the red light is reflected, but this is sufficient to provide an input signal for the SACD player. In order to be able to play both SACD and audio CDs, SACD players have twin laser diodes.

There is however some confusion over the status of the hybrid disc. It was originally thought that the hybrid disc would be a mandatory part of the SACD specification, but it's now optional. The benefits of the hybrid disc are claimed to include full backwards compatibility with audio CD, so that retailers don't need to hold dual-inventory stock. Some controversy has arisen over this compatibility, with Matsushita suggesting that up to 30 per cent of current CD players might be unable to read the discs. Hybrid discs are more expensive to produce than audio CDs, and pricing will be an issue. The DVD Forum has rejected the hybrid disc.

Table 1 provides data on the two layers. Note that the high-density layer has smaller data pits and a tighter track pitch: this is why the SACD requires a laser with a shorter wavelength and larger numerical aperture than for audio CD. The high-density layer can store a 74-minute two-channel mix (DSD-2) and a 74-minute six-channel mix (DSD-6) despite having a data capacity of only 4·7Gbytes.

The data on the disc is grouped into frames of 2,046bytes, with a 4-byte identification data area, two bytes for ID error correction, 2,048 bytes of main data, four bytes of error detection code and six bytes which are reserved. The data frames are scrambled and arranged in groups of sixteen to form error-correction code blocks based on a Reed-Solomon product code. After interleaving the rows of ECC blocks, recording frames are formed. These are modulated with an EFM (eight-to-fourteen) plus code, which is superior to the one used for audio CD. After modulation the data is arranged into physical sectors and recorded on the disc.

Direct Stream Transfer

SACD uses a data reduction coding system to store both two-channel and multichannel high-density audio. Known as Direct Stream Transfer (DST), the system was originally developed by Philips for computer applications.

Most data reduction systems are 'lossy': they delete data and use psychoacoustic models, based on the characteristics of the human ear, to recreate an audio signal that's close to the original sound – examples include MPEG-2 audio, MiniDisc ATRAC and Dolby AC3.

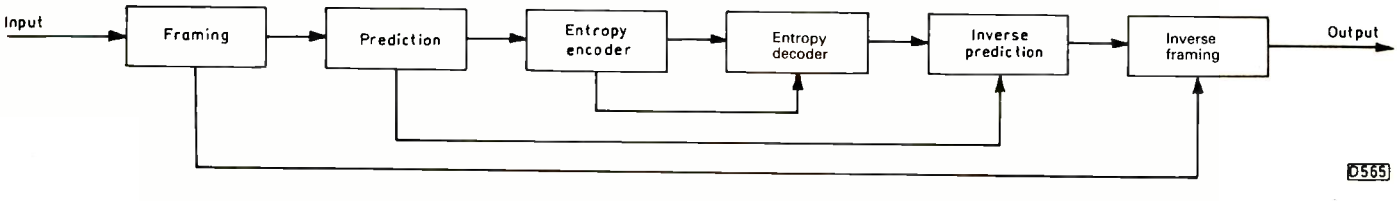


Fig. 4: DST record/playback system.

DST is a lossless system, the decoder creating a bit-for-bit replica of the original signal.

The DST system uses a combination of data framing, prediction and entropy encoding to achieve a fifty per cent data reduction. Figs. 4, 5 and 6 show what's involved in block diagram form.

Copy Protection

The advent of digital recording formats has brought the issue of copy protection to the forefront. Anti-piracy and copyright protection were indeed at the top of the original ISC list.

The DVD-Audio format will use a system developed by Intel, IBM, Panasonic and Toshiba. This employs a mixture of watermark and encryption technology to prevent unauthorised copying and make it easier to detect unauthorised discs. DVD-Audio discs will play only on licensed machines, and users will be able to make only one digital copy for personal use – at a lower quality than the DVD-Audio disc itself. This means that a DVD-Audio disc could be copied on to say a digital tape or recordable CD, but it won't be possible to make a digital copy of the copy. Music companies will also have the option is offering different levels of copying quality up to the full quality of prerecorded DVD-Audio.

The SACD format uses a system known as Pit Signal Processing (PSP). It places a faint image on the signal side of the disc. The image could be text or graphics and will be extremely difficult for pirates to duplicate, making it easier to spot pirated SACD discs. SACD also uses other anti-piracy techniques, including disc bar codes and invisible data that's embedded on the disc. This data can be read by the SACD player: if it's missing, as would be the case with a pirated disc, the player rejects the disc.

Marketing and Prospects

Version 1.0 of the SACD specification, known as the Scarlet Book, was published in March 1999. Within two months (on May 21st to be exact) Sony had launched the first SACD player, Model SCD1, in Japan at the equivalent of about £2,600. Initial production is running at 500 units per month. Philips will probably launch its first SACD player at this year's IFA show in Berlin. Sony Music has launched thirteen SACD titles, with more to follow. Universal Music plans to launch some classical music titles. But support from other major music companies – BMG, EMI and Warner – is lacking. They've pledged to support DVD-Audio.

What are the prospects for SACD? I've been fortunate to hear both SACD and DVD-Audio demonstrations. There's no doubt that they provide sound quality that far outstrips audio CD. But it remains to be seen whether either format will become a mass-market system. Most consumers are more than happy with audio CD, and few will want six-channel audio in their living rooms – assuming there's space for all the speakers. And the new discs will be more expensive than ordinary CDs.

Of the two new audio formats, SACD looks the more vulnerable. It lacks the wider support that DVD-Audio has been given by the two industries, and it is likely that DVD-Audio and DVD-Video players will be merged as a single Universal DVD player. SACD does not have this option.

It's a pity that yet another format war has broken out, this time over the next generation of music carrier. The signs are that, as with most previous standard battles in the consumer arena, marketing muscle rather than technical excellence will determine the issue.

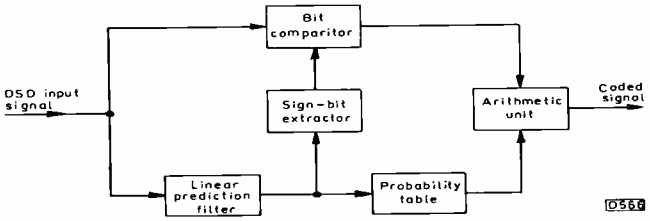


Fig. 5: Lossless DST encoder block diagram.

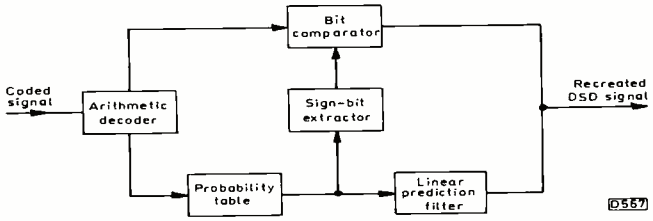
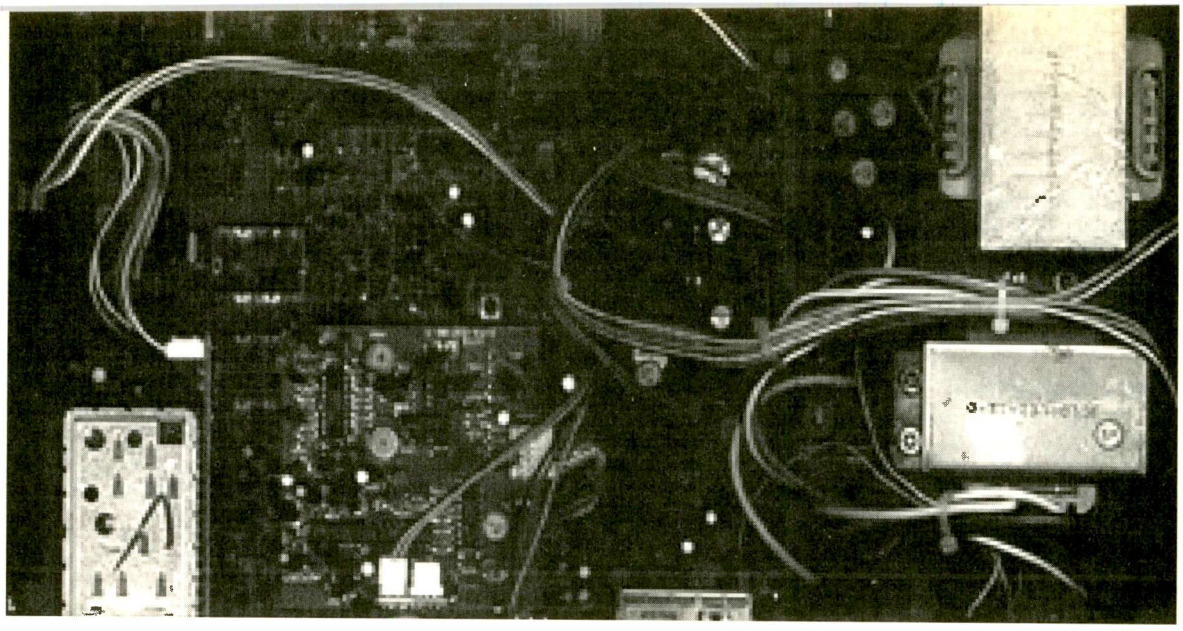


Fig. 6: Lossless DST decoder block diagram.

Acknowledgements

My thanks to Philips, Sony and Pioneer for help in the preparation of this article. Two papers published by Philips and Sony, *Super Audio Compact Disc – a technical proposal*, and *Super Audio CD, Format Summary*, were invaluable sources of information.



Satellite Notebook

Reports from Hugh Cocks and Christopher Holland

Pace MSS228LT

These non-IRD analogue receivers are ideal for weak-signal reception. In addition to wide and narrow IF passband switching, they incorporate a video FM threshold extension circuit. This greatly improves the quality of signals that would otherwise be marred by sparklies. The threshold extension facility can be stored on a channel by channel basis, which could be a great help to satellite enthusiasts anxious to pick up anything they can.

I own one of these receivers and was busy swapping and organising channels on it recently when it crashed. I had been moving a high channel to a low channel number area. The receiver normally shows a channel being counted down via an on-screen display: the count stops when the channel to be inserted has reached the required position. This didn't happen: the counting went on down to 1 then round to 1,000 (the receiver has only 500 channels!) and back down again. When the receiver was switched off then on, the on-screen frequency and other parameters were way off what should have been displayed. On top of this the English menus couldn't be selected. I had to settle for French menus, which didn't help.

All channel tuning parameters could be brought back, so a channel could be displayed. But it couldn't be stored. I used the Pacelink PC channel programming system to reprogram the receiver, which appeared to accept the information downloaded from the PC (the PC's monitor indicated that the process of accepting the new data had finished). But the MSS228LT would have none of it – no new information had been stored.

The answer is in the December issue of Pace's publication *Service Matters*. Revised software has been introduced, as the original version could occasionally cause EEPROM corruption. My receiver was fitted with the original microcontroller chip (U700), part no. 8098663131. I contacted Pace who within a short time supplied a replacement microcontroller chip, part no. 8098663132, and also a new EEPROM (D701, type 24C65) to replace the corrupted one.

We've recently had to replace some ageing analogue receivers that were used in a hotel SMATV system. The MSS228LT is an excellent choice for this purpose: it switches on automatically after a power cut, the output from the modulator can be set to any channel in the UHF band, and the price is low!

Don't confuse the MSS228LT with the earlier MSS228, which looks the same but doesn't have the video FM threshold extension facility nor, as far as I am aware, the EEPROM corruption problem. **H.C.**

SVA1 VideoCrypt Decoder

These decoders, introduced in 1990, have had a long life. The main problem has been dry-joints around the mains transformer. This showed up at an early stage however. More recently I've had to replace all the electrolytic capacitors in the power supply in several decoders.

Usually one of the two large electrolytics goes open-circuit. The on-screen symptom is an unstable mess, with 50Hz-type modulation being visible. Pin 8 (control) of the scart socket usually goes high as well, so the decoder is in effect permanently on and the receiver displays this symptom on all channels. So far the viewing card has survived the onslaught, with no "your card is invalid" display after the repair. Problems in the power supply area have, in the past, tended to zap the card. Maybe later-issue cards are more robust! **H.C.**

SkyDigital Card Problem

When a digibox without a viewing card in its slot is connected, the Electronic Programme Guide (EPG) lists no terrestrial UK channels: in addition BBC News 24, BBC Parliament, BBC Choice, BBC Knowledge and Sky 1 don't appear. The only channels that can be watched without a card are 181 Travel, 501 Sky News, 513 CNN, 660 QVC, 673 Shop and 688 Travel Shop.

Once the card is inserted, the BBC programmes appear in the EPG within a few minutes, even prior to card authorisation. This appears to be because cards intended for use in Ireland do not have authorisation for the UK terrestrial channels. As BBC1 is regionalised, the card contains information to insert the 'correct' BBC1 region at programme 101 in the EPG.

The problem with a recent installation was that the authorised channels all appeared normally but the receiver stubbornly proclaimed that the UK terrestrial channels weren't available.

I decided to see if they had been authorised. Going to the 'add channels' menu, I entered 11·722GHz horizontal and added BBC1

(England), BBC2, BBC Knowledge and BBC News 24 and stored them in the additional channels section, selected via 8 in the 'programmes' menu. Once this had been done the terrestrial channels were all found to be present and working, but could be accessed only via this menu. When 101, 102 etc were entered in the EPG the red 'channel unavailable' message was produced.

As a further test I stored BBC1 Northern Ireland in the same menu: the receiver wouldn't decode this channel, which was correct – only one BBC1 region per card is possible.

At this point Sky was contacted and a replacement viewing card was sent. It's not really acceptable to go to the additional channels menu every time you want BBC1! The new card worked normally, listing all channels in the EPG correctly. **C.H.**

Drake ESR4240E & ESR4240S

These receivers are now some ten years old. Several of our customers continue to use them however. Faults experienced over the years have been few and far between, undoubtedly because of the robust construction.

Over the past few months we have had tuning problems with a couple of these receivers. The receiver tunes to the highest frequency in the Astra analogue band and won't budge from there, except very occasionally when it goes to the channel selected but produces a picture with a number of horizontal lines.

The tuner is not mounted on the PCB in these models. It sits above the PCB, secured to the chassis by means of its F socket nut and by a plastic support pillar to its body. The IF output, and the output from the prescaler to the tuning loop, are both fed to the PCB via thin coaxial cable with phono plugs at either end. In both cases the cause of the tuning problem was tarnish inside the tuner's prescaler output socket, the result being poor contact with the phono plug. After cleaning the socket – also the IF one for good measure – we had good pictures. There were no further complaints from the customers concerned.

We used to get a similar type of problem when these receivers were used as part of a motorised system. The associated, separate positioner unit is connected to the receiver's coaxial input socket, so the receiver itself doesn't power the LNB. Instead, the LNB gets its supply from the positioner (with a fixed installation the LNB is supplied by the receiver in the usual way).

The tuner in these Drake receivers is very sensitive. It can provide almost as good a picture as normal when the inner of the coaxial cable from the positioner unit doesn't make positive contact with its coaxial input socket. But when contact here is poor the very low-frequency control signals don't reach the positioner. As a result the dish will no longer move, though the picture produced by the receiver is still reasonable. This caught me out the first time I had the problem. **H.C.**

AN240 = 150
AN316 = 390
AN3301K = 350
AN5015 = 250
AN5256 = 150
AN5512 = 100
AN5515 = 160
AN5321 = 100
AN5615 = 300
AN5701 = 150
AN5900 = 130
AN6612 = 080
AN7178 = 180
AN8377 = 400
BA3812 = 080
BA5115 = 075
BA5402 = 180
BA5406 = 180
BA6222 = 100
BA6235 = 050
BA6247 = 130
BA6248 = 150
BA7258 = 300
BA7751 = 125
BA2751S = 1450
CNX62A = 080
CNX82A = 060
CNX83A = 080
CNYIT = 225
DPY2540 =
HA1137 = 150
HA1199 = 130
HA1377 = 140
HA11215 = 299
HA11847 = 700
HA11351 = 765
HA11412 = 600
HA11702 = 300
HA11720 = 650
HA11744 = 330
HA12005 = 180
HA12411 = 575
HA13002 = 200
HA13118 = 140
HA13119 = 140
HA13151 = 800
HA13155 = 900
HA17384 = 200
KA2206 = 150
KA9257 = 120
KIA6210 = 400
KIA6281 = 250
LA 1180 = 075
LA1235 = 130
LA1260 = 075
LA1369 = 200
LA3155 = 175
LA3241 = 105
LA3400 = 250
LA4108 = 125
LA4178 = 150
LA4200 = 350
LA4275 = 200
LA4280 = 250
LA4282 = 350
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LA4445 = 200
LA4446 = 170
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LA4700 = 350
LA5601 = 110
LA5700 = 300
LA6510 = 150
LA7018 = 130
LA7223 = 485
LA7323 = 325
LA7505 = 500
LA7696 = 500
LA7830 = 090
LA7832 = 130
LA7835 = 150
LA7860 = 350
LB1234 = 225
LB1412 = 300
LC7011 = 500
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LM348 = 050
LM1035N = 350
LM1111 = 180
M105BI = 300
M490BBI = 1299
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NE645N = 1225
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SAA5231 = 850
SAA5250 = 750
SAA7010 = 680
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SDA3002 = 1115
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SL490 = 220
SL1454 = 750
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STK5481 = 470
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STRD4420 = 550
STRD5441 = 400
STRD6001 = 515
STRD6108 = 450
STRD6602 = 400
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STRM6546 = 795
STRM6549 = 725
STRM6559 = 900
STRS5701 = 1700
STRS5717 = 500
STRS5741 = 600
STRS5942 = 700
STRS6307 = 450
STRS6309 = 550
STRS6525 = 1350
STRS6545 = 725
STRS6707 = 800
STRS6708 = 550
STRS6909 = 550
STRZ2152 = 1000
STV2110B = 685
STV9379 = 400
STV9379F = 415
TA7075 = 300
TA7145P = 400
TA7210P = 200
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TA7271P = 220
TA7299P = 200
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TA7401P = 250
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TA7636P = 400
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TA7691P = 165
TA7698AP = 400
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TDA8709 = 600
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TDA9610H = 1185
TDA9860 = 500
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TEA1015 = 300
TEA1035 = 200
TEA1061 = 250
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TEA2018A = 110
TEA2019 = 1550
TEA2026CV = 650
TEA2029CV = 400
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TEA2164 = 160
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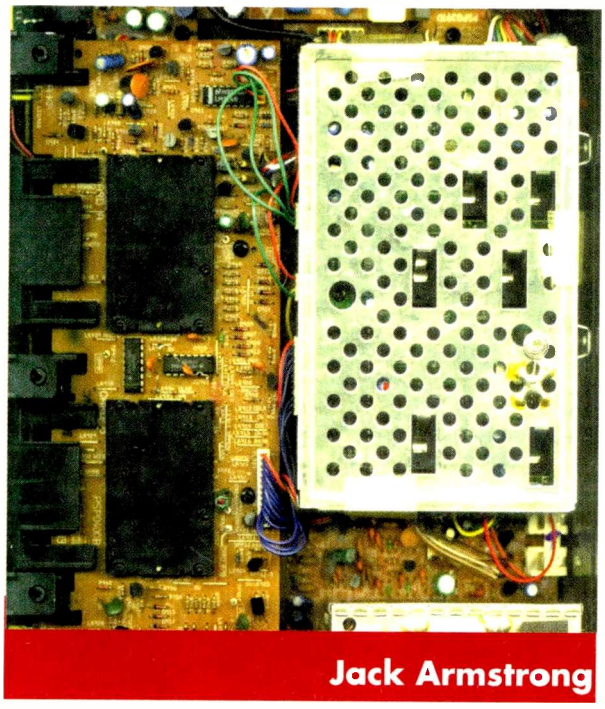
Satellite WORKSHOP



Jack Armstrong

Pace MSS100

A stooped, bearded gentleman shuffled in. He handed me a Sky smart card. "It's an invalid" he muttered, "fix it!"

Taken aback by such an abrupt approach, I retreated quickly to the workshop where I found that the card worked perfectly in another customer's receiver. So I took it back.

"That was quick. Is it fixed? How much?"

"There's nothing wrong with it sir."

"But the telly said 'your card is an invalid'!"

"I think you'd better bring in your satellite receiver."

"Huh? What's one of those?"

"The thing with the card slot."

"Ah, right, yes, bathroom scales, right."

He returned about an hour later with a Pace MSS100 receiver. On test it produced the "card invalid" message even without a card inserted.

This fault can sometimes be caused by the PTV113 card verifier IC, sometimes by the PTV115 chip. But before jumping in at the deep end I decided to try a simple test. I dropped a solder blob between the pins of the card-detection switch beneath the board. It's a simple leaf-spring arrangement inside the card slot. The on-screen message then gave the name of the programme and requested a smart card. This indicated that the switch was permanently open-circuit. Replacement of the contact assembly provided a simple cure and, since I'd taken it from a scrap PRD800, cost me nothing.

"How much?" demanded the fierce little man on his return.

"Just thirty five pounds please" I replied.

"Darn!" he muttered. "Hope it reads pounds now instead of kilograms."

"Pardon?"

"Bathroom scales. Never been right since I got 'un."

Amstrad SRD510

Despite the fact that digital comes "free" and analogue repairwork has decreased there are still people who are willing to pay for analogue receiver repairs – even when they aren't necessary!

I've had three SRD510s this week. The first was said to "ignore the remote", but I couldn't find anything wrong with it. The zero volt wire had been fitted; the 5V supply was correct at a fraction under 5V; and the capacitors from Relkit 3 had been fitted in the power supply and on the main board. As a precaution I made sure that the earth wire beneath the card-slot board was still connected – cowboys disconnect it for some reason – and cleaned the power supply connector's contacts.

The second one also seemed to be OK. So I fitted Relkit 3 and the earth wire, then adjusted the power supply's 5V output (RV600). The 13/17V LNB output needed a fraction of a turn on RV601 to bring it back within specification.

Unfortunately the receiver then produced a perfect picture but no sound – apart from a loud hiss. Fearing the worst I resoldered the TDA6160 FM demodulator IC, which is beneath the board. No better. Oh dear!

I decided to fit one from a scrap receiver. To extract the suspect chip I removed as much solder as possible then used a needle-tip iron to lift each of the IC's legs, one by one. A twist to break the glue bond released the nasty little beast. The replacement IC was removed from the scrap PCB in a different way. I inserted a knife blade under the IC and twisted it. The IC broke free with a bang, ripping tracks from the scrap board. It was easy to use the iron to remove the tracks clinging to the IC. But when I installed the chip there was still no sound!

It was some time before I realised that in scraping away the glue to desolder C86 I'd inadvertently broken the track that connects pin 15 of the microcontroller chip to the tuner via link J18. This data line also controls the TDA6160 chip, so it was not surprising that there had been no audio.

The third receiver had been brought in a while back, from a digital-upgrade customer, as "perfect". I fitted the parts as specified above and left the receiver on soak test overnight. In the morning there was neither picture nor sound and the LNB supply measured 3V. The board around TP303 (2SB1143), inside the little metal screening box, was blackened. A new 2SB1143 restored the receiver to life. I could find no cause for the failure.

Nokia SAT1700

A nicely-dressed lady brought me this Nokia receiver for repair. It had "gone off" suddenly. She'd taken it to Wossname up Church Street but he hadn't managed to find the cause of the fault. He had managed to lose two screws however!

I found that the channel number appeared in the display, the LNB voltage was present, and the on-screen graphics worked correctly.

But there was no picture or sound, except for an audible hiss, on any channel. As the microcontroller chip was working I assumed that the 5V supply was OK, and that the fault must be to do with the 12V supply.

Voltage checks showed that 12V was present at the input to the BC327 transistor TP08 but there was no output. I replaced it with an FXT749, which is rated at 1A – this was not easy, as the lead configuration is different. I now had a pulsing power supply. My Genie ESR meter confirmed that the electrolytic capacitors were all OK then, after a few minutes, I found that the cause of the trouble was TP13, another BC327 transistor. It switches the 28V supply to the decoder board.

When I removed TP13 the picture and sound came back and the receiver worked perfectly. I didn't replace it – Sky used to employ the high voltage to zap out-of-date cards but don't do this nowadays. How did I know that TP13 was faulty? Easy, I used my eyes: the board around it was darker than the rest. Sometimes you don't need expensive test equipment!

Pace MSS300

One of these receivers arrived courtesy of Parcel Farce. Despite this, it was intact and had been in transit for less than a week. The sender had packed it in a box inside another box, and had included a two-page letter that described his problem. In brief, he'd reconnected the receiver on return from his holiday and found that it simply made a ticking noise. He had enclosed Relkit 9, which he had purchased but hadn't dared fit.

I dared! It's simply a matter of being methodical and replacing each component one by one. The receiver then lit up and the picture was excellent. But there was no left or right audio from any output. I was undaunted by this: the MSP3400 audio processor chip quite often fails. I fitted a new MSP3400, then replaced the associated crystal, but there was still not even a whisper of sound. In desperation I phoned Pace, and a helpful young man suggested that the 3·3Ω resistor labelled LK140 might be faulty. I searched for it in vain, though I recall seeing it in an MSS500.

A glance at the circuit diagram showed that R619 was a 3·3Ω resistor and fed 5V to pin 18 of the MSP3400 chip. It turned out to be a surface-mounted resistor, beneath C148, and was indeed open-circuit. A replacement restored good audio.

I checked the 5V supply, as excessive voltage here can lead to failure of the 3·3Ω protection resistor. The measurement was 5·18V, which is within specification. Presumably the failure of the start-up capacitors in the power supply had caused a surge which had destroyed R619, but all was now well.

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:

jacksat@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, Sutton, Surrey SM2 5AS. Please enclose two first-class stamps.

Test Case 441

It's odd that we should have referred to VCR longevity in a recent Test Case (439), where the machine involved was a mere seven years old: the present tale concerns a twenty-year old, piano-key operated model! A Ferguson 3V16 to be precise, which is similar to the JVC HR3660E.

Cathode Ray's reaction to its appearance on the awaiting-repair rack was one of incredulity. In fact the machine had been repaired a couple of weeks earlier by Sage, who had been persuaded to take it on because, according to the customer anyway, these machines are becoming valuable as antiques. Whether or not that's true, the owner was happy to pay to have a cassette lamp and four drive belts fitted. It had now bounced, and Sage had abandoned the workshop for Marmaris in Turkey, where his thoughts were doubtless very far from video recorders.

The trouble was that Cathode Ray hadn't even started school when this machine came out, and he knew nothing about it. And no one else in the workshop that day had any experience with this type of VCR. Ray found a service manual, and settled down to study it.

The symptom was as follows. In the playback mode the machine would run for only a few seconds then the play key would shoot up and the deck would go to the stop mode. The same happened in the record mode. During the short playback period available the picture showed signs of mistracking, a minor problem that could be dealt with later thought Ray. The main cause of the trouble, he assumed, was lack of some sort of input to the system control section. So he tried the effect of the pause key, to check whether the reel-rotation sensor was responsible. But the pause key didn't stop the tape moving!

After a while Ray discovered that the reel-sensor was a Hall-effect device, with a rotating magnet driven from the take-up spool turntable. He found that it sent a good and sufficient signal to the syscon chip, which in this model is not a microcontroller. Looking at the syscon section of the circuit diagram, Ray saw that it was similar in broad principle to those in more modern machines, and that the same sorts of safety inputs are provided: reel sensor, end sensors and the drum flip-flop waveform (SW25), the latter to invoke deck shut down in the event of the drum not rotating for any reason. In fact the flipflop waveform was missing, and this was no doubt why the machine was shutting down.

There was no 25Hz squarewave at test point TP11. Ray recalled the second symptom, mistracking with a known-good tape, and concluded – rightly – that this probably stemmed from the same cause. Moving from the syscon to the servo PCB, our young man discovered that the drum PG tacho waveform at TP8 was of low amplitude, about 1V peak-to-peak instead of the 2V specified in the manual. Plainly this wasn't enough to trigger the flip-flop into operation.

Panic now started to set in. If the drum motor was faulty, would they be able to get another one? TechnoCrat, who had once worked for Radio Rentals, cured the fault easily next day. How? For the solution, turn to page 795.

Service into the New Millennium

Eugene Trundle reports from the '99 RETRA service conference, which was held at Solihull last month

RETRA's third service conference was well attended. It was introduced by RETRA president John Clough, who expressed his concern at the lack of new recruits entering the servicing profession. He cited a City & Guilds Servicing course at Stoke-on-Trent where, of an enrolment of 28, only three students chose to complete level three of the 2240 course. Consumer goods servicing is seen as being the most difficult and poorest-paid of the options available.

Another concern of Mr Clough's was the growing anomaly between the cost of carrying out repairs and the in-guarantee payments made by the manufacturers – in one case little more than £15. Talks on this between RETRA and the setmakers have begun.

The Digital Home

The first guest speaker, Jim Slater of the Digital TV Group, explained that up to now DTV teletext has been held back by poor and unreliable software. The problems are being solved, and digitext is set to bring us excellent text, pictures and interactive services in a Web-like form with key-click links rather than page numbers. E-mail will also be possible, plus a selection (a 'walled garden') of material from the internet.

Computer hard-disc based home recording systems are already available in Japan and the USA, with the capacity to store up to forty hours of TV programmes, selected automatically if required using the subject- and ident-codes transmitted with each programme.

Future possibilities include downloading music and video-telephony via the 'link', which consists of one or more transmission media and a set-top box. As nobody wants to have more than one box, it's essential that the next generation of STBs are capable of multi-system operation. Setting standards and ensuring compatibility is a primary function of the DTV Group. It has, with difficulty, been achieved in an 'open' way, i.e. a way that gives equal opportunity to all service providers and broadcasters.

A sub-group of DTV-G is looking at setting standards for true video-on-demand (VOD), which will make a vast number of movies, stored on hard discs, available on request. It's possible for the standard phone line to provide a two-way highway for interactive DTV using ADSEL: the line can carry an RF signal at a few MHz over a distance of several kilometres.

Jim Slater sees a great future for servicing in the digital home of tomorrow. Much of it will be in the realms of local networking and software manipulation.

Aerials for Today and Tomorrow

Tim Jenks, technical executive of the Confederation of Aerial Industries (CAI), provided some interesting and useful feedback on the first nine months' experience of terrestrial DTV reception. His first point was that this is "not a thirty quid job". It has become clear that measurement of signal quality, as opposed to mere strength as in the past, is important, especially when a distribution system is in use; also that the wideband UHF aerial is not as effective as was hoped in solving reception problems.

Those 'designed for digital' aerials are no con. They have been honed for DTV use, with for example redesigned directors, greater suppression of signals that arrive from the rear and better matching to the coaxial cable. Indeed good impedance matching all the way to the TV tuner is very important with DTV: we were urged to maintain the 'coaxiality', a neologism I rather like. Tim Jenks also stressed the need for interference shielding. To this end tape-and-braid cable (satellite type) is recommended.

Selection of aerial type is every bit as critical as good installation, having assumed greater importance with the proliferation of Ch. 5 and terrestrial DTV transmitters. Little more than half of UK transmitting sites radiate within one of the analogue transmitter groups..

Traditional tree-and-branch distribution networks are being replaced by star systems, with a single central distribution amplifier. This arrangement is more flexible and has fewer connectors and potential problems.

Building a Broadband Multimedia Infrastructure

Karl Gasson, assistant technical manager of Astra, reviewed the phenomenal growth of DTV in the UK, noting that it is in advance of all other European countries except for France and will reach a million by the time that Sky Digital completes its first year of operation. He sees many opportunities for dealers and service technicians – in 'special' and discrete dish installation and network building, in selling accessories such as remote control extenders and in particular in selling widescreen TV sets.

Astra has its sights set on providing paths for multimedia applications. Wideband paths permit fast, automated multicasting of, for example, computer data. There are uses for this in commerce, distance learning, point-to-point video and particularly internet access. We were shown live demonstrations of the latter, with graphics being downloaded at up to ten times the speed currently attainable via a telephone line.

From next year it will be possible to send pictures and data direct to Astra's Betsdorf uplink site, using a sending dish of about 90cm and a power of about 1W.

DTV beyond the Horizon

Gerry Stallard of the Independent Television Commission (ITC) took this as the theme of his very futuristic presentation. There's a target of 120 new transmitting sites to improve the coverage of terrestrial DTV, and work is in progress to minimise the Continental interference problems in the south and east of the UK. Speaking of the new digitext services, which should be up and running by the time that this is read, Gerry Stallard described new software, better subtitling with a new font, computer-generated on-screen sign language for the deaf and audio-description (whispering in the ear) for the blind. There will be interactivity, with a phone-line return path.

Looking farther into the future Gerry Stallard saw greater use of the MVDS system, which is cheaper than cable. More dramatic is the Teledesic network of 88 low-Earth orbit satellites that will make possible worldwide broadband intercommunications. This is planned to come into operation in 2003. There is also a plan to use 250 huge balloons, floating about 21km above major cities, to receive and send wideband signals.

Future possibilities outlined included Virtual-Reality and 3D-TV, also 'immersive TV' with 'smell-vision', thermal stimuli and a moving cradle/seat for the viewer. Wow – how much bandwidth would that need?

Servicing beyond 2000

Bringing us back to earth, in fact to the workbench, Steve Beeching described the equipment currently available for solder rework, and mentioned that sets of leads and jigs for camcorder repair cost between £200 and £3,000. Digital camcorders and set-top boxes now use six-layer PCBs and ball-grid-array ICs, for which a workstation is available – at £2,000 plus. Manufacturers are moving towards the situation where module replacement or scrapping solves any problem – at a cost. As an example Steve mentioned a replacement mechanism for a £1,000 camcorder costing £583 plus VAT net to the trade. You cannot service this deck, because service details and parts are not available. Hopefully such mechanisms will become available on an exchange basis at about £160.

Turning to field TV servicing, especially with large-screen TV sets, Steve pointed out that it's no longer practical to diagnose hardware faults and repair them on site, while transporting such sets to and from the workshop is very difficult. The solution, he suggested, is for manufacturers to make available exchange TV chassis and set-top boxes (or their motherboards) at realistic prices. This sort of thing was being said at the start of colour TV.

A possible solution to the problems that technicians and workshops currently face is to go for high-value equipment (computers and top-end white goods maybe) and invest in the necessary training and test gear.

Test Equipment

Still very much concerned with practical matters Martin Dixey of SEME, an ex-service engineer himself, discussed three pieces of test equipment designed to save time and money with fault diagnosis and with satellite dish installation. The capacitor Wizard and HR-Diemen LOPT tester are already familiar to readers of *Television* through reviews. The latter is now available in two versions, for TV set and PC monitor use. The Premier Satfinder, also reviewed recently in these pages, has now reached the Mark III version, with auto-recognition of five digital satellites (the two Astra ones, Hispasat at

30°W, Hotbird at 13°E and Thor at 1°W). Its value is the ability to read bit-error ratios. A version for digital terrestrial transmissions is in the pipeline.

The Nederman benchtop fume extraction system, designed to meet HASAW legislation, is a new service product available from SEME. It can filter/recirculate air or vent directly outdoors. The price is £400-£500, but the financial aspect of its purchase can be softened by a low-cost package available via SEME.

SEME has a wide range of CCTV surveillance equipment. There are mini cameras and split-screen and sequential-switching monitors. The company sees the supply, installation and commissioning of such equipment as one way in which technicians and service workshops can make use of their skills and expertise at a time when low-cost domestic electronic products and give-away hardware limit the opportunities for more conventional repair work.

White Goods Servicing

Brown-goods dealers are increasingly selling and renting white goods and taking on its servicing. Hence the presentation by David Sibthorp of GDA Service, Hotpoint's after-sales service arm that also embraces Creda, Cannon and Expelair products. GDA Service makes about two million calls a year to customers, from thirteen regional centres. Timed calls in AM/PM slots, and at weekends, are offered. David Sibthorp thinks that the service will have to be extended to eighteen hours a day, 364 days of the year. Also that technician registration, CORGI style, will be introduced before long.

GDA field technicians still use a paper/manual system for call logging and invoicing. A change to a portable computer system will be made when one that's better than those currently used in the field-service industry becomes available. A twenty-minute session with a laptop PC to produce a customer's bill was quoted as an example of the deficiencies of current systems. In the fullness of time a computer-based system could download an appliance's service history, provide remote fault-diagnosis and even enable a software-based upgrade to be sold to the customer.

Brown-goods service people were amazed that the cost of a service call to a Hotpoint product, once out of guarantee, is £75 (including VAT but not parts) for up to 40 minutes on site. So it was no surprise when David Sibthorp admitted that Hotpoint, in common with other white-goods manufacturers, jealously guards the after-sales service industry against 'outsiders', and that when a customer wants to take advantage of an extended warranty on parts only he has to use a GDA technician to fit the parts and pay the going rate for the house call.

Philips

Once again Philips was the only representative from the setmaker side of the industry. Roger Shaw of Philips Consumer Electronics spoke about 'the computerised technician'. He echoed Bob Green's presentation last year (CSM, Compare and Searchman), but this time was able to demonstrate the systems fully with a TV set and some specially-introduced faults. We were shown how some Philips TV sets can generate their own diagnostic test patterns, in conjunction with Compare. The Compare system costs about £300, with Searchman available separately at about £80. Free updates are available.

Last year's hopes that other manufacturers would adopt the same software and interfaces for their products have unfortunately not been fulfilled, even though the technology they use is similar.

Exhibitors

The cost of staging the conference was again covered by trade exhibitors. CHS demonstrated its computer-based ordering and communications systems CHESS and CHAOS. Euras showed the latest version of its fault database, which is now available in fax-back form for those without a PC. Konig exhibited a wide range of LOPTs, switches, video heads, idlers, motors, remote control units etc.

SEME's presentation has already been described. Servisol (Ambersil Ltd.), which was alongside, had a wide range of service aids, mostly in aerosol form, including a low-static freezer product, a flux remover and a de-icer for fridges and freezers. Willow Vale's main feature was the JBC JT6040 rework station: the WVE stand also featured new universal remote control units and the Censol range of aerosol service aids.

The Tudor Electronics stand aimed at increasing awareness of the Adapt/Electrical and Electronic Servicing project. The company is involved in training, NVQs and Modern Apprenticeships. Progress since our report last year (September 1998 issue, page 817) has been good.

In Conclusion

The conference was a good, informative event. Well worth attending. It would have been nice to have had the likes of Pace and Sony present in these troubled times, focusing on the service trade. Maybe next year . . .

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Test Report:

Global Remote Eye

It is probably not too widely known that the Sky digibox can be remotely controlled from a different room via one of its RF output sockets. The system is known as Extend Remote Control, and consists of a low-pass filter and associated circuitry that enable infra-red control commands from a standard handset in use elsewhere to be passed into the system-control section of the box. For transmission to the box via the RF cable, the remote-control commands are modulated on to a 10MHz carrier. A DC voltage at the RF output socket can operate a remote-control receiver/modulator. This and the handset can for example be used in a bedroom which has a TV set that's connected to the digibox.

Description

Global Communications is well known for its various satellite TV devices and problem solvers. The company's most useful product to date has been the ADX Plus switched frequency-changer for use with reception from the Astra 1D satellite.

The Remote Eye is a small, black eyeball, physically like a small egg cut in half, that's connected via 800mm of thin cable to a coaxial through-box smaller than a matchbox. The latter passes the selected Sky digital (or an off-air terrestrial) programme to the remote TV set. It also, powered from the digibox, passes remote control commands back down the cable. Fig. 1 shows the basic operation of the Remote Eye.

The Global Remote Eye thus does the same job as the type of remote-control extender (Powermax, Clipper, Powermaid) I reviewed in the July 1998 issue. It does so at much lower cost, but is confined to use with a digibox. The other devices just mentioned offer control over any equipment in the living room. This is a point to bear in mind when choosing or recommending equipment: some customers for example want to be able to control the VCR from afar.

On Test

I connected the Remote Eye to a 14in. TV set in my bedroom and, via an RF cable, the Sky digibox in the lounge. Once the digibox had been programmed (using the remote-control handset and set-up screen) the system worked very well, with the junction box connected to the portable TV set's aerial socket and the Eye itself on top of the set. The Eye has a friction pad beneath it.

I found that the Eye's sensitivity to the remote-control unit's infra-red signals is at least as good as that of the digibox. Terrestrial signals (both analogue and digital) passed through the system with no impairment that I could discern. The combined gain at UHF of the digibox, the modulator and any distribution amplifier(s) in use could however lead to receiver overloading and consequential cross-modulation. This could especially be so where a terrestrial digital receiver is in use and in strong-signal areas.

Because of the need to pass the DC operating voltage to the Eye and the relatively low-frequency control signals back to the digibox, it's important that the RF distribution cable has good continuity and contact, with good (ideally soldered) connections at its terminal plugs and sockets. Use of this device may remind you that UHF TV signals can take routes denied to direct current and even a 10MHz carrier! For the same reason existing distribution amplifiers are unlikely to be able to cope with this system: they can be made to work by using an inexpensive bypass kit that's available from Global.

Accessories

In addition to the bypass kit just mentioned, Global make and distribute several accessories for use with the Remote Eye. There are two-, four- and seven-way distribution amplifiers with internal DC and LF continuity: only the seven-way amplifier needs an external power supply – a 500mA mains unit is supplied with it. Diplexers are available to reduce the number of cable runs, also a compatible wallplate that incorporates a TV/FM diplexer and has DC continuity.

Up to ten Remote Eyes can be used in a system, with suitable accessories. If required, an installation can be made future-proof by fitting a Global distribution amplifier in anticipation of Sky digibox use. In this case the DC power for the amplifier(s) is provided by a mains unit and DC inserter.

The One-for-All 4

This is not a specific accessory for the Global Remote Eye but is one of the few 'universal' remote-control units that can command the Sky digibox. I was sent one by distributor SEME to try out with the Eye and found that it could be enabled for digibox control by keying in code 0847 – this is not currently listed in the user guide-book.

I also found that it could control just about every other piece of equipment I tried it on, in the workshop and in the peace of Trundle Towers, once the correct code had been keyed in. A good accessory then, but remember two things. First that the remote-control unit supplied with the digibox is also a universal type with a good repertoire of equipment control codes; also that, as we have seen, the Remote Extend feature is limited to the digibox. Thus any additional One-for-All control functions are confined to the room in which it is used. There's not usually a lot of equipment in, say, a bedroom.

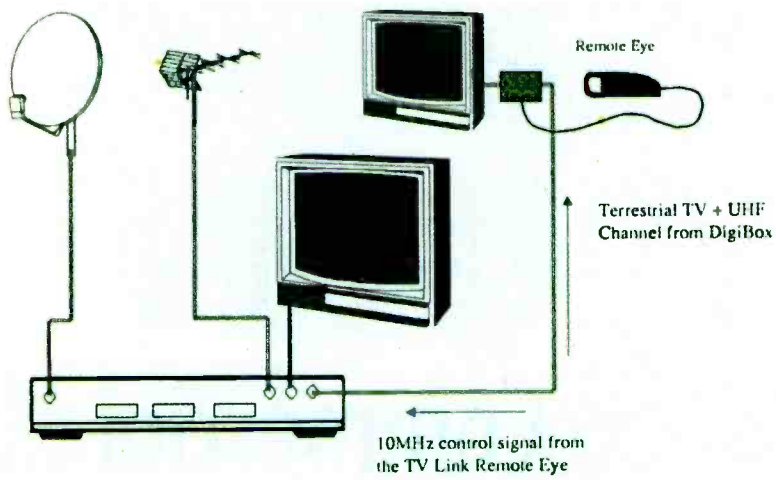


Fig. 1: Basic operation of the Remote Eye control system.

Verdict

The Remote Eye is a good, useful device with a very specific application. The price is well below that of conventional remote-control extenders, which are more versatile. Since the broadcasters are now 'giving' digital TV boxes away free, the sale of services and accessories is going to take on greater importance.

Price and Availability

The Remote Eye sells retail at about £20 plus VAT while the One-for-All 4 sells at about £23 plus VAT. Large discounts on these prices are given by SEME for trade orders – the other Global accessories mentioned above are also available from SEME. Order codes are SPAR2016 for the Remote Eye and REM2693 for the One-for-All 4. My thanks to SEME for the loan of the equipment.

SEME Ltd. is located at Hudson Road, Melton Mowbray, Leics LE13 1BS. The sales hotline is 01664 484 000, fax 01664 563 976.

Servicing

Commercial Microwave Ovens

Derek Townsend suggests a new source of income, servicing the microwave ovens used in catering establishments. They should present few problems for those used to the domestic variety

About five years ago, during a slack period in our servicing business, we were looking around for extra work we could undertake. As we all know, the summer months can often be a quiet time for TV engineers.

Getting started

We had already branched out into the microwave oven repair business. As we are in a busy tourist area, the Peak District, there are many hotels, pubs and cafes nearby that have at least one microwave oven working overtime during the holiday months. So we decided to send a mailshot to all catering establishments within a twenty mile radius of the workshop. It certainly paid off. Most of the places we wrote to had their ovens serviced by larger companies from the outlying cities that surround us. They obviously knew how to charge well! I won't discuss here the prices we ourselves charge: we all have our own ideas about fair prices, which can vary from area to area.

To the experienced TV engineer, microwave ovens are comparatively easy to service – you must of course adhere to safety requirements with respect to insulation testing and microwave leakage. When ovens are used in a public place, labels showing compliance with this should be attached to a completed repair. In our area the local domestic appliance engineers prefer not to service microwave ovens, referring customers to us.

Commercial ovens: the difference

The main difference between a commercial microwave oven and a domestic one is that the commercial version consumes and delivers about twice the power. There are two ways of doing this.

Some have a much larger magnetron and high-voltage transformer, otherwise working just like a domestic oven. There may be a separate filament transformer for the magnetron to keep it warm for instant power. The other approach is to use two magnetrons that operate at the same power as a domestic one, thus doubling the microwave energy. One magnetron delivers power to the base of the oven cavity through an opaque-glass bottom shelf (similar to the old Philips ovens) while the other one delivers power in the usual way through the cavity roof. Power is distributed evenly top and bottom by rotating antennae (I don't think you will come across one with a turntable – we haven't).

Servicing aspects

The latter system is better from our point of view, as in most cases domestic magnetrons can be used for replacements. You will find different types where a single, very powerful magnetron is used. They can be very expensive, and are thus not normally stocked until required. AWI on the Isle of Wight stock most magnetrons and can deliver by return if you require one in a hurry.

The mains transformers are so large and substantial that it's very rare to come across a faulty one.

Apart from this, the majority of faults are similar to those encountered with domestic ovens. Always check the door switches, as they get a lot of 'hammer' in a

hotel kitchen. Also make a point of ensuring that the antenna cover in the roof of the oven is intact. Kitchen staff forget to clean this area, as they don't seem to know what it's made of! We know that it is either fibreglass or mica, like the stuff from which domestic oven waveguide covers are made. We sometimes find that an oven has been working for months without the cover – it may have deteriorated to the extent that it just disintegrated. Without this cover the antenna becomes dirty, is unable to rotate and finally overloads the top magnetron. Always clean out the air ducts from the cooling fans, as these can also result in a poor magnetron overheating.

One of the main problems we had when first repairing commercial ovens was obtaining spares that are special to the oven concerned, for example Merrychef types that have doors which slide upwards when the food has been cooked. These work with two clock-type springs at either side of the door: the springs sometimes break. Don't stand in the way of those doors – we know of someone who did and got a nasty uppercut to the jaw!

A lot of these earlier ovens are becoming difficult to repair, as some spares are no longer available. But the owners of these monster machines expect you to work miracles keeping them going, as replacements can cost as much as £1,000 plus! With some earlier Sharp ovens the handles break after a lifetime of use: they are no longer available.

There are however many good ovens for which spares are available. If you have problems obtaining spares for any make, e-mail me on

dtowns5566@aol.com

and I will endeavour to help you if I can.

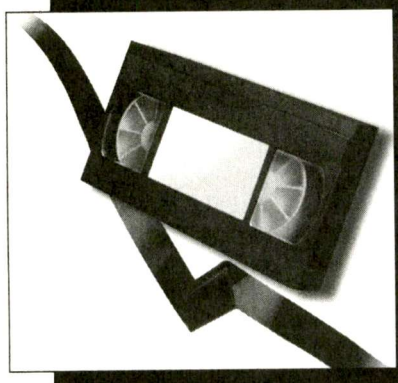
Don't be confused by some bottom-of-the-range commercial ovens that have a suggestion of say 1kW in the model number but deliver about 800W when you test them. Check the specification of the magnetron you've fitted. This should tell you the expected maximum power output.

Building the business

A year or so after the original mailshot I tried another one, which this time included nursing and residential homes. It brought in more new customers. Remember too that many pubs and hotels change management or ownership quite frequently. So don't underestimate the power of the occasional mailshot. It's cheaper and more effective than expensive advertising.

Final warning

As a final warning, beware all you fellow back sufferers. These ovens can be heavy to lug around! So try to do as much work as you can on site. Most commercial kitchens have plenty of room in which to work – but don't visit them at busy times, i.e. during the lunch period!



VCR Clinic

Reports from
Philip Blundell, AMIIEelec
Eugene Trundle
Giles Pilbrow
Paul Hardy
Kevin J. Green, TMIIE
Bob Longhurst
Michael Maurice
Terry Lamoon
M. Della Verita and
Martyn Davis, MIIEelec

JVC HRJ220

There was no E-E or playback picture or sound, though the mechanical functions and the display worked normally. Checks in the power supply showed that there were no AL12V or SWD5V outputs. The cause was Q859 (2SD1302S) which had an open-circuit base-emitter junction. I didn't have the JVC circuit diagram, but the **Philips VR6557** circuit diagram seemed to be very similar. **P.B.**

Grundig GV540GB

The complaint with this machine was lack of contrast. There was weak video at RF or via the scart connector, in either the E-E or playback modes, and the on-screen menu display was weak. I used a scope to trace back through the circuit. At connector 1545 I found that a normal signal was entering the OSD module at pin 5 but the output at pin 7 was low. Checks on the module showed that transistor 7905 (BC858B) was open-circuit base-to-emitter.

This particular machine had the OOSGD6-OSD type subpanel fitted on the motherboard. **P.B.**

Sony SLVE720UX

There was intermittent loss of the E-E sound and picture – not necessarily at the same time! Whenever the sound went then came back the 'stereo' caption appeared on the screen. The cause of the fault was in the IF module, where the earth lands around the edges of the PCB were dry-jointed to the screening can. **E.T.**

Sony SLVE280 and others

This machine operated correctly in all modes except for record. In this mode it would loose display (for a second), unlace then go to standby. The cause of the problem was circuit protector PR512 in the power supply: it had gone high-resistance. PR512 can also be responsible for an increased level of audio buzz on playback, because motor noise gets on to the audio supply. You get the same problem with the **SLVE220**, **SLVE520** and several **Sanyo** machines. **G.P.**

Hitachi VT450

There were slight hum bars on the picture – E-E, playback and record. Checks showed that the regulator pack was producing just over 13V instead of 12V, with slight ripple. A new STK5372H chip cured the fault. **P.H.**

JVC HRD660EK

The mechanism was jammed. When it had been cleared I found that one of the slit washers that hold the rack slider had fallen off. As a result it had lost engagement. The guide arm, load gear and master cam were replaced as they showed signs of damage. As a precaution the mode switch was also replaced. **P.H.**

Panasonic AG5700B

This is an S-VHS broadcast-type VCR. There is no tuner but the deck is the G type used in domestic models. As a result these machines suffer from the same mechanical problems with which most of us are familiar. There are a few minor mechanical part differences, for example the release lever unit, so you need the manual to ensure that you order the correct part. I've encountered very few electronic faults. The following is a run down of those found to date:

(1) The power supply connector P1001 is frequently dry-jointed and should always be checked. As these machines age, the capacitor problems experienced with domestic models may appear.

(2) The cause of no audio can be Q2 in the power supply. It provides the non-switched 12V supply.

(3) Poor colour and resolution with a humming noise that comes from the drum should lead to a check on the lower drum's PCB. You will probably find signs of overheating. A complete new upper and lower drum assembly will be required. **P.H.**

Akai VSF480

The playback picture was very unstable, as if the tape path was misadjusted. But the FM waveform was OK. Checks in the video processing section brought the cause of the trouble to light: the charge-coupled delay line IC401 was feeling unwell! **K.J.G.**

Samsung SV1401

This machine would load a tape and would go into the playback mode, but the tape didn't lace around the drum. I removed the mechanism and used an external supply to power the motor to see what was going wrong. As the motor moved, the main plastic slide-plate became cockeyed – because its retaining cut washer had sprung off. I found this item stuck to the base PCB and was able

to refit it. A blob of Evostick was added for good measure.

Retiming the slide-plate is fortunately a straightforward job with no need to refer to the service manual. I could find no reason for this fault: the washer was a good, strong fit. **B.L.**

VCR Quickies

Ferguson FV33: If the machine is totally dead, replace C14 in the power supply.
Toshiba V711B: A sluggish loading motor can jam the mechanism. Replace the loading motor block.
Mitsubishi HS520V: If the problem is erratic tape acceptance or not fully ejecting the tape, replace the mode select switch. **B.L.**

Hitachi VTF150E

The playback sound was wowy and when a tape was loaded or ejected the E-E picture flickered and the Nicam stereo LED flashed. Scope checks in the power supply showed that there was ripple on the V-Capst output, with voltage variations when different modes were selected. The smoothing capacitors for this supply are C12 and C13. Checks on these capacitors confirmed that C13 (470µF) was the culprit. **B.L.**

JVC HRS7000

As this machine wouldn't accept remote control commands the customer unplugged it. After that it remained dead. Some quick checks on the primary side of the power supply revealed that C2 (2·2µF, 63V) was open-circuit. A replacement restored normal operation – and the remote control unit worked. **M.M.**

Matsui VXA1100A

Initially there had been an intermittent loading fault which was cured by replacing the mode switch. This time the customer complained that a tape was stuck in the machine. Inspection showed that the back-tension lever didn't move out of the way of the entry guide. As a result, the guide jammed on the back-tension arm. The cause was the plastic plate assembly under the deck: it had cracked, and the metal peg that sits in the groove of the cam had come out. Unfortunately the customer decided to buy a new machine. **M.M.**

Sony SLVE225

The customer complained about a high-pitched squeal from this machine. It came from the drum assembly. The most likely cause was the static discharge brush, which is beneath the drum. Fortunately the construction of this centre-deck machine is such that you can remove the drum without taking the deck out of the cabinet. Slight adjustment of the brush and a dab of grease silenced the squealing. **M.M.**

Panasonic NVSD100

This machine had died following a storm. A new mains fuse and STRS6545 regulator chip restored it to life. **M.M.**

Ferguson FV71LV

The take-up spool intermittently failed to rotate during play. The machine would then shut down. There were other intermittent mechanical faults, such as tape ejection when a function was selected, but failure of the take-up spool to rotate was the most frequent one.

I selected play, switched off the power, removed the carriage and tape, and separated the deck from the main PCB. This revealed that the cam had been driven past the play position and was near the reverse search position, in which the idler cannot go to the tape drive. Mode sensing in this deck is carried out by two optocouplers that detect the signal from slots in the master cam. Replacement of the optocouplers cured the problem. If you look at the cam carefully you can see markings for stop, play and reverse. **M.M.**

Toshiba V804

This machine came in because it wouldn't load. The mechanism worked perfectly in all the other modes, but didn't load or unload. I found that cam lever K470, which operates the main cam, had broken. This seems to be an increasingly common fault. The machine worked perfectly once the cam lever and pinch roller had been replaced. **T.L.**

JVC HRD610

This machine was lifeless. A few checks on the primary side of the power supply showed that the voltages were rising and falling. I noticed a capacitor that looked quite stressed and replaced it. Hey presto, the machine then fired up and worked perfectly. The culprit was C12 (2·2µF, 50V). **T.L.**

Toshiba V703

If you get one of these machines with a dim display, check C810 (15µF, 10V) and C813 (47µF, 16V) in the power supply. Replac-ing them will usually produce a normal, readable display. **T.L.**

Akai VSG815

The customer complained that the machine intermittently chewed tapes, but only when it was in the timer record mode. This symptom can be a sign of a dodgy mode switch, so I fitted a replacement. After that all was well. **T.L.**

Alba VCP3000

We have on occasion had complaints about tape chewing with these machines. The solution is to clean the mode switch (or replace it if necessary), replace the idler spring, and straighten the idler – this can be done using a hairdryer. **M.DV.**

Panasonic NVL26B

This machine came in because it was dead, which often means a power supply rebuild. I was about to order the two chips when I decided to take a look first. All that was required was to replace C9 (1µF, 400V). **M.DV.**

Sanyo VHR277

This machine performed all functions correctly but would intermittently shut down while recording, the display showing blanks. A quick call to Sanyo's excellent technical department soon sorted this one out. The value of circuit protector PR512 (0·1Ω) in the power supply can go high, affecting the 5V output. As a result the deck micro is upset. **M.D.**

Ferguson FV100

There was a whirr on sound and noise bars were present on the picture. Something was obviously causing tape drag. The entry and exit tape guides were carefully examined and the back-tension was checked, but everything here seemed to be OK. I eventually discovered that the loading motor's plastic housing was catching on the top of the pinch roller. But it was difficult to see why: everything seemed to be in its correct place.

After spending far too long staring at the assembly I realised that I was looking at a fault I'd never seen before: the pinch roller itself had come apart! The outer rubber sheath had become detached from its inner metal shaft and had slid upwards, catching on the loading motor's housing. A new pinch roller cured the fault. **M.D.**

SERVICING

the Aiwa HVFX1500 VCR

John Coombes provides fault-finding know-how on this machine. The notes on deck faults are applicable to a number of models in different ranges

This VCR uses the same deck as a number of other VCRs. The list includes the following models:

Aiwa: HVFX150 and HVFX1500.

Alba: VCR6800 and VCR6900.

Amstrad: VS1000 and VS1140.

Bush: VCR161 and VCR162.

Matsui: VP9401, VP9501, VX2700 and VX6000A.

Orion: D4500 and D5000.

Saisho: VR3400.

Tatung: DVR634UN.

The following notes on the deck apply to all these models. The electronics may differ however.

Deck Faults

If the machine won't accept a cassette and the worm gear on the front loading doesn't activate, check the front loading gears. There may be broken or worn teeth on the cogs. The next thing to check is the pack springs on the cassette loading unit – for damage or being bent. Next check the voltage across pins 1 and 2 of connector CX5002. If 12V is present, suspect the loading motor. Another possibility is a faulty front loading switch. Ensure that the loading motor hasn't seized, and check the loading belts which could be stretched or cracked.

If rewind and fast forward operate correctly but playback is at twice the normal speed, the capstan motor is suspect. The capstan motor can also run slow, with wow and flutter as symptoms. Check it by replacement.

When the deck stops in playback, check for reel-sensor pulses at pin 11 of connector CX1003. If they are missing, first check that 5V is present at pin 10 of CX1003. Then if necessary replace the reel sensor.

If the capstan doesn't rotate at all, check the DC conditions at CX1003 and/or IC1001. IC1002 is suspect if the voltages are OK: check it by replacement. Alternatively the capstan motor may have failed.

If the capstan flywheel spindle rubs on the motor bearing there will be jitter on the playback picture. Should this occur, strip the flywheel spindle from the unit then clean and re-lubricate it. Reassemble and soak test the machine. If the fault is still present, replace the capstan motor.

If there is intermittent tape chewing, ensure that the capstan motor is free running and that the tape isn't creasing. Check the pinch roller which could be worn or have a highly-polished surface. A faulty pinch roller will cause tape slipping or creasing at the top or bottom. If necessary, check the back-tension band assembly which could be broken or incorrectly aligned. Alternatively the idler unit could be operating incorrectly. Ensure that no teeth are missing. This fault will cause lack of drive and thus tape spillage. Alternatively the limit-post arm assembly could be damaged, causing lack of tape movement and damage.

If the tape is being chewed and the reel drive doesn't rotate, check the capstan pulley which could be cracked and the reel belt which could be broken or badly stretched – check it by replacement. Tape chewing will also occur when the pinch roller arm spring is slack, since the pinch roller won't load properly and lock against the flywheel spindle.

If the tape is chewed when first inserted, with the VCR only partly loading and the sound of the loading motor racing at high speed, check the joint pulley (item 431) and/or worm assembly, which could be cracked or broken. If loading is not completed and the mechanism becomes very tight, check cam 1 and/or cam 2 for stripped or worn teeth. Also check the mode switch.

The mode switch can be the cause of many different

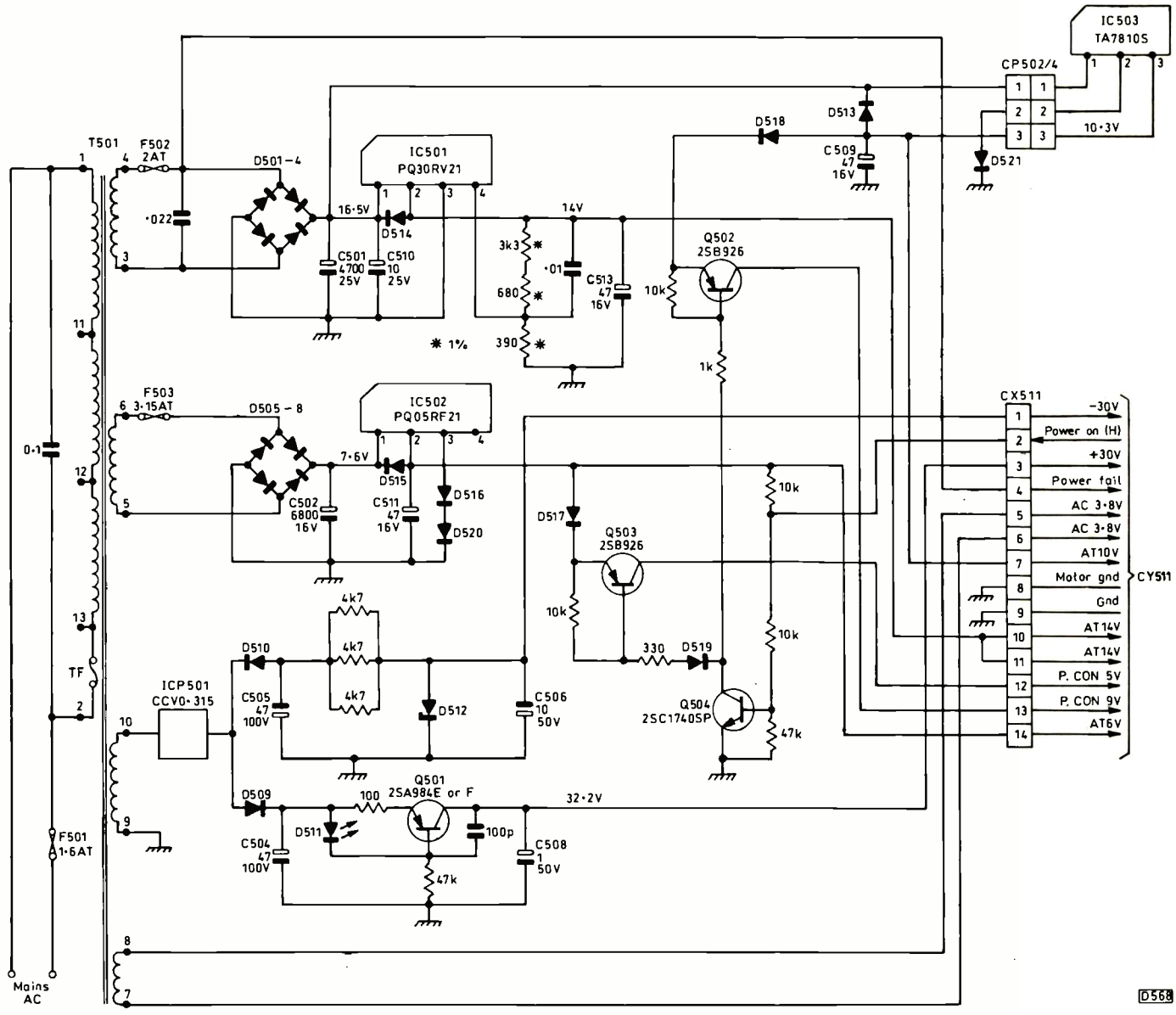


Fig. 1: The linear power supply circuit used in the Aiwa Model HVFX1500. See table below right for diode types.

faults, including no loading/unloading, no rewind or no fast forward. It can be dismantled, cleaned and re-sealed with a spot of silicone grease to ease movement.

If tape spills out when the machine is in reverse search, check the sub-brake lever by replacement. Alternatively the capstan motor bearing may be in need of re-lubrication or the mode switch may be faulty.

If the VCR stops intermittently in any mode the mode switch or sub-brake lever could be faulty.

For bent verticals or the picture breaking up, check the tension band and ensure that the extension arm isn't bent – this would affect the back tension. After replacement of the tension band and tension arm, set the torque in the standard play mode at 40-60g/cm.

No Fast Forward/Rewind

If there's a loud rattling noise and slow rewind or fast forward when a tape is inserted and REW/FF is pressed, check that the front loading mechanism is working correctly, dropping the tape low enough on the take-up and supply spools. If not, check that the cassette housing is correctly aligned and that there are no broken cogs or partially-stripped teeth. The idler assembly could be cracked or have damaged teeth; the reel belt could be stretched, cracked or damaged; and the mode switch could be faulty. You can clean the mode switch as a temporary check: if this confirms the cause of the fault, replace the mode switch.

Playback Picture Jitter

If the playback picture is jittery or shaking, check the FG pulses at pin 15 of CX4004. Their amplitude should be greater than 30mV peak-to-peak. If not, the drum motor could be faulty. If the pulses at this point are OK, check the pulses at pin 61 of the OEC8057C chip IC1001. If they are present but the chip isn't working correctly, replace it.

Playback Picture Noisy

When this is the fault symptom, check the FM waveform at TP4003. If the waveform is not of good shape, suspect the upper drum. A mis-shaped FM waveform with the picture jittering or jumping could mean that the lower drum is badly worn. Sometimes the effect of

Diode types

D501-4	DSA12TB
D505-8	DSA26C
D509	11E2
D510	11E2
D511	LTZ-MR15
D512	GZB30B
D513-5	1SS132
D516-7	SB10-03A3
D518	11E1
D519	1SS132
D520	1S2472
D521	SB10-03A3

lower drum wear may be very noticeable in the visual search modes, with the picture going into lines.

If only one head works, giving a partly visible picture, the other one producing a snowy or grainy picture, try cleaning the heads. If this doesn't work the upper drum will have to be replaced.

After replacing the drum assembly, ensure that the back tension is set correctly. Excessive tension will case premature upper and lower drum wear.

The machine will often provide normal playback but, in the Hi-Fi mode, the sound is very noisy – like helicopter rotors going round. A replacement upper drum should cure this, but if the lower drum is badly worn the whole assembly will have to be replaced.

Power Supply Faults

Fig. 1 shows the power supply circuit used in Model HVFX1500. It's a straightforward linear arrangement.

If the machine is dead with no display, check fuses F502 (2AT) and F503 (3·15AT). If F502 has blown, check diodes D501-4 (4 x DSA12TB) for shorts. If F503 has blown check D505-8 (4 x DSA26C) for shorts.

If F502-3 are OK, check for –30V at pin 1 of connector CX511. Absence of this voltage probably means that zener diode D512 is short-circuit. Alternatively circuit protector ICP501 could be open-circuit. Check for 3·8V AC between pins 5 and 6 of CX511: if this voltage is missing, check for dry-joints at T501.

If these supplies are present, check for 6V at pin 14 of CX511. Trace back to pin 2 of the PQ05RF21 6V regulator IC502 if this voltage is low or missing. There should be 7·6V at the input to IC502 (pin 1). Check C502 (6,800µF) which could be short-circuit if this voltage is missing or open-circuit if the voltage is low.

If the display is lit but the machine doesn't turn on, check that pin 7 of IC1001 (OEC8057C) is in the low state. If not replace IC1001. Care is required when doing this: use a hot-air soldering unit and make sure that the heat setting is not too high, otherwise associated components may be damaged.

If IC1001 is OK, check the voltages at IC501 (PQ30RV21). Check IC501 and the associated components as necessary.

If there is no playback or E-E video but mechanical operation is OK, suspect IC502 (PQ05RF21). Check for dry-joints here and if necessary replace IC502.

No E-E Signals

Check that the following voltages are present at the terminals of the tuner/RF unit TU6001: B+ (9V), BB (5V), TU (30V) and MB (5V). There could be dry-joints here. If any voltages are missing, check back to the source in the power supply. If there is no video signal (IF) at pin 18, replace the tuner unit. If necessary go on to check whether IC6303 (µPC574J-T) is short-circuit and the DC conditions around IC6302 (LA6358ST). If IC6303 is short-circuit R6314 (10Ω) will probably be open-circuit.

If the 9V supply (B+) is missing at pin 13 of TU6001 check back to IC503 (TA7810S) in the power supply. There should be 16V at its input. Check whether bridge rectifier diodes D501-4 (4 x DSA12TB) are open-circuit if this voltage is missing. There should be 10V at pin 3 of IC503. If not, check for dry-joints then if necessary replace IC503.

Whistle from the RF Modulator

There have been complaints of a whistle from the RF modulator. To overcome this Aiwa has issued a modification: add a 470pF capacitor between pin 5 of the tuner and chassis.

No Playback Audio

If the E-E audio is OK, check whether there's 9V at pins 53-55 of the LA7252M hi-fi audio processor chip IC5500. Check back to source or the peripheral circuitry if this voltage is missing. The next check should be for audio at pins 62 and 64 of IC5500. If there's no audio here, check the chip by replacement. If audio is present, check the voltage at pin 23 of the LA7286 audio amplifier chip IC5001. If this isn't low, check the DC conditions around the OEC8057C chip IC1001. Replace it if they are incorrect. If the voltage at pin 23 of IC5001 is low, check for audio at pin 8. Should the audio signal be missing or incorrect, check that the playback audio level control VR5001 is correctly set. If there is an audio signal at pin 8 of IC5001, check whether the audio/control head is dirty. If, after cleaning, there is still a problem and the connections to the audio head are correctly seated, replace IC5001.

No Record Audio

First check whether there's a bias signal at the oscillator transformer T5001. If not, check the voltage at pin 19 of IC5001 (LA7286). There should be 9V here. This voltage comes from Q502 (2SB926) in the power supply. If the 9V supply is missing, Q502 could be dry-jointed or open-circuit. Check the DC conditions around IC5001, and that 9V is present at the collector of the bias oscillator transistor Q5001 (2SC1317). If this voltage is OK, T5001 could have shorted turns. Check it by replacement. If the bias signal is present, check for an audio input at pin 10 of IC5001. There should be audio outputs at pins 13 and 15. If not, replace IC5001. Check the connections to the audio/control head if necessary.

No Playback

If there's no playback, check the FM envelope at test point TP4003. If it's missing, check for dry-joints on the head amplifier PCB and/or the DC conditions around the LA7416 chip IC4101. Replace it if they are incorrect.

The cause of the fault could be at IC4001 (LA7439). Check for 5V at pins 14 and 39. Check back to the power supply if this voltage is missing. Otherwise replace IC4001.

Should everything be OK up to this point, check the DC conditions around the LC89970 delay line chip IC4002. If there's an error here replace the chip.

Corrections

Satellite TV: The Fidelity equivalent of the Amstrad Model SRD700 is Model SR950+, not SR920+ (August issue, page 681)

Indiana 100 chassis: The Alba Models CTV704T and CTV744 were included in error in the list of models fitted with this chassis (May issue, page 494).

Tesco Tellys: A connection blob is missing in Fig. 1. Q1's source, and the other components connected to this point, should also be connected to the line that links pin 4 of IC1, pin 5 of TR1 and the 'earthy' side of the mains bridge rectifier D1-4 (August issue, page 675).

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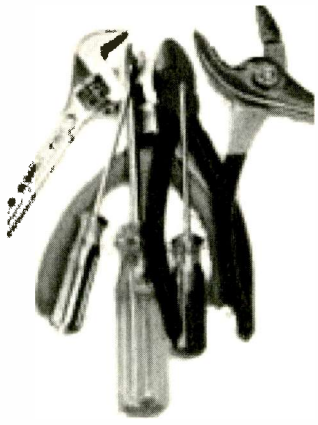

John Edwards' Casebook

GoldStar CIT9902F (PC04A chassis)

The top quarter of the raster was severely distorted, the lower three quarters being normal. This chassis has a fairly standard field timebase circuit based on a TDA1170N chip. Many checks were carried out in this area before I discovered the cause of the problem: the flyback boost diode D301 had slight reverse leakage. Its case was dull, the type number couldn't be discerned and I didn't have a manual. So a 1N4001 was tried. During a three-day soak test the set worked perfectly.

Two Alba CTV713s

The first of these sets produced normal sound but there was no EHT. As the 16V feed for the audio output chip and the 12V feed for the signals circuits are derived from the power supply, the cause of the problem was loss of line drive. I replaced the short-circuit 2SC1555 line output transistor Q210, using a BU508DF, but there was still no line output stage operation.

The TDA4505E IF/timebase generator chip normally supplies a healthy 2V peak-to-peak line drive square-wave at pin 26 and a 3·5V peak-to-peak field drive at pin 3. There was nothing at either pin, though the normal 12V was present at pin 7 – this made sense, as the power supply was working. Scope checks at the IC's pins showed that the video and audio waveforms were all OK, but the line oscillator signal at pin 24 was of very low amplitude. How did I know all this? Well, there are my *TV IC Data File* books! I then tried heating and freezing the components around the IC, but this made no difference.

A few minutes later a nice new TDA4505E chip had been fitted. And less than a minute after that I found I needn't have bothered: there was still no line drive. Then, purely by chance (so often the case!), I noticed a bare link wire mounted high off the board alongside the vertically-mounted preset line hold control. In fact it was because the link was so close that my attention was drawn to it. Close examination with the main board fully retracted from the set showed that the link was touching the legs of the preset. I turned the board over to look at the print and was relieved to discover that the link should have no electrical connection with the preset. Just a slight movement of the wire link away from the preset was all that was required to restore oscillator operation and line drive.

When the set's owner came to collect it he told me that his brother had a problem with his CTV713 – the two sets had been bought at the same time. I asked about the nature of the problem.

"Well, John, it may be too much even for you. Personally I reckon it's the tube."

I suggested that his brother brought it along next time he was passing. His brother arrived about half an hour later and placed the set on the bench.

"Probably wasting your time" he said, "I reckon it's the tube or a duff picture valve."

I couldn't bring myself to comment on this, so I concentrated on plugging the set in and switching it on. A good picture came up, but with text lines across the top. "Looks like cap problems" I pronounced.

"What's that, some sort of valve?"

I gave him a guesstimate and he cheerfully departed. C267 (4·7µF, 160V), which is mounted close to the heatsink for Q212 in the field output stage, looked tired and proved to be leaky when tested. I fitted a replacement and glanced at the line hold preset before switching on. I needn't have worried: all was well.

Philips VR6561/05R

I'm not fond of the Philips Charlie deck. Some engineers sing its praises, but I've never understood the reasoning behind its design. When it was introduced, much simpler and more service-friendly VHS decks were being made by every other manufacturer, including the newly fashionable centre-deck types, and are still in use. I hate renewing the video head, with those silly spacers to get the gap correct. To me, a deck strip down is a nightmare. We all have our likes and dislikes, but this deck always makes a Charlie out of me!

I was reflecting on this while the customer told me that his machine wouldn't rewind, fast forward or play, and that the tape looped on eject. I suspected the worst.

I removed the top and inserted a dummy cassette. The spool carriers remained stationary while the drum and capstan did their things. After a short while the deck shut down, as it should. Eject was normal, except that the supply spool didn't rotate. Hence the tape looping. Frightening thoughts about weird mechanical problems between the two-layer deck design filled my head. I quoted £70-£80 to be sure the customer would grab the machine and run, but to my surprise he told me to go ahead.

The next day, after psyching myself up to do the job, I removed the front panel and the three screws underneath the machine, then raised the deck to its service position. I was in luck: the capstan-to-reel pulley belt had snapped. That was it – no nightmare this time.

The following day I gave the customer the good news. I told him exactly what the problem had been, and that

the charge would be £20, not £70-80. To my amazement he turned quite nasty, accusing me of fitting second-hand bits to get the price down! Said he wanted a proper job done, not a bodge.

I give up! After some thirty years in this trade, I thought I'd seen it all. Maybe next time I'll stick to my original estimate. Just to keep the customer happy of course!

Panasonic TX28W1 (Alpha 2W chassis)

The only sign of life was a screaming power supply. So I disconnected the thermal resistor (R567) in the feed to the line output stage and connected a 60W bulb across the HT reservoir capacitor C854. The HT then measured 158V and all was quiet. I was about to accuse the line output transformer when the HT suddenly rose to 175V, the bulb took on a new brilliance and the power supply screamed viciously at me. So it was a power supply fault after all.

Cold checks in the power supply revealed that C808 (10µF, 50V) was slightly leaky. I also discovered that R567 was in fact open-circuit. Apart from a few crusty looking joints in the power supply nothing else seemed to be amiss. So I replaced the two faulty components and blanket soldered the power supply. For good measure I also resoldered the line driver transformer, as this is a known cause of problems with these sets.

When I switched on after removing the bulb and reconnecting the the feed to the line output stage the HT was stable at 158V and the set produced a good picture. After an eight-hour soak test I declared it fit for normal service.

Mitsubishi HSM54

This machine accepted cassettes and worked OK in the fast forward and reverse modes. But when play was selected the tape returned to the stop position and was then ejected. The machine would either shut down or sit there innocently, waiting for the tape back.

Close inspection of the pinch-roller mechanism during the brief period between selecting play and the tape being unlaced showed that the roller was lowered into position, then rotated towards the capstan shaft. After trying the machine a few times, and with my nose almost resting on it, I noticed that the roller didn't turn when it engaged with the rotating capstan shaft. The tape was then ejected.

I switched off, removed the pinch-roller circlip and top cover, then attempted to remove the roller assembly. It normally slides off without effort. This one was almost seized however. A few drops of WD40 and rigorous to-and-fro movements eventually loosened the roller from its shaft. After a good clean with a cotton bud moistened with methylated spirit, followed by application of a tiny drop of light oil to the shaft, the pinch roller worked like new.

Replacement of the pinch-roller assembly is a common job with these machines. The plastic arm that's attached to the roller and follows the rotating pinch-cam groove breaks away as a result of fatigue, jamming further movement of the roller assembly. I'm surprised that the roller section remained intact, considering how tight it was on its shaft.

Hitachi CPT1646R

There was a channel indication but no sound or raster because fuse FS901 was open-circuit. That's all. A few more like this one, please!

TV-VCR COMBIS

Reports from Michael Dranfield and Gerry Mumford

Sharp VT3700H

There was no tuning, no sound and a cassette couldn't be inserted. Some voltage checks soon revealed that the output from the 12V regulator IC751 was low. This wasn't the end of the story however. The 33V tuning voltage stabiliser IC1005 was short-circuit while its feed resistor R760 (220Ω, safety) was open-circuit. In addition the overvoltage protection zener diode D757 (15V) was short-circuit.

Once these items had been replaced the unit worked well. But the print around the rather expensive STRM6523 chopper chip was badly discoloured. I came to the conclusion that it had probably been the cause of the problem and replaced it as well. **M.Dr.**

Sony KV21V6U

If the unit's recordings play back as snow with a hissing sound, check for dry-joints at tuner unit TU101. This tuner is used for recording only, so the TV section isn't affected. The tuner has an aerial filter/isolator block fixed to it and they don't seem to be plugged together properly. So they are too high above the PCB when soldered in. The result is very poor soldered joints. It's best to remove the tuner and filter completely and push them together as far as possible before soldering them back to the PCB. **G.M.**

Aiwa VXT1410

If one of these combi units seems to be stuck in standby, check for dry-joints at the pins of the power/standby key switch on the front PCB before you delve into the power supply and system control circuitry. This seems to be a very common problem. **G.M.**

Philips 21PV688

This unit wouldn't accept a tape. As usual with this type of fault the deck was mistimed and the cure was to retime it. While testing however another fault became apparent. The picture would disappear after about five minutes, and in addition there was no teletext. Freezing the SAA5281 text processor 7900 brought the picture back but had no effect on the teletext. It looked as if a replacement would be necessary, but at this point I noticed a much simpler solution – there was a dry-joint at the nearby 27MHz crystal 1880. **G.M.**

Sony KV21V6U

There was no picture, though on-screen messages were displayed. The unit appeared to tune, and the deck operated correctly – but with a totally blank screen! All video sources converge at the CXA1855Q video switching chip IC401, which is bus controlled. It's a surface-mounted, flat-pack device. As the inputs were all present under the correct conditions and the chip's supply was OK, a replacement was fitted. Fortunately this cured the fault. **G.M.**

Sony KV21V6U

This unit displayed a strange error message, asking to be reset, whenever access was gained to the clock-set or preset-set on-screen menus. A fair amount of time was spent on going through the menus and searching the service-mode for any options or set-ups that could account for the problem. As I was not getting anywhere I decided to replace the ST24C16FM6TR EEPROM chip IC002. The unit then worked perfectly – once a full set-up had been completed to load all the data into the new chip. **G.M.**

Philips 21PV688

If one of these units is stuck in standby, check the fusible resistor 3514 (4·7Ω, 3W). It goes open-circuit when the TDA8356 field output chip 7510 fails. **G.M.**

Philips 20PV164/05

There was no sound in any mode unless the volume was turned to almost maximum, which resulted in a very distorted output. Otherwise the unit worked perfectly. As there was an audio input to the TDA7056B audio power amplifier chip IC7240 and all the surrounding voltages appeared to be normal, the chip was replaced. This cured the fault for a short time, but a week later the unit bounced.

I replaced the IC again, also the BC848B muting transistor 7250 and the BZX79C18 protection zener diode 6242. The unit worked for a few minutes then the fault recurred. After examining the audio section very thoroughly I finally saw what was happening. There are a number of bare wire links under the tuner. These are connected to the audio IC, and some were bulged upwards and intermittently touched the earthed underside of the tuner can. This destroyed the IC. Flattening the links with a slim-bladed screwdriver and replacing the IC for the third time finally cured the fault. **G.M.**

Philips 14TVCR240/05

There was no picture or sound. The only sign of life was the front LED which was lit. When a cassette was inserted the deck operated, but that was all. The power supplies were found to be OK, but the line output stage was inactive because there was no line drive. Checks in the line driver stage showed that there was the correct squarewave at the base of the transistor but only a low-amplitude sinewave at its collector. The associated UG06B clamp diode was leaky. **G.M.**

Sony BC4 Chassis: See also fault reports on page 778. This chassis is used in the Sony KV21V6U and other models.

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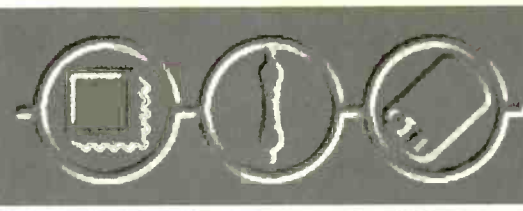

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SS9200 , SS9210 , SS9220	SATP-
SU2	
MSS100 , PRIMA	SATPSU8
APOLLO , MSS200 , MS290 , MSS300	SATPSU9
PANASONIC	
TU-SD200	SATPSU1
TU-SD250	SATPSU9

MAKE & MODEL	CODE
PHILIPS	
STU802/05M , STU804 , STU811 , STU824	SATPSU1
STU801	SATPSU2
STU3301	SATPSU20
STU909	SATPSU22
STU350	SATPSU9
SONY	
SAT301	SATPSU10
THOMSON	
SRD11 , SRD 14	SATPSU1
SRD7/8 , SRS3 , SRS4	SATPSU2
THORN	
SAT99 , SAT120	SATPSU1
TOSHIBA	
SAT99 , TU-SD200	SATPSU1
TS540	SATPSU10

CODE	PRICE	CODE	PRICE	CODE	PRICE	CODE	PRICE	CODE	PRICE
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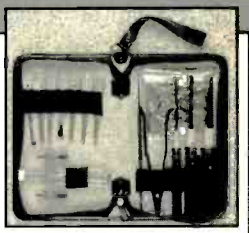

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1 x 2M - 6 pin DIN Plug to 6 pin DIN Plug
1 x 2M - 8 pin Camcorder Plug to 6 pin DIN Plug
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Samsung TV	RCUNI07
Toshiba TV	RCUNI08
Ferguson TV	RCUNI09
Grundig TV	RCUNI10
Goodmans/Alba/Bush TV	RCUNI13M
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BU2508AF	110p	BUW13A	200p	MJ15015	250p	TIP33	50p	LM324	30p	STR40090	350p	TDA1170N	85p	TEA2261	185p	UC3844AN	80p
BU2508D	130p	BUZ80	135p	MJ15016	350p	TIP33C	60p	LM339	35p	STR4211	315p	TDA1175	175p	TEA2262	275p	UC3845AN	80p
BU2508DF	120p	BUZ80AF	200p	MJ15022	400p	TIP34C	60p	LM393	45p	STR440	800p	TDA1180	120p	TEA5101A	175p	UPC1188H	350p
BU2520AF	170p	BUZ90A	180p	MJ15023	400p	TIP35C	65p	LM723	40p	STR441	950p	TDA1518BQ	240p	TEA5101B	175p	UPC1488H	115p
BU2520DF	225p	BUZ90AF	280p	MJ15024	400p	TIP36C	65p	SAA1293	550p	STR44115	475p	TDA1557Q	300p	TEA5170	200p		
BU2525A	325p	BUZ91A	260p	MJ2501	100p	TIP41A	20p	SAB3035	275p	STR451	800p	TDA1558Q	300p	UC3842N	60p		
BU2525AF	220p	IRF510	70p	MJ2955	55p	TIP41C	22p	STK4131	480p	STR4512	400p	TDA2004	150p	UC3842AN	80p		
BU2525D	240p	IRF520	75p	MJE13007	100p	TIP42C	22p	STK4141 II	420p	STR50103A	260p	TDA2005	150p	UC3843	80p		
BU2527AF	400p	IRF530	75p	MJE13009	100p	TIPL791A	80p	STK4142	530p	STR54041	320p	TDA2030	80p				
BU426A	70p	IRF540	100p	MJE18004	125p	AN5151	200p	STK4151	680p	STR58041	250p	TDA2030H	100p				
BU508APH	60p	IRF610	80p	MJF18004	175p	AN5601K	750p	STK4152	650p	STR59041	300p	TDA3562A	260p				
BU508D	75p	IRF620	100p	MJF18006	200p	BA5406	180p	STK4171	900p	STR6020	270p	TDA3653B	80p				
BU508DF	85p	IRF630	75p	MJF18204	350p	BA6209	85p	STK4172 II	680p	STR61001	475p	TDA3653C	85p				
BU508V	110p	IRF640	150p	MJW16206	600p	HA13150A	1150p	STK4191	700p	STR81145	375p	TDA3654	80p				
BUF405A	200p	IRF710	150p	MJW16212	350p	HA13151	875p	STK4332	365p	STRD1706	360p	TDA4565	150p				
BUH1215	450p	IRF720	85p	S2000A3	175p	HA13152	800p	STK5331	300p	STRD1806	360p	TDA4600	200p				
BUH315	200p	IRF730	125p	S2000AF	90p	HA13153A	900p	STK5332	180p	STRD1816	350p	TDA4600 II	160p				
BUH315D	175p	IRF740	90p	S2000N	150p	HA13155	920p	STK5333	650p	STRD4420	550p	TDA4601	120p				
BUH515	200p	IRF820	90p	S2055A	175p	HA13157	950p	STK5337	550p	STRD6108	450p	TDA4605	190p				
BUH515D	250p	IRF830	85p	S2055F	175p	LA4440	200p	STK5481	470p	STRS6707	1000p	TDA4950	100p				
BUH517	275p	IRF840	85p	S2055N	150p	LA4445	200p	STK5482	285p	STRS6708	575p	TDA8170	170p				
BUH517D	175p	IRF9610	95p	TIP121	35p	LA4460	120p	STK73410	350p	STRS6709	600p	TDA8171	230p				
BUH715	425p	IRF9620	85p	TIP122	30p	LA4461	120p	STK73410 II	500p	STV9379	400p	TDA8172	200p				
BUT11A	35p	IRFBC30	120p	TIP125	30p	LA4705	400p	STK7348	400p	TA8207K	175p	TDA8350Q	275p				
BUT1AF	35p	IRFBC40	210p	TIP127	35p	LA7830	90p	STK73605	375p	TA8215	300p	TDA8362N3	1200p				
BUT12A	80p	IRFZ44	160p	TIP2955	50p	LA7851	200p	STK73907	700p	TA8221AH	600p	TEA1039	150p				
BUT12AF	90p	MJ11015	250p	TIP29A	22p	LM1207N	450p	STK7406	650p	TA8227	250p	TEA2018A	80p				
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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: Standby mains transformer (10V) for the Solavox Model 16RI9. Wayne Haverson, Haverson Electronics, 7 The Grove, Westbourne, Emsworth, Hants. 01243 370 526.

Wanted: Panasonic NVMC30B camcorder for spares – a good main PCB is required for a doting customer! Please name price etc. David Woodnott, 01227 751 594 or e-mail david.woodnott@virgin.net

Wanted: Circuit diagram (not layout) for the deflection/timebase section of the Sanyo CVP9111T/9110T projection TV receiver. Also an LA1461 sync/timebase generator chip and a tripler. Would consider purchase of a scrap unit (excluding case). Philip Lane, 8 Prince's Avenue, Aberaeron, Dyfed SA46 0JJ. 01545 570 550.

Wanted: Spares for the Canon PW1080A dot-matrix printer. A serviceable head and drive components would be useful. A complete non-working machine might be considered. Also require any non-parity SIMMS (4Mb or higher) suitable for a DEC PC Model 450D2LP. Richard Newman, 154 Cudham Drive, New Addington, Surrey CR0 0LX. 01689 843 687. E-mail frnewman@tesco.net

Wanted: An RM95 adjustment remote control unit for the Sony CCD-FX300E camcorder (part no. is J6082-053-B). C. Howells, 81 Wye Court, Thornhill, Cwmbran, Gwent NP44 5UL. 01633 838 464.

Wanted: Operating instructions and possibly a circuit diagram (photocopy OK) for the Taylor 45C valve tester, or possibly a scrap unit. Jim Littler, 363 Atherton Road, Hindley Green, Wigan, Lancs WN2 3XD.

Wanted: Circuit diagram for the 17in. Sony colour monitor Model CPD17SF2. M.N. Hussain, 26 Chetwynd Road, Chilwell, Notts NG9 5GD. 01159 176 028.

Wanted: Service manual or circuit diagram for the Manhattan digital receiver Model SC2000Ci. Ron White, 29 Nunnery Street, Castle Hedingham, Essex CO9 3ND. 01787 463 091

Wanted/for disposal: Require service manual (photocopy OK) for the Ferguson 2000 colour chassis. Have for disposal £1.00 coin meters, some electronic. Service TV, 18 Benfleet Road, Hadleigh, Essex SS7 1QB. 01702 558 444.

Wanted: 2SK150A IC for the Aiwa SAP30K amplifier. A second-hand one would do – it's apparently no longer available. Also a plug-in decoder panel for the Mitsubishi Model CT2142TXV. Doug Carson, 89 Holborn Hill, Millom, Cumbria LA18 5BL. 01229 774 749.

Wanted/for sale: Does anyone have for disposal a non-working Quad FM4 tuner? Have for sale a Quad 33 preamplifier at £65 and a Quad FM3 tuner at £60. J.M. Ainscoe, 49 Lon Ceredigion, Pwllheli, Gwynedd LL53 5PP. 01758 613 790.

Wanted: Tripler for the Sanyo CVP9110 or CVP9111 projection TV model. James Thomson, 41, Aitken Street, Glasgow G31 3ND. 0141 554 3018.

Wanted: Service manual or circuit diagram for the Yoko 14in. multi-standard Model TV3716M (photocopies OK). Steve Ormondroyd, 64 Witney Green, Lowestoft, Suffolk NR33 7AP. 01502 572 966.

For sale: Sony 12in. complete COPS system in excellent condition £30; new boxed PCB type UE2473 for the Sharp CTV Model CBP2576, £20; six 24-box storage units with components etc. £25 the lot; two oscilloscopes and a rejuvenator, £30 the lot. David Churchill, Trade Electronic Services, 88 Heath Road, Salisbury, Wilts SP2 9JX. 01722 327 494.

Wanted: User's handbook for the Ferguson Model 3V48 VCR (photocopy OK). Leslie Wragg, 29 Eastern Road, Sutton Coldfield, West Midlands B73 5PA. 0121 354 4265.

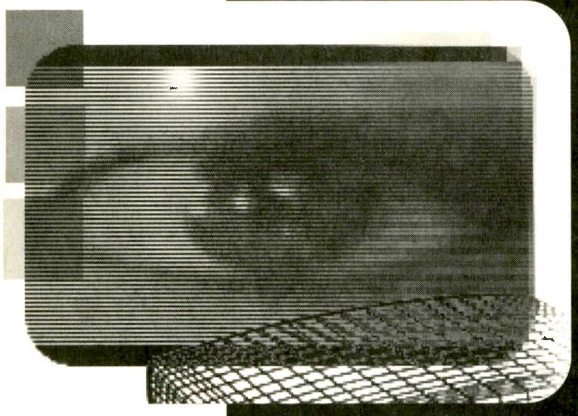
Wanted/for sale: Require service manuals or circuit diagrams for the Hitachi TRK8600E radio-cassette player and the Sanyo RDW340 twin cassette deck. Have for sale one RBM type 55 405-625 pattern generator; *Radio and Television Servicing* volumes 1959-78 (70-71 missing); manuals for the Philips N1700 and V2020 VCRs (the latter with circuit description), and a V2020 video tape with design description. Cyril Randle, 1 Corn Hill, Orchard Hills, Walsall, W. Midlands WS5 3DJ. 01922 620 456.

Wanted: Either the TMS3757ANL-10 microcontroller chip, or a scrap chassis with a known good micro chip still in it, for the Philips 10in. CTV Model 10CX1120/05. Dave Hewitt, DDTV, 47 Albury Grove Road, Cheshunt, Herts EN8 8NS. 01992 621 136. E-mail dave@ddtv.freeserve.co.uk

Wanted: Philips LP/SP hi-fi VCR Model VR6870/05 for spares. Stan Fenton, 199a Heywood Road, Prestwich, Manchester M25 1LB. 0161 773 1562.

For sale: Service manuals for the following VCRs. Hitachi Models VT7E, VT17E, VT33E, VT35E, VT57E, VT63, VT88, VT498 and VT580E; JVC Models HRHD110EK, HR210E, HRD1240EK, HR3330E, HR3660E and HR7650; Panasonic Models NV688, NV777 and NV788; Sharp Models VC486, VC387, VC388 and VC581. All at £3 plus postage. I also have an AVO 9 Mk 4 in perfect order with case (needs new leads) at £40 plus postage. David Forfar, 65 Ormskirk Road, Old Skelmersdale, Lancs WN8 8TR. 01695 735 132.

Recall! Could Mr 'Angus' (Dundee) who called Mr Mode on 0161 862 9628 about SN7673 ICs please call him back as the telephone number he took down is not recognised by the exchange.



TV Fault Finding

Reports from
Philip Blundell, AMIIEelec
Michael Dranfield
Chris Watton
Robert Marshall
Martyn Davis, MIIEelec
Graham M. Colebourn
Giles Pilbrow
Colin J. Guy and
Pete Gurney, LCGI

Philips 21PT1532/05 (L6.1AA chassis)

After a few hours' use the sound would go off and the set would refuse to carry out any remote-control request. Normal operation would be resumed for ten minutes or so if the set was turned off at the mains switch then switched back on again after a few seconds. Something was upsetting the microcontroller chip, but what?

I spent a few minutes looking through past issues of Philips Service *Link* and discovered that a modification on the low-voltage side of the power supply is suggested for text versions of the L6.1: change 7505 to a BC337-40 (part no. 4822 130 41344) and 3500 to a surface-mounted 470Ω resistor (part no. 4822 051 20471). I tried this, but it didn't cure the fault. The microcontroller chip itself was the cause of the problem.

The microcontroller chip originally fitted was type SAA5290ZP/039 L6TXT MEU-1.0 (part no. 4822 209 14646). When I ordered it I discovered that it has been superseded by the SAA5290ZP/072 L6T MOE-1.1 (part no. 4822 209 15954). **P.B.**

Mitsubishi CT2525

"Intermittently dead" the report said. To me this meant dead on cold mornings – or electrolytic capacitor trouble. A few minutes spent using the freezer can soon revealed the culprits: C906 (47µF, 25V), C905 (220µF, 25V) and C912 (4·7µF, 50V) were all in need of replacement. **P.B.**

Panasonic TX21T1 (Alpha 2 chassis)

The channel indicator was working but there was no sound or picture. A look around the high-value resistors in the power supply was fruitless, and a check on the outputs from the power supply failed to reveal any shorts. I then decided to lift the diodes on the secondary side of the power supply to check whether any were leaky. D851 had developed this condition. **P.B.**

Sharp DV5937

This set was dead with a faulty 2SD1546 line output transistor (Q600). No reason for its failure could be found, so a replacement was fitted and the set was left on soak test. Two days later the new transistor died. A lot of time was spent on further investigation. Finally the cause of the trouble was found to be a dry-joint at the scan coil socket – on the coils themselves. A mirror was needed to view the back of the scan coils PCB. **M.Dr.**

Samsung CI5937AN

This set wouldn't come out of standby. The power supply was OK, but the microcontroller chip wouldn't issue the power-on command. The cause of the problem was traced to the user control panel at the front of the set. When it was unplugged (connector CN007 on the main board) the set could be switched on using the remote control unit. The control panel part number is given in the manual, but it's no longer available. So, much the customer's annoyance, the set can now be operated only by remote control. **M.Dr.**

Alba CTV842

For no colour, replace the 0·47µF electrolytic capacitor connected to pin 12 of the TA7698AP colour decoder/timebase generator chip. This tip could apply to any set that uses this IC. **M.Dr.**

Matsui 1436XA

If only the standby LED lights up, the STK7348 chopper chip is probably short-circuit. In his case you will also have to replace R653 (1·5Ω, 2W), R659 (1kΩ, 0·5W), R651 (27Ω, 2W) and C655 (0·47µF, 50V). Failure to do so will result in the destruction of the new STK7348 chip at switch on. **M.Dr.**
Editorial note: The **Bush** Model 2004 appears to be the same, but the resistor wattage ratings shown on our circuit diagram differ slightly.

Sharp 66CS03

This set was dead with only the orange neon glowing. The cause of the trouble was traced to a leaky blue disc ceramic capacitor that's connected across the line output stage tuning capacitor. The offending 2·2nF, 2kV capacitor is on the underside of the PCB. There was a split across its body. **M.Dr.**

NEI E28G1TFXN

There was intermittent loss of the sound and picture and the power LED was dim. The cause was poor joints at the rectifiers on the secondary side of the chopper transformer. **C.W.**

Salora M1 Chassis

The line output transistor was short-circuit. When a replacement had been fitted the picture was shifted, with about an inch border at the left-hand side of the screen. In addition the new transistor was

overheating and soon failed. Obviously the line drive was incorrect. All the transistors in the line driver stage were replaced, also the supply decouplers which are a frequent cause of this fault. But the problem persisted. I eventually discovered that DB528 (BA157) was open-circuit. It provides the positive supply for the line driver stage when the set is not in standby. A new diode cured the fault.

A new line output transistor was fitted then, ten minutes later, the field output chip failed. Fortunately this was an unrelated fault. The cause was a dry-joint at the boost capacitor CB571 (100µF). **C.W.**

Nokia Euro Stereo Chassis

When the set is apparently dead, with no display, sound or raster though EHT is present, the usual cause is I^2C bus failure. It can be checked at the test plug. First ensure that the 5V supply is good, then check the clock and data lines (SCL and SDA). If low, remove the Nicam PCB. If the set then works, suspect the plug-in MSP2400 chip. This fault is not uncommon. **C.W.**

Ferguson ICC5 Chassis

This set tripped three times then died. Checks in the power supply revealed the culprit, CP24 (47µF, 100V). It couples the drive to the chopper transistor TP24. **C.W.**

Hitachi C2808

Intermittent loss of the left-hand channel sound had been a problem with this set for about a year. We thought we'd tried everything. The set would work correctly for weeks, then the left-hand channel sound would drop out, maybe for minutes or for hours. Eventually it went off permanently. With scope in hand I soon found the cause of the trouble. The left-hand speaker coupling capacitor C420 (470µF) was open-circuit. **C.W.**

Morphy Richards CT870

This 6in. set was dead. I didn't have the circuit diagram but soon found that the efficiency diode D304 in the line output stage had failed. An RGP10 was tried as a replacement and ran cool during a lengthy soak test. **C.W.**

Daewoo GB2896ST (CP775 chassis)

This set came in dead. An initial investigation showed that the 2SD1880 line output transistor Q401 was short-circuit and two nearby resistors were burnt with unreadable values. So a service manual was ordered from CPC, and I'm glad I did this. The cause of the trouble was one of those blue, high-voltage disc capacitors, C416 (680pF, 2kV). It's connected to the collector of the line output transistor and is used to tap off line-frequency pulses for feeding to various ICs. An associated 1N4148 diode (D503) was short-circuit, also a 10Ω chip resistor (RC527). The resistors that had originally provided clues to the cause of the trouble were R503 (10kΩ) and R409 (4·7kΩ). Since these had both burnt the board the replacements were fitted stood off it. **R.M.**

Editorial note: This chassis is also used in the **Goodmans** Models 255NS and 285NS.

Hitachi C2864TNZ

There was a single blink from the LED. A check with the manual showed that the HT voltage at D930 should be 149V. When the set was switched on after being off for several hours, an EHT rustle was heard but the supply voltages fell back and the set remained dormant. The line output transistor is on a separate panel. You can check the HT voltage with a bulb as a dummy load when the plug to this panel is disconnected – it has one orange and one green lead. Because VR930, which sets the HT voltage, was making poor contact the HT was nearly 170V. I then found that safety resistor R509 (1Ω), which is next to the line output transformer, was open-circuit. Be sure to fit an 0·5W component in this position.

This was not the end of the matter. The TEA5101A RGB output chip IC800 and C821 (4·7µF, 250V) had to be replaced to restore normal operation. **R.M.**

Crown CRV47 (11AK08 chassis)

This set was dead with R809 (0·47Ω) in the power supply burnt out. The cause is usually the chopper transformer TR801 going short-circuit, taking out Q801 and possibly IC801 as well. But not this time!

When R809 had been replaced the power supply ran but was pulsing. So I set about isolating each output on the secondary side of the power supply in turn, expecting to find a short-circuit. The power supply finally got going when I lifted D810 (26V and 12V supplies), but the HT was high at 126V and couldn't be reduced to 110V. Back then to the primary side of the power supply, where I eventually found that R805 (330kΩ, 1W) was open-circuit.

Once this resistor had been replaced the set was OK. What a relief! These little sets can be really awkward if the fault isn't absolutely straightforward. **M.D.**

Philips 29PT9113 (MD2.2AA chassis)

This set came in 'dead'. The green LED came on for about twenty seconds then went off, to be replaced by the red LED. There was no other power-up. The thing to do is to check for 8V at IC7569 and 5V at R3564 on the main board, then for 4·7V at the main-is-alive pin on the left-hand vertical panel. If these voltages come up for a while, the 4·7V pulsing, you have a control software problem. The cure is to replace IC7202, part no. 4822 900 11058.

Fortunately the chip is a push-fit into its socket. It takes a good deal less time to fit than it does to find the above-mentioned test points! **M.D.**

Bush 2850NTX/A (TV8 chassis)

This set had apparently been smoking when it packed up. On inspection I found a burnt-out track between the scan-correction capacitor C307 and the adjacent scan yoke connector pin. The capacitor and connector had to be removed so that the damaged section of board could be cut away. The capacitor was OK, but the connector pin was useless – the scan connection had to be hard wired.

I then found that the BUH515D line output transistor T308 and the TDA8170 field output chip IC401 had both been damaged and had to be replaced – they can be obtained from SEME. R408 (0·22Ω) in the supply to IC401 had also failed.

In addition to all this the CRT was heavily magnetised and refused to demagnetise until the degaussing coil connector had been unplugged and refitted. The degaussing posistor was checked and found to be all right. **G.M.C.**

Thomson 10MG73B (TX91 chassis)

When this 10in. set had received a heavy jolt the aerial socket had broken off the tuner and the sound had packed up. To our surprise the board was OK. The sound was missing because RA08, a surface-mounted 22kΩ resistor (of the cylindrical Melf type), had been dislodged by

contact with the plastic side runner in which the board slides. **G.M.C.**

Philips 22CE2561 (2A chassis)

We've now replaced several line output transformers in these sets without incident, but there were complications on one occasion recently. It's well known that C2609 in the EW modulator circuit can cause problems, so this was also replaced. But the fault persisted. When the set was cold, or whenever the programme was changed, the channel display and indicator LEDs would flicker and throb violently and the main HT supply would dip briefly about ten times a second. The screen would be blank, and there was no sound.

When the feed to the line output stage was disconnected and a dummy load (60W bulb) was connected instead the HT was correct and steady at 140V. The cause of all these symptoms was found to be repeated resetting of the microcontroller chip on the control panel. Its reset drive is derived from the 7V rail, the relevant rectifier (D6642) being fed from pin 5 of the LOPT via a fuse and a 27µH choke (L5642) with an 82Ω damping resistor in parallel. This supply was 0·5V low, enough to activate the reset circuit. An additional 10µH choke connected across L5642 restored the 7V supply without impairing the filtering too much. **G.M.C.**

Bush 2866NTX

There was no reception – all that appeared was noise and the on-screen graphics. Checks showed that the tuning voltage was missing. R124 (15kΩ), which feeds the 33V stabiliser, was open-circuit. It's right at the front of the main board. **G.M.C.**

Sony BE4A Chassis

This set was dead except that the standby LED flashed four times, which indicates that there's no line output stage operation. Checks showed that there was no line drive output from the MC44007P chip IC301. A replacement, part no. 8-759-333-44, restored normal operation. **G.P.**

Sony BC4 Chassis

We've had several of these sets that either shut down with the standby LED flashing twice (excess current) or operated with line foldover and an overheating line output transistor (Q802). The cause is R624 (180kΩ), which either goes high-resistance or open-circuit, upsetting the line flyback pulse at pin 38 of the jungle chip. We normally fit a high-quality 0·6W metal-film resistor in this position whenever we see one of these sets. **G.P.**

Nokia 3742A

The picture produced by this portable had very low contrast. A check at pin 25 of the TDA8362 chip showed that the voltage varied, but this had no effect on the picture. A replacement TDA8362 IC cured the fault. **G.P.**

Grundig P37549/12 (CUC5305 chassis)

The problem with this set was no picture when the input came via the scart socket. IC2350 (TDA5931-5) on the IF panel was faulty. **G.P.**

Sony BC4 Chassis

If the set is completely dead, check the output from the standby power supply transformer. The usual suspect when this is missing is the TOP223Y-BB chopper chip IC610, which tends to take R602 (0·1Ω, 0·5W) and D603 (S1WB60) with it. The part numbers are 8-759-470-64 (IC610), 1-202-933-61 (R602) and 8-719-510-06 (D603). **G.P.**

Grundig G1000 Chassis

There was an unfocused band of illumination, about 6in. wide, down the centre of the screen, with normal sound. The HT was spot on and nothing in the line output stage seemed to be under stress though the focus and EHT voltages were both low. My HR LOPT tester exonerated the transformer. A check on the line drive from IC800 (MC44007) then revealed that it was at exactly twice the correct frequency – and was synchronised when a signal was present.

Apart from the crystal, which was checked by substitution, there don't seem to be any other discrete components that could affect the line frequency. The manual states that line control setting is carried out during production and cannot be readjusted. Needless to say replacing IC800 had no effect. We had to replace the microcontroller chip IC500. **C.J.G.**

Sony KVM2531U (AE1C chassis)

This set worked normally from switch on, but if the volume up or down buttons were touched the sound went to full blast – and I mean full blast! The sound could be turned down or up as normal from then on, until the set was switched off then back on. The cure was to replace the SDA2546 EEPROM chip IC005. **C.J.G.**

Sharp 51CS03H (CS chassis)

The power supply outputs were OK but there was no line drive. It was not being produced by the expensive, surface-mounted TDA8374B jungle chip IC201. When a replacement had been obtained and fitted the drive appeared – together with a dazzling lightning display from the LOPT.

I switched off rapidly and looked in depair at all the surface-mounted digital ICs – and at the price limit set by the customer. In the end I decided to take a chance and replace the LOPT. Once this had been fitted the set worked perfectly – even the EEPROM hadn't been corrupted. It's time designers appreciated that digital ICs and high voltages should at least be on separate PCBs, if not in separate cabinets! **C.J.G.**

Salora K Chassis

This set was dead because the integrating capacitor CB711 (22nF) in the diac start-up circuit was leaky. **C.J.G.**

Akura CX25/CX26/1400

Most odd intermittent effects, such as no picture, one colour predominant etc., can be cured by carefully resoldering the earth links on the component side of the digital processing PCB. To do a proper job however it's necessary to remove three of the ICs, as there are links beneath them. These are links J771 and J779 under the TPU chip; links J747, J792 and J746 under the VSP chip; and link J772 under the VCU chip.

I've repaired several of these sets now and have found that the ICs are quite tolerant of being removed and replaced. **C.J.G.**

Matsui 1482

This set displayed a bright, blank raster. The cause was C630 (100µF, 25V) which was completely open-circuit. It's the reservoir capacitor for the 12V supply. **C.J.G.**

Protech 7295

The problem with this set was severe tuning drift and no sound. When the PCB was lifted I saw that it had received attention elsewhere: the tuner had been replaced, along with a number of other components. A check on the 33V supply showed

that it was varying between 31-32·5V. The 33V zener diode and its 15kΩ series resistor R818 had been replaced. They are connected via a resistor to a digital/analogue converter transistor, which is followed by a filter network. A check from the collector of this transistor to chassis produced a reading of 17kΩ, which seemed to be on the low side. By disconnecting components I isolated C504 (0·1µF) as being the cause of the leak. It's a small, disc-type capacitor part way along the filter.

The cause of the loss of sound was initially traced to the TDA1521A audio output chip, which is on the Nicam panel. It had been incorrectly fitted, with pin 1 connected to pin 10 – for reference, pin 1 is towards the rear-facing edge of the PCB. After some checks a replacement was fitted but died immediately. It took me some time to find the cause. One of the speaker coupling capacitors, C380 (1,000µF, 35V), was going almost short-circuit under load. It seemed to be OK when checked with a capacitance meter. **P.G.**

Panasonic Alpha 2W Chassis

The customer complained that the picture would intermittently go bright red, then the set would trip off. There was just enough time to carry out a few checks on the CRT base panel before the protection circuit operated. The voltage at the collector of the red output transistor Q353 was found to be only 3·5V, and there was precious little voltage at either side of its load resistor R353. There's a 180µH peaking coil (L353) in series with this resistor. It was going open-circuit. **P.G.**

Goodmans 2032

A few of these sets have been brought in because of smoking/burning. In each case I've found that the line output stage tuning capacitor C444 (330pF, 2kV) had become a pile of ash. **P.G.**

Nikkai NT20

Intermittently dead was the complaint with this set. I put it on soak test and found that the fault occurred about once a week. It eventually lasted long enough for some checks to be carried out. I found that there was no voltage at the collector of the chopper transistor Q811, though there was 340V at the other end of the transformer's primary winding.

The transformer was going open-circuit intermittently. When I removed it I found out why: there was a faulty joint at one pin of the primary winding. It looked as if the connection had never been soldered from new. There were no further problems once I'd made the transformer's connections good. **P.G.**

JVC CS2181EK (BYX chassis)

There was intermittent tuner drift and severe patterning. The fault appeared to be thermally sensitive: it was not present when the workshop was cold. I inspected the vision IF module and found several bad joints, mainly at the AFC and vision demodulator tank coils and the SAW filter. These were made good and the set was then put on soak test. It was left there for a week, during which there was no further trouble. **P.G.**

Fault Notes on the

11AK03 TV Chassis

This Vestel chassis was used in several NEI and Bush models. Alan Dent provides fault-finding tips

The 11AK03 is a fairly conventional modular chassis that produces no nasty surprises. It was used by NEI in Models NE5147 and NE5544 and by Bush in Models 2714, 2720, 2721, 2814T and 2820T. Note that the NEI and Bush versions are not identical. The power supply information given below applies to both versions, the audio information to the NEI version.

Power Supply

This is a conventional circuit based on a TDA4601 control chip (IC801) and a BU508A chopper transistor (TR801). Here are some quick fault-finding checks.

Will not start (no pulse output at pin 7 of IC801): F801 (2·5A), R801 (2·2Ω, 5W), TH802 (a thermistor, should read 4·7kΩ when cold), R803 (2·7kΩ), R810 (100kΩ), R804 (220Ω), R806 (1·2kΩ) or C813 (8·2nF) could be open-circuit. C809 (100µF, 16V) or D802 (1N4007) could be short-circuit. IC801 could be faulty.

Will not start up (one pulse every 300msec at pin 7 of IC801): R808 (47Ω), R805 (10kΩ), C814 (100µF, 16V), L802 (4·7µH), D801 (BA157), TR801 or T802 (pins 3-4) could be open-circuit.

Uncontrollable HT: Check whether VR801 (4·7kΩ), R807 (12kΩ) or D801 (BA157) is open-circuit.

Slow start-up: Check whether C814 (100µF, 16V) is leaky.

Tripping at 1Hz (chirping sound): The HT rectifier D806 (BY299) or the line output transistor TR602 (BU506D) or any other component on the secondary side of the power supply could be short-circuit.

R801 (2·2Ω, 5W) open-circuit and TR801 (BU508A) short-circuit: Check R809 (270kΩ). The resistor used in this position must be of the correct type.

F801 blasted: TR801 (BU508A) is probably short-circuit to its heatsink.

No or low energy output (chopper transformer T802 squealing and TR801 hot): There could be internal shorting in the chopper transformer T802, also check the line output transformer T602.

No energy transfer to secondary side of the power supply: Check whether C815 (100µF, 25V) is open-circuit.

No 12V supply: Remove the standby-switching transistor TR802. If the 12V supply then appears, the problem is with the microcontroller chip or TR802.

Audio Faults

The following information is based on the NEI models which have two audio PCBs, one for Nicam.

No audio output: Check the 28V and 12V supplies. If there's an input to IC308 but no output, check the I^2C bus.

No audio output, IC309 destroyed or getting hot: Check for oscillation at the output pins. If there's oscillation in both channels, check C373. If only one channel is affected, check the relevant Zobel network: C361/R338 or C360/R339.

Low-level mono sound, Nicam OK: Check the alignment of VL302.

No audio (muted sound), may produce mono audio sometimes depending on bus conditions, i.e. method of coming out of standby: Check for data pulses at pin 15 of IC302. If missing, check the voltage at pin 1. If this is 0V, 5V or oscillating, add a small capacitor (approximately 4-7pF) between pins 17 and 18 of IC303. There should then be approximately 2·5V at pin 1 of IC302. It may be necessary to select the capacitor value to obtain 2·5V.

Switches to mono on some picture scenes or channel changes: Check the alignment of VL301. There should be no video on the 6MHz carrier at pin 14 of IC301.

Mono audio (red on-screen display, cannot switch to stereo with handset, also noisy PLL line): X301 (13·104MHz) has gone high in frequency.

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Hitachi C2544TN, C2564TN, C2565TN, C2864TN, C2874TN, C2976TN, CL2560TA, CL2564TA, CL2860TA, CL2864TA, CP2565TA, CP2574TA,CP2865TA, CP2874TA, CLE877A	IR9653	320-00187	9.25
Matsui 14R1, 14T120, 21N1	IR9715	320-00233	9.25
Mitsubishi CT1525/35, CT2125/31/32/42/44/46/47/53/54, CT21M1TX, CT2525, FA5939P21201	IR9312	320-00065	9.75
Philips RC5991, 218-20631	IR9072	320-00014	6.99
Sony RM670, RM671, RM672, RM673, RM674, RM676	IR9123	320-00025	6.99
Tatung 576, 616, 617, FXA	IR9546	320-00127	8.35

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Ferguson/Thorn 14D2, 14J2, 14L2, TX85, 00E2-201-002	MS57	420-00022	1.15
Ferguson/Thorn 41P3, 59M5, 68K4, 68M5, B59F	MS81	420-00035	2.15
Ferguson/Thorn A36F/A36R/A51F/A51N/A59F/B51F/B51NX/B78NT	MS145	420-00077	1.95
Ferguson/Thorn TX9/TX90/TX100 (Remote), 00E2-145-001, 00E2-185-002/3	MS47	420-00016	1.10
Grundig P37-540, P50-540, P55-245/90, ST63-655/8, T51-540, T51-540A, T70-540,T70-640, XS63/8, XS70/8, 29703-291.21, 29703-291.22, 29703-291.32	MS102	420-00050	1.50
Grundig T55-440, T63-2406, T63-270T, T63-430, T70-440, 29703-291.02	MS46	420-00015	2.70
Philips K30/KT3 (Remote)	MS31	420-00010	1.70
Sanyo CBP2151/52, CBP2551/52, CBP3143, CBP3012, CBP3001E, Baird RR5190	MS144	420-00076	2.90
Tatung 165/166/167, 20/4065-4	MS49	420-00017	1.10
Universal Kit	MS40	420-00013	2.70

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Ferguson/Thorn A51F, 0040-148-300	FAT3729	460-00314	10.99
Ferguson/Thorn TX100 59 & 66cm, 06D3-093-001, 06D3-512-001	FAT3837	460-00347	10.99
Ferguson/Thorn TX100 22" & 26" Green Spot, 06D3-084-001, 06D3-087-001	FAT3758	460-00318	9.99
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Hitachi CMP2130, CPT2174/76, CPT2476, 2434593	FAT30003	460-00131	10.15
Philips 14", 15", 17", 21", 23", 25", 28", 37", 43", 52cm, 140-10306, 140-10353, 140-10367	FAT3830	460-00344	10.40
Philips 52cm, 56cm, 66cm, 140-10274	FAT3829	460-00343	10.60
Philips AT2076/40, AT2079/40, 140-10406, 140-10566	FAT30186	460-00222	9.99
Philips AT2079/23, Toshiba 1510RBT/RDT/TB5/TBT/TBW, 156R9BG/BT/BW, 156T9BT/BW, 1569BT, 23236255, 23236428	FAT30170	460-00210	9.75
Philips GR-1 AX Chassis, 140-10369, 140-10379, 140-10421	FAT30057	460-00155	9.99

Top 10 Video Heads

Model/Chassis/Part Number Reference	Konig Ref	ARD Part Number	Low Price
Amstrad VCR6000, 153063	VH2732	470-00125	8.25
Ferguson FV-31R, 40104700	VH2836	470-00174	10.99
Hitachi VT540/545/546/548, VTD660/665, VTM598/640/645/646/730/731/735/736/740/741/745/746/747/748/753/754/768/830/831/835/838E/840/841/845/930/931	VH2702	470-00109	15.95
JVC HR-D170/D230, PDM2001B-8, PDM2008/B/C	VH2580	470-00049	7.95
JVC HR-D720, PDM2002A-2/B/B-2/C/D/E/H	VH2783	470-00153	12.60
Mitsubishi HS-249/B31, 948B13804, 948B231020, 948B231090, 948B284016	VH2654	470-00089	19.45
Panasonic AG-1000E/EN, VEH0270, VEH0287	VH2595	470-00059	8.50
Panasonic NV430/NV460,VEH0286, VEH0621, VEH0706	VH2529	470-00026	8.35
Panasonic NV-G30/40/130, VEH0386, VEH0416, VEH0519/32/99, VEH0657, VEH0708	VH2681	470-00106	7.95
Panasonic NV-G33/G45, VEH0385, VEH0417, VEH0508/18/31/98, VEH0612/24/56, VEH0705	VH2680	470-00105	9.70

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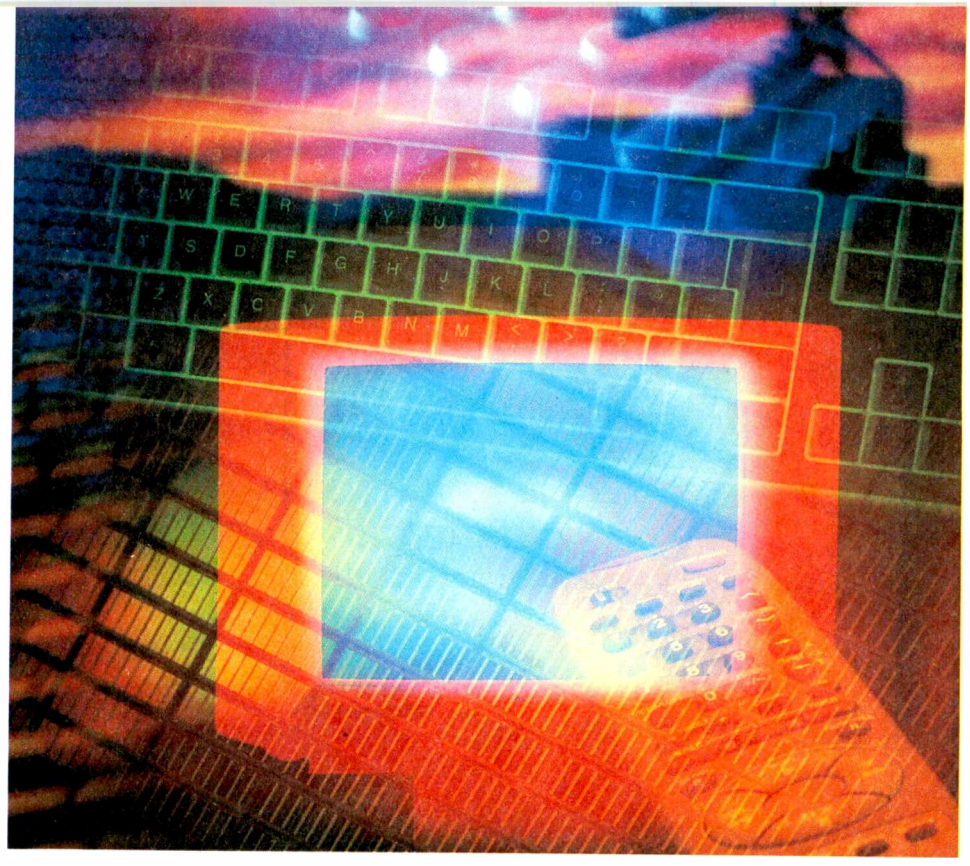
Much has been written on MPEG-2 decoding, rather less on how a digital TV signal is demodulated prior to this. K.F. Ibrahim starts a two-part article on the front-end section of a digital STB/IDTV



Digital TV

The Receiver Front End

We'll begin with a digital receiver overview. Fig. 1 shows a basic block diagram of a digital TV receiver or decoder. The first block, labelled front end, receives the modulated RF signal and demodulates it, reproducing the digital transport stream created at the transmitter. This stream consists of data packets that belong to four or five different TV programmes, multiplexed together. The following demultiplexer selects the packets for the required programme, under the control of the microprocessor bus: it identifies each packet by its PID (packet identification) byte, then reassembles the required packets.

When a packet is scrambled it's fed to the CAM (conditional access module) which asks the inserted smart card whether the user has a current subscription to the selected programme. If there isn't a valid subscription, the CAM informs the system microprocessor chip which prevents the signal proceeding farther. When the subscription is valid the packet is returned to the demultiplexer for subsequent processing.

The transport demultiplexer produces two outputs: eight-bit wide bytes of video data, and serial audio data. These are fed to their respective MPEG-2 decoders. A fast SRAM memory is used as a buffer for the video and audio data, so that onwards transmission to the decoders takes place in bursts. Nowadays these decoders are usually in a single chip. The video section decompresses the video data stream, converting it back to its original components: Y (luminance) and CR, CB (chrominance). The three components are fed to a PAL encoder, which converts the digital video into a standard PAL analogue video signal. This is applied to a UHF modulator so that the signal can be fed to the aerial socket of an ordinary analogue TV receiver.

The audio section of the V/A decoder chip produces left and right audio signals in analogue form. These are fed to a summing amplifier which produces a mono sound signal for the UHF modulator. There are also separate L and R outputs.

Both decoders operate in conjunction with DRAM memories. Amongst other things the audio one introduces a one-second delay to ensure audio and video synchronisation.

The Front End

The basic sections of the front end are shown in Fig. 2. To start with there's a tuner which is under I^2C control. It selects the required channel (which carries several different programmes). The output is an analogue signal that carries the digital modulation. An analogue-to-digital converter then produces a multi-bit digital output for the channel demodulator. The final block, labelled FEC (Forward Error Correction), detects and corrects errors introduced in the transmission path.

The design of the front end depends on the type of reception, terrestrial or satellite. This is because these different types of broadcasting use different methods of signal modulation: quadrature phase-shift keying (QPSK) is used for satellite transmission; quadrature-amplitude modulation (QAM) is used for terrestrial transmission, within a coded orthogonal frequency-division multiplex (COFDM).

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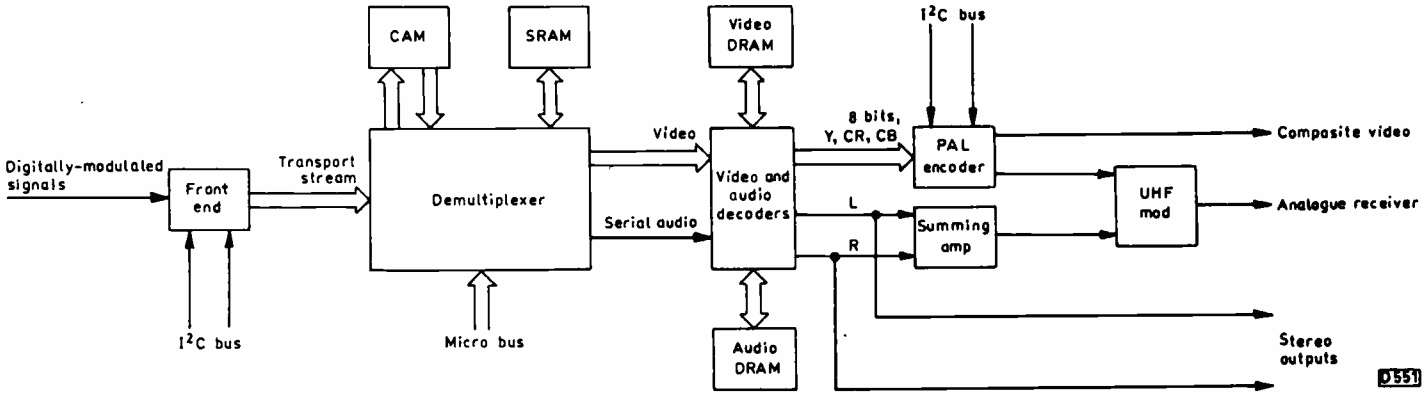


Fig. 1: Basic digital TV receiver/decoder block diagram.

Before investigating the operation of the front end we'll take a look at the error correction and modulation techniques used.

Forward Error Correction (FEC)

A digital signal needs an efficient error detection and correction system, especially when a high level of data compression has been applied. With digital TV broadcasting the bit error ratio (BER) must be of the order of 10^{-10}-10^{-12}, which is the equivalent of 0·1-10 erroneous bits during one hour of transmission. A channel with such a low bit error ratio is known as a quasi-error-free (QEF) transmission. To achieve such a stringent requirement, measures have to be taken to ensure that errors introduced by the transmission medium are detected and, when possible, corrected. This is the purpose of forward error correction.

There are three stages to FEC, see Fig. 3: outer coding (Reed-Solomon); convolutional interleaving; and convolutional inner coding. Reed-Solomon coding does not provide correction when error bursts, i.e. errors in adjacent bits, occur. Interleaving is used to overcome this limitation. It separates initially adjacent bits before they are transmitted. Should the transmission medium introduce lengthy error bursts, they will be spread about and can thus be corrected. At the receiving end a de-interleaver (see Fig. 4) restores the correct order before the signal arrives at the outer decoder. The Reed-Solomon code chosen for digital TV transmission is 204:188. It adds an extra 16 bytes to the transport stream packet. The Reed-Solomon outer decoder can detect and correct 16 bytes of errors in a 204-byte packet.

Inner coding/decoding is a form of convolutional coding that adds further error-correction capabilities. A full (100 per cent) convolutional inner coder produces two simultaneous output bit streams, X and Y. Each replicate the original data stream. The X and Y bit streams are both modulated and transmitted. While this provides very powerful error correction, it introduces a very high redundancy rate, effectively doubling the channel's bandwidth requirement. The bandwidth requirement can be improved by using a technique known as puncturing. Only one of the two simultaneous bits in the X and Y streams is selected for transmission: the other bits are 'punctured'. Alternate X and Y bits are used, within what is known as the puncturing ratio. A high puncturing ratio improves the correction efficiency at the expense of channel capacity. The broadcaster may select a puncturing ratio of 3/4, 2/3 or 4/5, based on the transmitter power, the size of receiving aerials in use and the desired quality of reception.

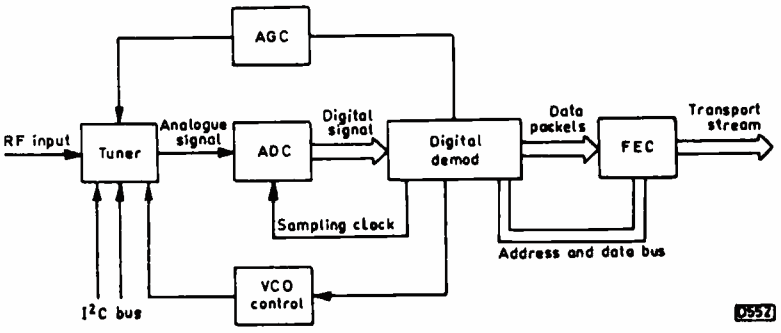


Fig. 2: Front end block diagram.

Fig. 3: FEC at the transmitter.

Fig. 4: FEC at the receiver.

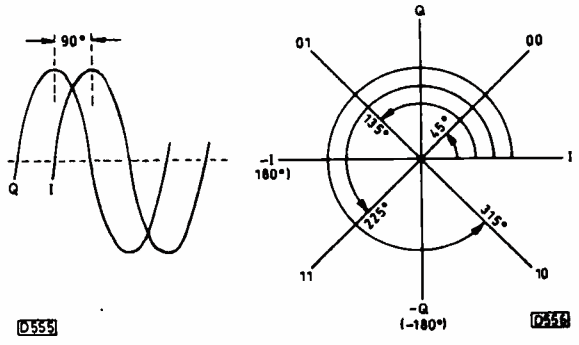


Fig. 5 (left): The I and Q carriers. Fig. 6: (right) Four-phase PSK.

Modulation

Modulation is the process of using the information signal, whether analogue or digital, to change one of the characteristics of the transmitted carrier waveform. A carrier is a sinusoidal waveform of constant amplitude, frequency and phase. The modulating waveform, for example speech or digital data, changes either the carrier amplitude (amplitude modulation), its frequency (this is known as frequency modulation or frequency shift keying – FSK), or its phase (phase shift keying – PSK).

Unlike an analogue modulating signal, which has an

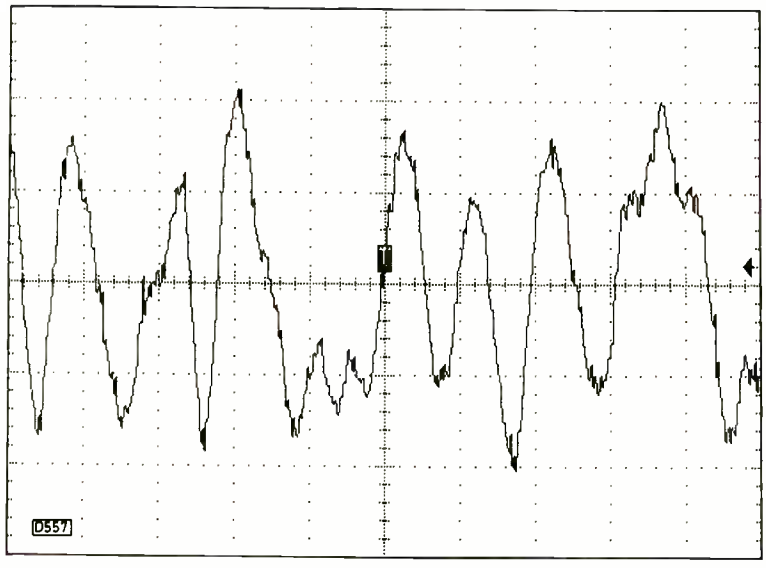


Fig. 7: The distinctive QPSK waveform. This trace is a digital storage oscilloscope print out.

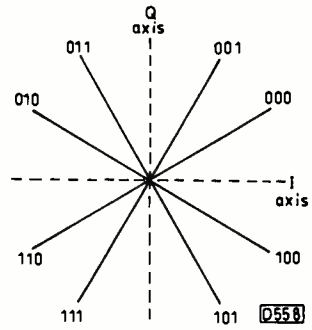


Fig. 8: (right) Eight-phase PSK.

infinite number of levels, a digital signal has only two states, 1 and 0. Thus only two different carrier amplitude, frequency or phase states are required to convey the digital information.

With amplitude modulation a high amplitude is used to represent logic one and a low amplitude to represent logic zero. Each transition of the carrier waveform represents a single data bit. A transmission speed of say 100 bits/second thus requires 100 carrier transitions per second, which is known as the transmission symbol or baud rate. With frequency modulation the carrier is shifted by typically +150Hz for logic one and –150Hz for logic zero. Hence the term frequency shift keying (FSK). As with AM, each carrier transition represents one bit (one bit per symbol), giving a baud rate that's identical to the bits/sec rate.

In terms of bits per symbol, the most economical form of modulation is phase modulation, which is known as phase shift keying (PSK). The carrier frequency remains constant, but its phase shifts in discrete steps in accordance with the logic state of the data bits. Binary PSK is a two-phase modulation technique: the carrier 0° phase condition represents logic one while 180° represents logic zero. This means one bit per symbol. But the number of bits per symbol can be increased by using smaller phase shifts, such as 90° for four-phase PSK or 45° for eight-phase PSK.

QPSK

Quadrature phase-shift keying, which is also known as four-phase PSK, has four phase conditions. The four phase conditions are implemented by using two carriers that have a phase separation of 90°. They are known as the I (In-phase) and Q (in-Quadrature) carriers, see Fig. 5. While the frequency of the two carriers remains constant, their phase can be shifted by 180° to produce four phase conditions (phasors): 45°, 135°, 225° and 315°. Fig. 6 illustrates this and shows that each phasor can be used to represent two bits of data. The advantage of this type of modulation is its ability to send twice as much information as binary PSK in the same bandwidth.

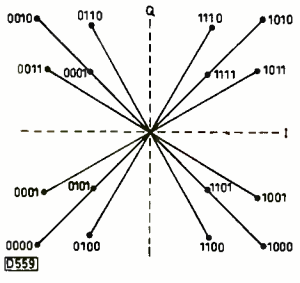
QPSK modulated carriers display a very distinctive waveform, see Fig. 7. The resultant obtained by adding the I and Q carriers has the same distinctive wave shape as each individual carrier. For transmission purposes it modulates a further carrier. With satellite digital TV broadcasting the I + Q resultant frequency modulates an SHF carrier for reception using a dish.

QAM

The efficiency of PSK can be increased by using a greater number of phase angles – eight in the case of 8-PSK, 16 in the case of 16-PSK. With 8-PSK modulation the carrier takes up one of eight different phase angles, as shown in Fig. 8. Each phasor represents one of eight 3-bit combinations.

Quadrature amplitude modulation (QAM) is an extension of this, in that the carrier is modulated in amplitude as well as phase to provide increased bit representation. For example, 16-QAM encoding increases the modulation 'bit width' to four, as shown in Fig. 9. There are twelve different carrier phasors, four of which have two amplitude states to further increase the number of 4-bit combinations. Fig. 10 shows the possible carrier phase angles and amplitudes for 16-QAM: it's known as a constellation map.

Cable digital TV employs 64-QAM: each transmitted carrier phase/amplitude condition represents 64 possible 6-bit combinations. This form of modulation is also used



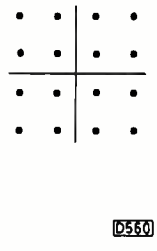


Fig. 9 (left): 16-QAM phasor diagram.
Fig. 10 (right): Constellation map for 16-QAM.

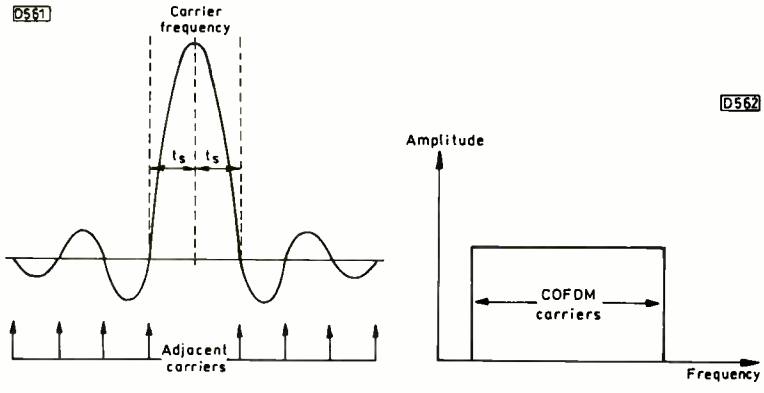


Fig. 11 (left): Frequency spectrum of a single OFDM carrier.

Fig. 12 (right): Channel spectrum with COFDM.

for digital terrestrial TV (DTTV), but with an added complication.

Uncoded OFDM

64-QAM is very effective and efficient. Unlike satellite transmission however DTTV suffers from multi-path interference. In addition to the signal that comes direct from the transmitting aerial, the receiving aerial may receive other signals that have been reflected from tall buildings, trees or moving objects such as aircraft. A reflected signal takes longer to arrive at the receiving aerial than a direct one, i.e. there's a certain propagation delay. With analogue TV reception the result is a second, fainter picture to the right of the main one on the screen – a ghost as it's known. This is most noticeable with reception using an indoor aerial. With digital TV reception a reflected signal can cause partial or full picture and sound break-up, depending on the amount of signal delay. If the delay is anywhere near 180°, complete picture and sound failure will occur.

To avoid this, a multiple carrier technique known as orthogonal frequency-division multiplexing (OFDM) is used. It involves distribution of the serial digital bit stream across a large number of parallel carriers (2,048 with DTTV in the UK) which are closely and precisely spaced across the available TV channel bandwidth. Each carrier transmits part of the total bit stream: the carriers are quadrature amplitude modulated simultaneously at regular intervals.

Because of the large number of carriers, the time during which each signal bit is active, i.e. the duration of each OFDM symbol, is considerably longer than the duration of one bit of the original bit stream. Consider for example a modulating bit stream that consists of 500 bits with a bit duration of 0·1μsec each. If the 500 bits modulate a single carrier, the time during which each bit is 'active', i.e. the symbol duration, will be 0·1μsec. If on the other hand the 500 bits modulate 500 carriers, forming an OFDM symbol, the duration of each symbol is 0·1 x 500 = 50μsec.

This long symbol duration gives the receiver time to wait until all echoes and reflections have arrived before it evaluates and processes the signal. Reflected signals that arrive during this time will strengthen the direct transmission. Further improvement is obtained by adding a guard interval (also known as a guard band) before the symbol period: the receiver pauses during this interval before it starts to evaluate the carriers. A guard interval of a quarter of the active symbol duration provides protection against echoes with delays as long as 200μsec. The introduction of a guard band reduces the number of active carriers available for modulation by the signal bit stream: in the UK, the number of active carriers is reduced to 1,706.

The OFDM carriers have a common, precisely-calculated frequency spacing – this provides the orthogonal condition, see Fig. 11. The spacing is determined by the active symbol duration, i.e.

$$\text{OFDM frequency spacing} = 1/ts$$

where ts is the active symbol duration. By maintaining the orthogonal relationship of the carriers, each carrier demodulator is unaware of the other carriers, thus avoiding crosstalk and removing the need for explicit filtering at the signal demodulation stage.

Because of the large number of carriers spread evenly across the available channel bandwidth, the OFDM frequency spectrum is as shown in Fig. 12. This flat spectrum reduces the ERP (effective radiated power) required by a digital TV transmitter in comparison with an analogue TV transmitter – with the latter the carrier power is concentrated in narrow bands around the vision carrier and the chrominance, FM sound and Nicam subcarriers. OFDM transmitted energy is more efficiently spread across the channel spectrum.

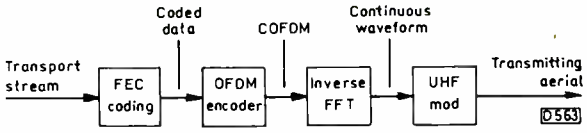


Fig. 13: Block diagram of the modulation process at the transmitter.

Coded OFDM (COFDM)

In addition to multi-path interference, a terrestrial transmission suffers from frequency-dependent interference and fading caused by the presence of isolated narrowband interference signals within the channel bandwidth. COFDM copes with this by use of forward error coding (FEC) – the C in COFDM.

Forward error coding/correction is an integral and essential part of terrestrial digital TV transmission. It enables 'soft-decision' decoding to take place at the receiver. Because of noise in the transmission path, bits can loose their original logic levels. FEC soft-decision decoding establishes whether a received bit is actually logic one or logic zero before an irrevocable decision (hard-decision) is taken about its integrity.

The procedure involves gathering information on the effect of noise on all the carriers in the multiplex. A history of possible sequences and their relative likelihood is thus built up. When this information, known as channel-state information (CSI), is combined with FEC punctured codes any errors caused by frequency-selective interference and fading can be detected and corrected.

8k/2k COFDM Modes

The European DVB (digital video broadcasting) system for digital terrestrial TV (DTTV) uses COFDM modulation with either 8k (8,192) or 2k (2,048) carriers, the symbol duration (ts) being 896μsec or 224μsec respectively. The effective number of carriers, i.e. the number of carriers that are actually used for COFDM modulation, is 6,818 in the 8k mode and 1,706 in the 2k mode. The remaining carriers are used for the guard band, and to provide continual and scattered pilot carriers. The former carry the parameters of the particular transmission while the latter are used for carrier reference.

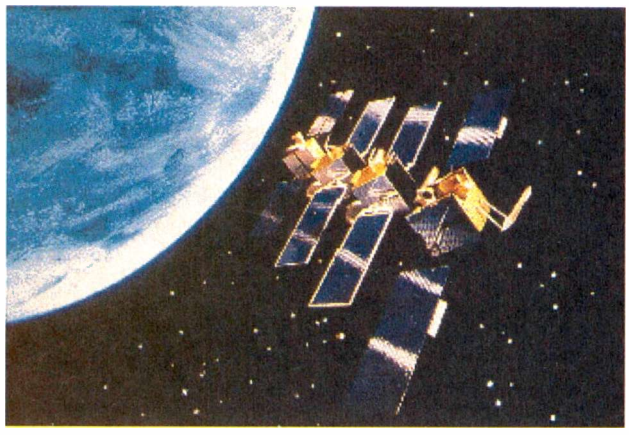
The carrier spacing (1/ts) is 1·116kHz in the 8k mode, 4·464kHz in the 2k mode, while the spacing between the extreme carriers is 7·61MHz and 7·62MHz respectively.

The 2k COFDM mode is currently used in the UK. DTTV being a very flexible broadcasting system however, the 8k mode could be introduced in the future. It's more costly, but is good for mobile reception.

Fast Fourier Transform

The series of carriers produced by COFDM is very similar to that produced by a fast Fourier transform (FFT) algorithm that analyses a continuous waveform into its frequency components. To produce a continuous waveform that can be used to modulate a UHF carrier suitable for transmission, the reverse of FFT is carried out on the COFDM carriers. This process is known as an inverse fast Fourier transform (IFFT), see Fig. 13. At the receiver end the original COFDM set of carriers is reconstructed by feeding the signal from the UHF demodulator to an FFT processor.

In Part 2 next month we will take a look at current digital TV receiver front-end technology.



DX and Satellite Reception

Terrestrial DX and satellite TV reception. Overseas and satellite news. An introduction to Digital Audio Broadcasting. Roger Bunney reports

There was little terrestrial DX-TV reception during June. The signals that arrived via Sporadic E (SpE) propagation came mainly from the south – Spain, Portugal and Italy. Reception has been so poor that I considered carrying out an aerial inspection. But the intrusive interference at 49MHz – around S9/+30dB on the scanner's signal-level meter – confirmed that the aerial was OK. It was just the poor propagation conditions at present. Here's a collated SpE reception log for the month:

4/6/99	RAI (Italy) ch. IA; Canal + (France) ch. L2.
5/6/99	NRK (Norway) ch. E2.
6/6/99	YT-2 (Ukraine) ch. R1; RTP (Portugal) E2, 3; TVE (Spain) E2-4.
7/6/99	TVE E2-4; RAI IA, B; MTV (Hungary) R1; TVA (Italy) IA; Video (Italy) E2.
9/6/99	TVE E3, 4; NRK E2; RTP E3.
10/6/99	TVE E2-4; YT-2 R2; NRK E3; RAI IA; TVA IA.
11/6/99	TVE E4.
18/6/99	TVE E3; TVA IA; RAI IB.
19/6/99	TVE E3, 4; RAI IA; SRT (Syria) E2, 4.
20/6/99	RAI IA; ORT (Russia) R2; LTV (Lithuania) R2; TVE E3.
21/6/99	RTP E3.
22/6/99	SYT (Syria) E2 plus second Arabic 'floater'; TVA IA; Video E2; RAI IA.
23/6/99	NRK E2-4; SVT (Sweden) E2, 4; RTP E2, 3; C+ L2; YLE (Finland) E4; TVE E2-4; RAI IA.

A Turkish reporter in Kosovo reporting back to the Ankara studio.

The Italian commercial station TV-Napoli (TVA) has performed unusually well this year. Peter Barber (via TRN) tells me that it operates 'out-of-channel', with the vision carrier at 54·095MHz (the ch. IA vision carrier is at 53·75MHz).

Interference in the lower parts of Band I from 49MHz apparatus can be alleviated by using a notch filter from HS Publications, 7 Epping Close, Derby DE22 4HR (01332 381 699). There are two types. The fixed C70 provides a very narrow notch with -40dB attenuation. It comes ready aligned, though peaking for optimum local results is simple. Price is £14.95. The C71 varicap filter has similar notch characteristics but can be tuned over 47-65MHz. It sells at £17.95 and requires 12V from a standard masthead power supply, e.g. the Fringe Electronics P1290. Both filters are housed in the type of small metal case that's commonly used for Taiwanese one in/two out splitters. The prices include post and packing (UK).

Aerial Techniques is selling a 7in. monochrome portable that handles systems B/G/I/L (France) with coverage of chs. E2-4 (A-C), E5-10 (D-H1) and E21-68 (UHF). Unusually, it has baseband video/audio inputs via phono sockets. Operation is from a 12V source.

Finally a date for your diaries. The Region 1 ATV (Amateur TV) contest is being held from 1800 hours GMT on September 11th to 1200 on September 12th. Check for activity at 435MHz and 1,300MHz.

Satellite Sightings

With the end of the Kosovo conflict the number of news feeds from the region has fallen considerably. SNG trucks followed as the NATO forces moved NE through Kosovo, establishing uplink circuits at each pause in the advance. There was one outbreak of violence: as the camera panned round, a white uplink truck was seen at the far end of the main street – I suspect it was the Starbird UKI-94 truck, which was in Pec on June 21st. That same day SIS-34/UKI-494 arrived in Pristina, representing ITN. All feeds from the area have been digital, mainly via

Eutelsat II F3 at 36°E.

Earlier in the month there had been coverage of troops assembling at UK bases to fly out. On June 6th the 11·097GHz H digital feed at 36°E carried an unusual ident, "UKI-495 ch. 2 Brize Norton" and, on the same screen, "UKI-494 ch. 1 Skopje". Prior to embarkation the MOD took the opportunity to provide a press update via this circuit.

There was extensive coverage of the wedding of Prince Edward and Sophie on June 19th. I picked up a couple of feeds via 36°E, with SISLink/ITN carrying street interviews at 11·097GHz V (digital). Analogue coverage was seen via Telecom 2C (3°E) at 11·688GHz V.

On the same day 2C produced a live pop-type presentation at an unknown beach, at 1700 hours; just down the band a bit, at 11·647GHz V, I found colour bars and "UKI-90 Paris", an analogue transmission. The uplink switched off before there was any programming. Can anyone identify these two sources?

An evening C-band news feed via Arabsat 2B (30·5°E) from Sudan TV (4·077GHz, RHC), again on the 19th, provided extensive footage of Col. Gadaffi's visit to the Sudan. He's evidently popular there. Odd that during this transmission the EIRP level suddenly fell, adding more noise to the signal.

Back in Scotland the media circus found that the newly-wedded royal couple were at Balmoral. UKI-515 (BBC Scotland) established an uplink outside the royal gates in the royal rain, providing a feed at 1800 hours via 36°E (11·080GHz H, SR 5,632, FEC 3/4).

UK breakfast shows continue to use both 36°E and 21·5°W (NSS-K) for live inserts. On June 4th SIS-4 was parked on a wind- and rain-swept Blackpool sea front to enable the weatherman to present his forecast from the beach. For his 0730 offering he was huddled under an umbrella next to the Tandoori Hut take-away. The climate had become even worse by the next broadcast: as the skies opened, he had taken shelter in the uplink truck (11·634GHz H via K at 21·5°W).

While coasting across Telecom 2B/D at 5°W Cyril Willis came across an interesting digital bouquet, eleven channels at 11·493GHz V (SR 27,500, FEC 3/4). Most were encrypted, but a couple produced colour bars and the UK "Brookmans Park" ident. Cyril has also come across increased activity via the new Arabsat 3A at 26°E, with digital bouquets at 11·767GHz and 12·034GHz H, SR 27,500, FEC 3/4. You can find Sharjah, Saudi-1, Kuwait, Libya, Oman, ANN, Jordan, Palestine, Algeria, Future, Aljazera, LBC Lebanon, Yemen, Bahrain, Syria, Dubai and Morocco here. I checked and can confirm that all these channels were present with excellent quality. I also found channel IQRA at 11·767GHz: it seems to have predominantly religious programming. Pity Israeli TV cannot appear in the bouquet.

There are still plenty of analogue signals about. While checking Eutelsat II F2 (10°E) on June 27th at 1720 I came across a prolonged news feed from a remote site for Star TV, Turkey. This was at 11·145GHz V with the audio at 6·60/7·02MHz. At the same time American Fox Sports was preparing coverage of the WorldBall '99 European Championship between Frankfurt and the Barcelona Dragons in Dusseldorf (final of the NFL European League). This was at 11·616GHz V.

Football fans might find it worth checking Telecom 2C (3°E) for Setanta Sports football, which is in clear analogue form, on Sundays from mid-late afternoon. On the 20th UKI-DGSP (BBC Northern Ireland Unit) was uplinking a game for Dublin.

Motor cross sport was carried for International Sportsworld Communications on June 6th from 1830 via NSS-K (21·5°W) at 11·615GHz V. On the same day, via the Belgacom lease at 36°E, the Italian Motor Cycle Grand Prix was featured from 0900. This was at 11·170GHz H.

Terrestrial News

UK: The ITC has received 67 applications for RSL-TV licences in its latest offering. Two large regional paper groups have fronted applications for the Birkenhead area. The Asian RSL-TV station MATV, Leicester, opened on May 27th. It transmits for eighteen hours daily in ch. E68, running at 4kW, and serves a population of one and a quarter million.

Ireland: I have been told by TRN, Derby that the high-power ch. B (53·75MHz vision carrier) Maghera-Gort RTE-1 transmitter has closed down. This deprives us of yet another source of possible SpE signals. Gort was listed at 80kW horizontal, but in recent times ran at a lower ERP level. It had often been received across Europe as an SpE signal, and was occasionally received in the UK via tropospheric propagation.

France: The daytime educational channel La Cinquieme and the cultural channel Arte are merging to form a fifth terrsterial service. Other changes, introduced with the latest government broadcasting bill, include less advertising on the France 2 and 3 networks – the reduction is from a maximum of twelve to eight minutes an hour. The main public service channels

This signal is at the digital threshold, the symptoms being pixellation and lock-up. With further reduction in signal strength the screen blanks out.

A dual-based SNG feed via Eutelsat at 36°E.

will gain valuable subsidies, totalling over £240m in the current year, though there are to be moves to try to find other ways of maintaining finances.

Germany: All RTL-2 transmitters in the Hessen region are to close because of poor viewer figures. Limberg ch. E34 and Marburg ch. E60 have already ceased transmissions: the others are to close by September 8th.

Baltic states: All Estonian TV transmitters are being converted from PAL to Secam and will adopt CCIR E channel frequencies instead of the present OIRT R channel frequencies. Tallin ETV-1 (120kW ERP) is moving from ch. R1 to ch. E2 with, I presume, 5·5MHz sound-vision spacing. Latvian TV is to move to PAL though retaining the R channels. There are no plans for transmission changes in Lithuania.

Spain: The second TVE channel, LA 2, is to become a cultural programme. This December will see the start of the first DTT pay-TV service, Onda Digital, with fourteen channels. It will be in competition with Canal+ Digital and Via Digital for digital subscribers.

Turkey: CNN is to start CNN Turk, a terrestrial news channel.

Australia: Nine Network commenced DTT tests in the Sydney area in June and plans to start a full DTT service in January 2001. Transmission will be in ch. A8 (188-195MHz) at 50kW from the Willoughby site. Australia has adopted the DVB rather than the ATSC standard. There has been widespread concern over possible interference to hospital equipment.

Satellite News

BBC World has become available 24 hours a day via the Russian NTV analogue/digital subscription service. The Israeli company TEL-AD is negotiating with E! Entertainment TV Networks to provide an Israeli E! channel. Canal+ is moving into Asia in partnership with ZEE-TV: they will be offering a 100-channel encrypted service from this autumn.

Sony is providing hardware, servers etc. for the new Canal+ Info Channel which opens as a 24-hour digital TV service on November 4th. This date is Canal+'s fifteenth anniversary.

The PanAmSat PAS-9 is to be launched next spring, providing C- and Ku-band coverage over the Americas and Europe. PanAm intends to expand its Latin American services.

RTP (Portugal) is to relay TV services across Africa via Intelsat 605 (27·5°W), moving to Intelsat 905 when this is launched in 2002. RTP will provide three services, NET RTP, RTP International and RTP Africa, via high-powered C-band downlinks.

Agreement has been reached between SES Astra and Eutelsat over the use of the 28° slot. See Teletopics last month for further details.

The high-powered Eutelsat SESAT craft was launched in late July. Check at 36°E. The satellite has eighteen transponders with coverage from the Atlantic to central Asia via wide and spot beams. Downlink frequency ranges are 10·95-11·2GHz, 11·45-11·7GHz and 12·5-12·75GHz. This bird could provide real satellite DXing.

If you are considering the purchase of a new digital satellite receiver, here's a bargain. RSD has just introduced a new model that incorporates a CA module. But the free-to-air 1998 Model ODM300, with latest software, 500 memories etc., is on sale at £179 (inc. VAT) ex-factory (phone 01786 450 572 for further details). I have an ODM300 and find it very easy to use. Set the SR and FEC to auto, tap in the frequency and the receiver works the rest out for itself, putting the hopefully discovered signal straight into the memory. I carry out a digital band search using a cheap Manhattan analogue receiver in the scan mode: when it stops at just noise or a slightly darkened noise screen a digital signal is likely to be present.

Finally a warning. The Praxis 9800ADP receiver, made at the Korean Handan factory, has been given good reviews in UK and German satellite magazines. However the factory manufactures the same receiver for Echostar – Model AD2000IP. Praxis originally had marketing rights in the Middle East/Asia, but then started to sell in Europe in competition with Echostar. As a result, Echostar has forced Handan to cut off supplies to Praxis. Anyone considering a European/UK purchase of the Praxis model should first check on the service/spares/upgrade back-up facilities.

DAB

Digital Audio Broadcasting (DAB) is slowly – very slowly – becoming established in the main UK centres of population. The BBC has been carrying out tests and trial broadcasts (ten programmes) from Crystal Palace since Autumn 1995. Now commercial broadcasters are taking an interest. The Birmingham and Manchester multiplexes have been allocated to CE Digital. There are three applicants for the London area multiplex, CDE Digital, Switchdigital and MXR London. Score Digital has applied for the Glasgow multiplex. The ITC is awaiting applicants for the Newport/Cardiff, South Wales, Tyne/Wear and South Yorkshire multiplexes. More are to be announced, and by July 2001 two national services (BBC and commercial radio), six regional and twenty local services should be in operation. The commercial franchises will last for twelve years initially.

There's unlikely to be a profit bonanza for the radio/TV trade, initially at any rate. The only domestic tuner, the Arcam Alpha, currently sells for about £800. Media watchers think that take-up will be between 5-11 per cent by the end of 2007 – assuming that the cost of a tuner falls to about £350.

To be successful, broadcasters will have to provide extensive new programming rather than relying on simulcasting the present FM/AM services. The BBC will offer more talking radio, but commercial broadcasters are likely to concentrate on music channels, special interest programmes and ethnic-language services.

The initial DAB allocations are in the 217·5-230MHz band (chs. E11-12), with vertical polarisation. In the more distant future there may be allocations in the L band, at around 1,466-1,492MHz. The Arcam tuner covers 174-230MHz and 1,450-1,492MHz. Siemens has

designed a domestic DAB decoder/IF/RF package and has produced prototypes for setmaker testing.

DAB transmission uses CODFM (Coded Orthogonal Frequency Division Muliplex), as with DTT. Low transmission data rates (1kbits/sec using QPSK) with Musicam compression enable in excess of 1,500 carriers to be used within each 1·5MHz channel block. FEC enables much lower transmitter powers to be used than with analogue services (5-10kW ERP in most cases compared with typically 100kW, the DAB receiver requiring just a few dB above the nose level). The result is excellent receiver signal/noise figures with interference/multipath rejection as a bonus.

Many radio channels plus data information can be crammed into each 1·5MHz channel. The 217·5-230MHz band had been divided into seven 1·5MHz channels with 200kHz guard bands in between. The channels are at present known as 11B, C, D and 12A, B, C and D. For more information, coverage maps and local DAB block occupation apply to BBC Digital Radio, 505 Henry Wood House, Langham Place, London W1A 1AA (08700 100 123).

One of our readers, Dave Wiltshire (North Hampshire), has already gained considerable experience of DAT reception using an Arcam Alpha-10. His local station (Hannington) transmits a BBC multiplex (BBC Radio 1-5, Parliament, Promo, World Service and test) at 225·648MHz. After acquiring an elderly 405-line, five-element Band III aerial he tried reception (sort of DX) from the Crystal Palace, London transmitter which runs at 10kW ERP. In late April Dave found Classic FM and Digital One Test 1-6 on the 224·064MHz multiplex; GLR 94·9, Heart 106·2, Sunrise Radio and Virgin (London and WRN1) on the 220·351MHz multiplex; and the BBC multiplex at 225·648MHz. Interesting that Classic FM ran at a data rate of 192kbits/sec, stereo, whereas Sunrise ran at 64kbits/sec mono. The receiver has an LCD readout for displaying messages etc.: Classic FM has been scrolling for comments from listeners.

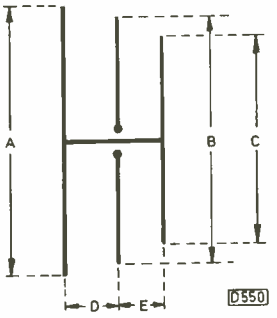


Fig. 1: Simple three-element aerial design for 215-230MHz reception. A (reflector) 27in.; B (straight dipole) 25in.; C (director) 23in.; D 8·5in.; E 6·5in. Additional directors could be added, but the dipole would have to be folded to maintain matching to the 75Ω downlead cable.

Fig. 1 shows a simple three-element high Band III aerial design in case you want to experiment. You could make it from an old Band III aerial or cut down an FM Band II aerial.

Dave found several web sites that are very informative and worth a visit. These are:

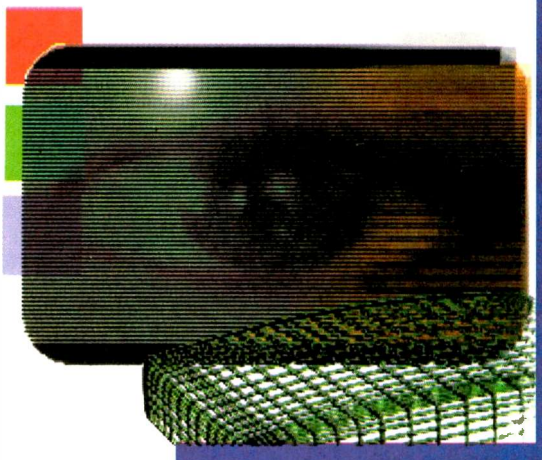
www.gwrgroup.musicradio.com

www.bbc.co.uk/cgi-bin/random.pl/dab

www/bbc.co.uk/info/reception/rpb/dab.shtml

www/ctxi.com

My thanks to Dave for providing this information.



Monitors

Reports from
Ian Field
John Edwards
Chris Hawkins and
Russ Phillips

CTX 1565D

This monitor was dead with the LED out. There was voltage at the drain of the chopper MOSFET in the power supply, but nothing at any of the pins of the KA3842A chip IC101. The transistor-assisted start-up resistor was producing pulses, but the second transistor, which acts as a safety shut-down, was clamping them before they reached IC101's supply pin. So the 3842 was doing something after all – but it was doing it too fast for my DMM to be able to respond.

This suggested that an overload or excessive voltage was activating the safety trip. The most likely suspect was the 2SK890 B+ chopper MOSFET Q401, which proved to be short-circuit. It's rated at 200V, 10A, 75W. Sometimes the line output transistor or transformer can be the basic cause of the trouble, but in this case the damage had been caused by C729 (0·33µF, 400V) which was dry-jointed and arcing. **I.F.**

Project LM1564

The customer had a forthright way of putting things: "grotty picture" it said on the job card. The display was dull, murky brick red with comet-tail type smearing from the top to the bottom of any sharp contrast change. The symptom was similar to what you get when the video HT reservoir capacitor C716 (10µF, 160V) fails. But this time it was innocent.

The culprit was Q761 (2SC3954), which is the common-base transistor (the one with the heatsink) in the cascode green output stage. It had severe base-emitter leakage.

This explained the lack of green in the display, but not the murkiness of the red and blue. The three common-base RGB output transistors share a bias voltage at their bases, also a blanking pulse feed. Q761's leaky base-emitter junction was clamping the pulses and upsetting the bias voltage. **I.F.**

Tystar TY1415

The on/off switch seems to be a weak point with this model. It is usually of the type with 'turned-pin' style solder posts. The sturdier version of the same switch, with 3/16in. spade terminals, seems to last longer – but the tags must be cropped or shaped, as the CRT's Rimband is very close. People put things on top of monitors, and the cabinets flex! **I.F.**

AST LR14

C322 had melted and, unusually, the line output transistor Q312 (2SC3885A in this version) was undamaged. The RGP02-8 efficiency diode D313 is the same size as a regular 1A plastic diode. This monitor usually has a line output transistor with integral efficiency diode, e.g. a 2SC5003: the Toshiba data book confirmed that the 2SC3885A does not incorporate a diode.

D313 is more likely to suffer a corrosive attack from brown glue. If it looks tired, I replace it with a larger device of the type used in the equivalent position in a different chassis. A BY359F1500 should adequately exceed the required specification. **I.F.**

Digital PCXBV-BC

The power supply in this Philips-manufactured monitor was tripping, with the degaussing relay clunking loudly in sympathy. Checks showed that the BU2525A line output transistor was short-circuit.

There was a fair amount of heat-degraded soldering around the transistor and associated diodes. In addition, a crust of baked flux covered the 10kΩ surface-mounted resistor near the EHT-adjust preset 3618. This resistor is alongside a 2·2kΩ surface-mounted resistor. Both are connected to the emitter of a surface-mounted transistor. When I carefully scraped away the flux I found that the components seemed to be in better condition than expected. Checks confirmed that they were OK.

The two 'buck-regulator' MOSFETs had already been proved to be OK. Once a new line output transistor had been fitted and the soldering in this area had been made good, there were no further signs of distress in the EHT adjustment circuitry. **I.F.**

Mitac 1564PDM/ Ecoscan 15

The fault sheet said one colour missing. So I took a look at the CRT base panel and found that C707 (1µF, 50V) had attempted a blast-off, but had run out of steam as soon as it had ejected the rubber seal! C707 is in parallel with two other 1µF, 50V capacitors, C727 and C747. They all decouple the 12V supply, which is common to the three RGB output stages. C707's failure would therefore not be the cause of the fault symptom complained about.

As I made further checks on the CRT base panel I became increasingly suspicious. I decided to remove the VGA plug from the PC and found that it had been damaged by being forced in with pin 2 bent. It was now so neatly folded flat against the inside of the plug shroud that it seemed to fit normally!

If there's a suspected fault on the CRT base panel, the OSG plug can be removed to eliminate the possibility of trouble on the digital display board. Also, the OSG drive transistors (Q702, Q722 and Q752, all type 2SC945) can be removed without affecting the analogue circuitry.

If you are working on the CRT

base panel, reassemble the monitor to test and find that it's suddenly dead, don't panic. Check whether J707 has pulled out. It supplies sync pulses to the main board. Without these the 'green switch' shuts down. **I.F.**

NEC Multisync XV14/ JC 1433VMB

This monitor would start from cold all right. But if the power was interrupted for any reason the monitor would refuse to restart – unless it was left for about a day. Instead, the power supply would tick a few times then shut down. The cause of this was a start-up resistor, but not the one in the main power supply. This chassis has a small auxiliary chopper power supply to run the front-panel microcontroller circuit. I assume that failure of this power supply to start meant that certain load-switching devices weren't activated, the main power supply then shutting down because of incorrect loading.

The auxiliary power supply is based on transformer T902 and transistor Q971 (2SC3150). Its start-up resistor R9D4 (680kΩ) feeds the base of Q971. When I checked it I found that it was beyond the range of my DMM (>20MΩ), but it provided sufficient bias to start Q971 from cold. My theory is that current via the optocoupler affects the start-up when the power supply has been in operation. **I.F.**

Compaq 460P

This monitor's mains fuse had blown. I found that D908 (BYV26E) was short-circuit. It's between one of the primary-side tappings on the chopper transformer and the negative terminal of the reservoir capacitor. **I.F.**

Data General 6628/ Compaq 420T

The elderly CRT in this monitor required the usual 'massage', which is done by temporarily bypassing L354 in the heater feed and running for a few hours with a peak-white raster. As usual, this restored a reasonable level of tube emission. In a severe case, a few turns of L354 can be shorted to reduce the voltage drop across this coil. Only one or two turns need to be shorted, because a single shorted turn affects all the unshorted ones as well.

During the following grey-scale set up I noticed that the front panel brightness control had no effect. When I followed the path from this control I came to a three-pin connector that had been neatly Ty-Rapped to the wiring harness. This plug should go to the PCB socket marked VR306. It took some finding, as it's almost concealed beneath the VGA cable close to the metal P-clip.

Brown glue also played its usual part in this monitor's downfall. **I.F.**

ICL ERGOPRO 141P (JVP7134T)

This monitor's power supply was tripping silently, so R603/4 (33kΩ, 2W) weren't open-circuit. And as HT was present at the collector of Q310 (BU2508AF) it wasn't short-circuit. The chassis has a number of power-switching transistors to select different taps on the secondary side of the chopper transformer for various scan rates. Sometimes one of these will fail and there will be excessive HT at the line output stage. Depending on which transistor has failed, the monitor may continue to work in DOS's default start-up mode, and may even continue to operate in whatever resolution Windows has been set to run. Sooner or later however a mode that reveals the fault will be selected. This monitor had failed in the DOS mode anyway.

In this particular version of the chassis the switching transistors are Q703, Q701, Q705 and Q712 (all type 2SB649A). Newer versions have more transistors, older versions fewer. In this monitor Q712 was the culprit.

It's easier to check each transistor for leakage or being short-circuit than to test the monitor in all possible resolutions. As usual with this chassis, the monitor worked all right once the offending transistor had been replaced, proving that the overvoltage shut-down works very well. **I.F.**

Packard Bell 1412SME

This monitor had a blank raster. I discovered that the CRT's heater supply was missing. D810 was open-circuit and its reservoir capacitor C814 was short-circuit. **J.E.**

Packard Bell 2020/FCC ID DK42020

A local computer shop brought this monitor in, the complaint being that its 1·25A mains fuse (F101) blew instantly at switch on. I clipped a 100W bulb across the empty fuseholder, unplugged the degaussing coil and gingerly switched on. Sure enough the bulb lit up at maximum. Before probing around I discharged the 220µF, 400V reservoir capacitor C105, using the same bulb.

Some measurements revealed that the 2SK1118 chopper MOSFET Q101 was short-circuit. As I didn't have one in stock I replaced it with an IRFIBC30G (the fully isolated version of the IRFBC30). The UC3842AN chopper control chip U101 was also replaced as a precaution. I then carried out some checks on the secondary side of the power supply, and found that the HER305 HT rectifier D111 and the BU2520AF line output transistor Q307 were both short-circuit. The 5·3nF, 2kV tuning capacitor looked dodgy as well. Once these various items had been replaced the monitor ran correctly. A U5408 can be used to replace the HER305. **C.H.**

Packard Bell 2020/FCC ID41CM15006

Externally this monitor was indistinguishable from the previous 2020, but the innards were completely different. It had already been got at, and someone had forgotten to put the line output transistor (Q424) back. Not knowing what it had been, I fitted a BUH515. I also replaced the 5·6nF, 2kV tuning capacitor C430. The monitor then worked, only a few adjustments being required.

Note that Q802 is a MOSFET, usually an IRF630 or a YTAF630, but the PCB markings say ECB instead of SDG. **C.H.**

Philips 17A280BQ/02C

The complaint with this monitor was that it would die intermittently. Resistor 3944 on the primary chopper power supply board was open-circuit. It's value is 1MΩ. **R.P.**

DELL D1528LS

Frame collapse is usually caused by failure of the TDA8172 output chip I302. When it fails make sure you check Q305 (2SD471A) and Q306 (2SB564A). **R.P.**

AOC CM335

If one of these monitors comes in dead, check R101 (2·2Ω, 10W). It sometimes goes open-circuit. **R.P.**

Tatung TM4422

This 'dead' monitor made a noise that sounded like an arcing CRT. On investigation I found that the mains bridge rectifier's reservoir capacitor CE806 had gone very low in value. A capacitance check produced a reading of 15nF instead of 100µF (400V). It looked perfectly all right physically. **R.P.**

Letters

We welcome letters from our readers and try to publish as many as we can. You can send them typed, handwritten, or on disc. Address them to the Letters Editor, Room L302, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

What Future?

The crunch we have been hearing about for years has arrived. Most of you will have noticed a rapid decline in the demand for servicing and in the sale of second-hand TV sets, VCRs and satellite equipment. Computer hardware and monitors are going the same way.

The disastrous fall in the prices of new goods in the shops means that the latest equipment is readily available to even the least affluent. The future for us as engineers is very bleak, because the cost of carrying out a repair is virtually the same as the cost of a new product – which will, of course, have a guarantee.

Our costs go up and our profits go down. We can't go on in this way forever. Our suppliers are also seriously affected. Wholesalers and distributors, as well as some manufacturers, no longer keep many items in stock. Who can blame them? Stock costs money, and stock that doesn't shift becomes dead stock. Unless it can be moved fast you might as well not stock it. The consequence is that on those increasingly rare occasions when a customer does want old equipment repaired any spares required take longer to arrive – if they arrive at all!

What about the future? Portable TV sets and most VCRs are now throw-away items. This is also true of some hi-fi equipment. But larger and more expensive equipment will still need to be serviced. Who will do it?

If you were starting your career now, would you become a TV/VCR engineer? If I had my time again I certainly wouldn't, and I wouldn't recommend it to anyone starting out. Indeed I feel that the time has come for me to change career – if I can. So will it be possible in future to get repairs carried out?

It is surely not essential for electrical goods to become ever cheaper. I would lay odds that if a basic VCR cost £250-£300, with Nicam models costing £400-£500, large quantities would still be sold.

I am told that the test equipment required to diagnose faults in digital equipment will cost thousands of pounds. Figures in the region of £30k-£40k have been quoted. Let us assume that you decide to take the plunge and make the investment. As any business person will tell you, you would expect to get a return on your money. After all if you simply left it in the bank or building society you would at least earn some interest. Would you, over say five years, earn an equivalent amount on your digital equipment investment, not to mention getting your money back? The answer is probably no.

The situation is even more serious if you don't have the money to invest. You will have to borrow it, and no lender is going to provide that amount of money without security. For most of us this means our home or business. Is it worth the risk? The answer, again, must be no.

The way in which digital satellite and terrestrial TV set-top boxes are being handed out for next to nothing gives the public the impression that there's nothing of value in them and that the technology is worthless.

I am told that in future only those who are really serious about servicing and are prepared to invest heavily in new equipment and in keeping up to date with the technology will be able to stay in the business. But in the meantime I, like the rest of us, have to provide a roof over my head and sustenance for my family. Right now it's not easy to see how this can be done.

Michael Maurice,
Wembley, Middx.

Test Card Music

In the March letters page Keith Cummins asked for information about a CD of test card music entitled The Girl on the Test Card. Two CDs are in fact available, and I have them in my collection. The first is Test Card Classics – The Girl, the Doll, the Music (FBCD2000), the second Test Card Classics – Big Band Width (FBCD2001). They are the original BBC recordings and should be available from Flyback, Chandos Records Limited, Chandos House, Commerce Way, Colchester, Essex CO2 8HQ (phone 01206 225 225).

G.A. Grayson,
Middlesbrough, Cleveland.

Like Keith Cummins I was reminded of long-gone days by Don Bullock's recent comments on test card music. The test card or, rather, its accompanying music was something that brightened the working day. Most of the lads in the medium-sized workshop where I worked in the Sixties had their favourite pieces, which would often be accompanied by improvised percussion – usually involving a screwdriver and the metal shade of the bench lamp. This did nothing for the life expectancy of the bulbs!

Sadly, like so many other things that made being a TV engineer the Best Job In The World, test card music is now a thing of the past. There are two CDs, catalogue numbers FBCD2000 and FBCD2001, under the general title Test Card Classics (for further details see letter above – *Editor).* They were first issued about two years ago. I ordered mine through a Virgin record shop – some shops will not order minor label products.

Most of the tracks, which are mainly from the mid-Sixties to the mid-Seventies, were originally

recorded in stereo and sound quite spectacular after years of being heard in mono. FBCD2000 contains varied types of music. As suggested by its title, FBCD2001 is mainly big-band tracks.
Tony Blakemore,
Ripley, Derbyshire.

I bought my copy of Test Card Classics – the Girl, the Doll, the Music at a CD shop near Oxford Circus in December 1997. It came complete with a picture of Effy on the front.

Not long since a freelance sound engineer told me that one of his recent jobs had been to compile and digitise more Test Card music, so there may well be more forthcoming.

As a young record collector I remember saving up to buy Sounds Like – Herb Alpert and the Tijuana Brass, later retitled Sounds Happy, only to discover that it was the album used by ITV to accompany Test Card C around midday during 1967-8!

While on this subject, how many out there remember the BBC's pie-chart clock, used from about 1963 to 1967? There was a picture on page 864 of the September 1990 issue of *Television* (Fig. 12). This was originally a two-minute film that heralded the start of a school's programme.

The first minute was of the five-sectioned 'pie chart'. As the second minute commenced, the BBC logo in the bottom right-hand corner faded and the pie was animated to reveal a black clock face underneath (I even recall a slight animation fault at about the twenty-five to position!). This is not to be confused with the later version, which was performed 'live'.

In the later version the first minute appeared as before but was a video still. For the second minute, a larger black clock with a white second hand that revolved to count out the last minute cut in. Sometimes it would refuse to revolve on request, and consequently became out-of-step with the music, which had to be faded – sometimes up to ten seconds early.

The music used in this second version was a mainly percussive piece, in three-quarter time, with tambourines, shakers, vibraphone and marimba – only the BBC could have commissioned it!

My problem is that no one I've spoken to seems to remember the music used with the original animated version that made such an impression on me. It was in common time and was played by a string quartet. Any suggestions about its identity or, better still, its whereabouts?
Peter Graves,
Clapton, London.

In addition to the Flyback CDs there is Testcard Music Volumes 1 and 2, which are available on the Apollo Sound label. These CDs can all be obtained from HMV music stores or ordered from any good record shop.
Peter Litler,
Stockport, Cheshire.

Matsui Colour Portables

A few years ago the most common fault with the Matsui 1420, 1440 etc. was failure of the STR50103A chopper chip. We now find that failure of the scan coils is much more common. Investigation has shown that it's caused by the three rubber wedges which are used for static convergence adjustment. They undergo some sort of chemical change, becoming moisture absorbent. When the wedges are pushed into the yoke they come into contact with the line scan coils and the moisture attacks the enamel. This shows where the winding becomes green. The eventual result is shorted-turns, with burning.

In most of the sets we've checked the rubber wedges have become very hard and have taken on a shiny appearance – as if they are wet. Multimeter probes touched on the surface will usually produce a reading of between 50-200kΩ. The tubes that seem to be affected most are those manufactured by Orion.

After repairing one of these sets we now always check the rubber wedges. If they are soft to touch and matt black in appearance no further action is required. If the rubber is hard and shiny however the wedges are removed, wrapped with insulation tape, then refitted. Remove them one at a time and resecure with silicone rubber. This will ensure minimum, if any, need to reconverge the scan coils.

Perhaps someone with a background in chemistry could explain what happens. I didn't think rubber could become moisture absorbent – otherwise it wouldn't be used to make wellington boots!
Michael Dranfield,
Buxton, Derbyshire.

Monitor Repairs

While most monitor faults are similar to those you get with TV sets, fault finding can take much longer. There are two reasons for this: difficult physical layout, and the fact that you can seldom obtain a circuit diagram.

I now charge a non-refundable fee to check out a monitor. Parts are often scarce or too expensive – if you are lucky enough to track down the manufacturer's spares department. On all too many occasions I've fixed a monitor then provided an estimate, often after a lengthy fault-diagnosis session and numerous phone calls. Sometimes I have gone to great lengths to obtain a spare part to confirm that there was nothing else wrong, only to have the estimate refused. The same can happen with TV sets and VCRs of course – but not nearly so often.
John Edwards,
Welling, Kent.

CD Player Mystery

I've recently repaired two JVC UXA5 micro hi-fi CD players. Both had sound drop-out symptoms. The problem was worse with the higher track numbers, and became so bad that even track one wouldn't play properly. The machines were both of the same age, but one had been used much more than the other.

With the first machine I started off by replacing the Optima 5 laser unit, but the fault didn't clear until I replaced the spindle motor. With the second machine I replaced the spindle motor first then had to replace the laser unit. I'd previously swapped the spindle/optical units over to prove that the electronics were OK.

Does anyone know what the real fault was? I don't believe that the motor and laser unit can both deteriorate with time, not use, at the same rate!
Ray Porter, M.Sc., C.Eng., MIEE,
Stourbridge, West Midlands.

Ferguson ICC5 Chassis

I had an unusual problem recently with a Ferguson Model 59M5 (ICC5 chassis). It first came in with a short-circuit line output transistor. This was replaced, along with the flyback tuning capacitor which had been arcing. A few days later the set came back with the line output transistor once more short-circuit. I couldn't find any reason for its failure, but the heatsink was a lot hotter than expected. Ferguson technical suggested various component replacements, but none of them made any difference to the temperature. Instead of a plastic S2000AF line output transistor I

fitted a metal BU508V, which lasted for a few weeks before the set came back again.

While the set was being soak tested on the bench I noticed that the line output stage heatsink was hotter nearer the chopper transformer, away from the transistor. I fitted the transistor to a temporary heatsink on the bench and was surprised to find that the original heatsink was still overheating, with no components on it. It occurred to me that the cause could be magnetic radiation from the chopper transformer, so I took it to a local coil-winding company for advice. I was told that the heating effect was caused by magnetic leakage, as the transformer had been made with a large air gap on the outer legs of the ferrites. The recommendation was to fit a shorted but insulated copper 'belly band' around the outside of the windings and core to cover the air gap, thus reducing radiation from the gap.

Before I did this I found that a transformer on a scrap ICC5 chassis didn't have an air gap on the outer legs (the centre leg would be gapped instead). When I fitted this transformer the heatsink ran normally. The set has been working for several months.

I've now had a 68M5 in for replacement of the back-up battery and noticed that the flyback tuning capacitor had started to arc. So this was also replaced. A week later the set was back with the line output transistor short-circuit. I fitted a replacement and left the set on soak test. Once again the heatsink was getting very hot, and the transistor lasted only a day. This time I fitted a belly band around the transformer. The heatsink is at normal temperature and the set now works well.

I've not come across mention of this problem with the ICC5 chassis anywhere, and feel that I am curing the symptoms rather than the cause. Could it be that the newer transistors are not capable of running at such high temperatures? Has anyone else had this problem. Can anyone offer any suggestions?
M.J. Bennett, LMB Electronics, Romford, Essex.

Unbelievable

A customer brought in a Philips Turbo deck VCR and said there was a picture fault. Easy I thought – dirty heads, pinch roller, nothing serious. Silly me. After a thorough test I could find no fault.

I phoned the customer to let him know the situation. He asked me to bring the VCR to his house to check the connections to his TV set. When I did this the machine produced perfect pictures. The customer wouldn't pay me, because I hadn't done anything to his video. He then told me that another company had repaired it three weeks previously. He explained that he is busy and can't take it back to them.

As I left the house I thought "you can't win them all".

A week later, just as I was about to have my evening meal, the phone rang. It was the same customer.

"That b****y video you brought back has gone wrong again. I want you to come round *now* to sort it out."

"No thanks" I said, "why don't you take it back to the original repairer?"

"I'm too busy" he replied.

"So am I" I said, replacing the phone gently.
Jim Lee, JLTV, Dagenham, Essex.

Salora M Chassis, CB Radio

I feel sympathy for John Edwards who wrote (letters April, page 404) about an EW problem with the Salora M chassis (Hitachi Model C25P759). My articles in the August and September 1997 issues suggested a line output circuit rebuild. I've checked the components in this area many times and have found that though they read OK they break down under load. This is particularly the case with the three diodes (DB523/524/525) in the line output transistor's collector circuit. They are quite often the cause of failure of the line output transistor and the BS208 EW driver FET. I recommend replacement rather than checking. As to the costly BS208, I have never fitted an Hitachi-specification transistor in one of these sets. I always use a transistor from CPC, part no. SCBS208. It's priced at 29p, and I have never had a repeat failure.

In my article on repairing CB radios (March 1999, page 310) I mentioned one or two sources of components and circuit diagrams. The business previously handled by S.J. Tonks is now handled by Astra Communications, 5 Hartburn Close, Crow Lane Industrial Estate, Northampton NN3 9UE (01604 402 403).
Chris Watton, Wrangle, Lincs.

ONdigital STB Timer

I initially assumed that the timer in my Philips DTX6370 ONdigital STB would operate in the same way as the timer in a VCR. Not so. Once the on/off programme times have been set as required, the timer automatically subtracts five minutes from the start time and adds five minutes to the stop time. I assume that this is a useful built-in safeguard to ensure that the programme is not partly missed. But if two consecutive programmes on different digital channels are set to their published on/off times with a one minute gap, as you do with a VCR, the first channel will switch on OK (five minutes early) but the STB will remain on that channel until five minutes after the second programme is due to finish. The second programme is therefore not recorded. No mention of the built-in five-minute safeguards or this overlap effect is made in the operating manual.

The anomaly can be allowed for as follows:

Timer 1: Set programme one to start at the normal time, giving a five-minute safeguard at the beginning. Set it to finish four minutes early, giving a one-minute safeguard at the end.

Timer 2: Set programme two to start five minutes late, giving no safeguard at the beginning. Set it to finish at the normal time, giving a five-minute safeguard at the end.

I don't know whether the timers in other manufacturers' STBs are similar.
Chas Mussell, Portsmouth.

TV Set Conversions

I run a TV service business that specialises in converting sets brought from the UK to Australia. Over the past two years more and more sets have been of the digital type, which require a completely different approach to conversion. It involves putting the set into the 'service mode', after which a qualified serviceman can use the remote control unit to carry out the adjustments required.

Unfortunately, details of these adjustments are in many cases not included in the service manual and are not available to people who, like myself, do not reside in the UK. The result can be a very irate customer who may have to send the set back to the UK or dispose of it.

My attempts at obtaining information, circuits etc. have all too often met with little success.
E. Samek, Applecross, Western Australia.

Answer to Test Case 411

– see page 753 –

Cathode Ray had done well to get as far as he did with his diagnosis of the fault with the ancient VCR, which was nearly as old as himself and whose like he had never seen before. The tacho pulses from the drum were at about half the required amplitude, and were thus insufficient to trigger the flip-flop that drives the head switching, phases the chroma processor, helps maintain the tracking phase – and keeps the syscon happy.

In more modern designs the PG pulse is generated deep inside the drum motor. Thus a PG problem very often necessitates motor replacement. In this old-timer however the PG generator is separate from the motor. It consists of a stationary coil and a flywheel-mounted magnet that wizzes past it. The pulse amplitude had fallen for the good and simple reason that the drum flywheel had slid down its shaft, away from the coil – possibly when the machine had been banged down on the counter in the shop!

All TechnoCrat did was to push the flywheel back up the shaft and tighten its Allen grubscrew. Miraculously, this cured the pause-key problem as well: some quirk of the syscon design, perhaps. Meanwhile, does anyone know whether these machines really have acquired great value? Should we all be seeking and hoarding them?

NEXT MONTH IN TELEVISION

Tuner in a Chip
The conventional varicap tuner has held sway for over a quarter of a century. It is one of the remaining stalwarts of traditional TV receiver design. This could be about to change. In recent months a complete multiband tuner in IC form has become available. Eugene Trundle reports on a significant breakthrough in IC and TV technology.

Servicing Panasonic NVSD200 series VCRs
ATP (Automatic Tuning Procedure) was introduced with this range of VCRs. Brian Storm explains the system and provides fault-finding help.

Microsoft's WebTV
Microsoft, best known for its PC software, has become increasingly involved in broadcasting. It has developed set-top box software and owns WebTV, an internet TV format. George Cole reports on these developments.

Digital Front Ends
K.F. Ibrahim describes the satellite and terrestrial digital TV tuning and demodulation technology used in current STBs and IDTV receivers.

Free-to-air Digital TV
Digital TV is not all pay-TV. There are plenty of free-to-air channels from a number of satellites. Ian Martin reviews a suitable receiver, the RSD Communications ODM300, and reports on what's available from the skies.

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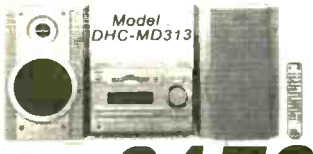

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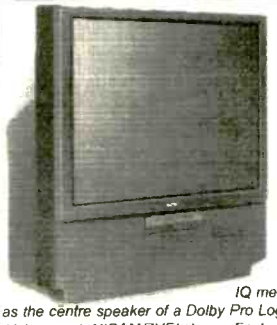

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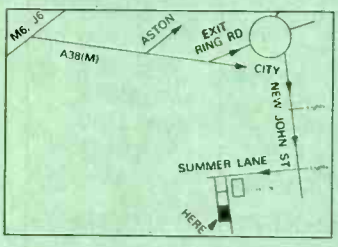

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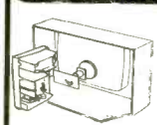

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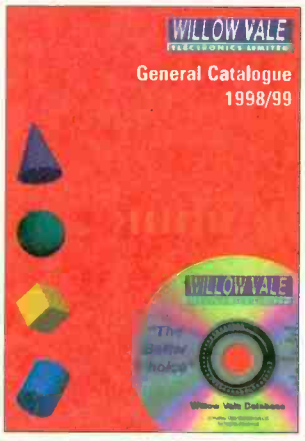

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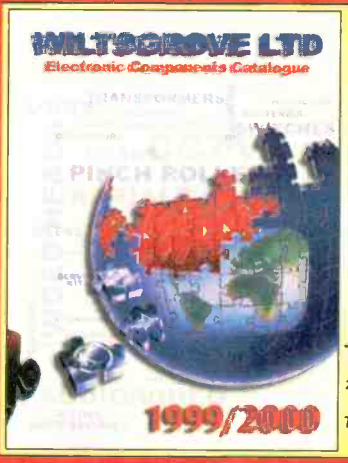

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7812F	20p	2SD180T03	15p	BU208	80p	BUT71/800	15p	BYX10	10p	HEF4093	20p
2SC930	£1.00	2SD1878	£1.00	BU208A	£1.50	BUW11	40p	BYX38/300	25p	HGA1124A	50p
2SC3795	£1.00	2SK1460	£1.00	BU208D	90p	BUX84	60p	BYX55/350	10p	HM6264	
2SC3973B	£1.00	2SK1464	£1.00	BU222	£1.00	BUX39	£1.00	BYX55/600	10p	ALP-15	£3.50
2SC4313	£5.00	2SC4891		BU326	£1.00	BUX84	50p	BYX71/60	20p	IK7ST 6931 BI	£3.00
2SC4589		1500V/15A	£2.00	BU407	40p	BUX84AF	50p	BYZ106	10p	IN5401	3p
10A/1500V	£2.00	AN5521	£1.00	BU508A	90p	BUY49	20p	BZW-C110	5p	IR106A	10p
2SC7350	15p	AN5551	£1.00	BU508AF	£1.00	BY187	5p	BZW83-C20	3p	L298N	£4.00
2SD200	£1.00	AN5831	£2.00	BU508D	80p	BY208-800	8p	CA3123Q	50p	LA7830	£1.00
2SD401	40p	BC550C	20p	BU508DF	£1.00	BY228	15p	CD4555BE	20p	LA7831	£1.00
2SD716	£1.00	BDV648	50p	BU705	£1.00	BY229	6p	CL8871A	£5.00	M708 ABI	£1.50
2SD787	30p	BDV658	50p	BU801	50p	BY255	5p	FE3B	4p	M708 LBI	£1.50
2SD789	30p	BF869S	20p	BU806A	£1.00	BY299-200	15p	HA1140	£1.00	M3720HECSP	£1.00
2SD820	£1.00	BF870	20p	BU807	50p	BY299-800	30p	HA1185	£1.00	M58658P	£1.00
2SD868	75p	BPW41	15p	BU808DFI	£1.00	BYT71-800	15p	HA1196	50p	MN650	£1.00
2SD880	30p	BT Phone Batterys	£1	BU824	50p	BYV19-30	15p	HA11485ANT	£1.50	S13522V	£1.00
2SD1264	50p	BU105/04	80p	BU826	£1.00	BYV28-200	15p	HA11804INT	£1.50	SAA1061	£3.00
2SD1266	£1.00	BU108	£1.00	BUK444/800	£2.00	BYV95B	10p	HA51338SPI	£2.00	SAA3018	£1.00
2SD1398	£1.00	BU124	50p	BUK445/600	£2.00	BY95C	12p	HA51338SP3	£2.00	SAA5010	£2.00
2SD1415	£1.00	BU126	80p	BUK454/600	£1.00	BYV96D	10p	HCF4520	50p	SAA5231	
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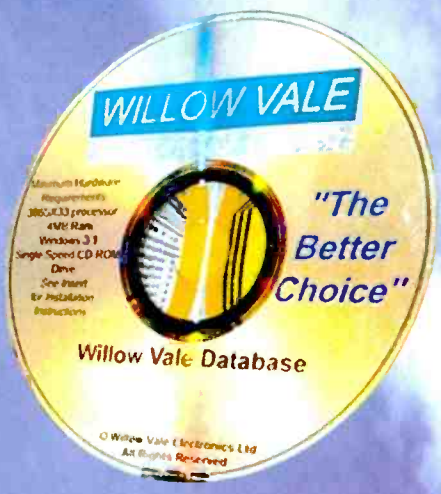

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